Impact of Digital Games on Early Reading Skills in a Developing Country Context

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Abstract

Reading is the basic component of learning that constitutes one of the first steps towards educational attainment. Amongst others, some of the pressing issues the developing countries face are lower literacy rates, education quality and access. Pakistan comes under the list of countries with appalling literacy rates, where 22.6 million children are out of school and have no access to education at all. Recent research indicates the use of digital technologies as a vehicle for change across developing countries in the world. The use of low-cost digital technologies offers opportunities for equitable access to quality educational experiences and the development of lifelong learning skills for marginalised factions of society.

The present study explored the role of digital games using low-cost tablets in improving reading skills in multilingual societies within Pakistan- a developing country context, where Urdu is the lingua franca, and English is the second or sometimes third language, while the medium of instruction in schools, specifically at the textbook level, is English. This study considered English as the second language (L2) and Urdu as the first language (L1) in Pakistan. The study also intended to explore the factors essential to developing an effective digital game-based learning environment conducive to developing reading skills for students belonging to low socioeconomic status. Through the lens of constructionist epistemology and theoretical frameworks of pragmatism and transformative emancipation, this research utilised a multi-phase-mixed methods-embedded research design to investigate the effectiveness of digital game-based learning (DGBL) in developing reading skills in a multilingual developing country context. Data were gathered through multiple methods in different phases of the research, incorporating pre-post and delayed-post tests, surveys, classroom observations, student group interviews, and individual teacher interviews. A sample of 288 students was drawn from a population of out-of-school children of ages 7 to 16 years, enrolled from Grade 1 to Grade 5 on different campuses of a charity school in an urban setting of Pakistan. The results indicate that learning to read using a pedagogically balanced digital game significantly improved reading skills in English (L2) and Urdu (L1) with a large effect size. The results also indicated the cross-linguistic transfer of reading skills from English (L2) to Urdu (L1) using the digital game and long-term retention of reading skills after the digital games were removed. This study has furthered the understanding of the design and nature of an effective digital game-based learning environment (DGBL) in regards to the use of digital games, the arrangement of learners, and creating opportunities to transfer skills to the wider real-life context. The design of the DGBL environment influenced the social interactions, classroom discourse, identities, and social practices in the co-construction of knowledge and introduced transformation in teachers' roles at various stages of learning within a DGBL environment. The study indicated that social interactions in learning environments and the role of the teacher in designing an effective learning environment are crucial to fostering transferable skills in students that lead to emancipation and prepare students for the real world outside schools. These findings have important implications for policymakers, teachers and teacher educators, students and parents. Key implications associated with the use of digital games for reading development included the need to develop: a centralised DGBL unit in collaboration with the game industry, pedagogical experts, teachers, and researchers to develop pedagogically balanced digital games to suit the educational needs of the target populations; a mechanism to provide schools, students and their parents subsidised access to the digital games to improve reading skills; and teacher education and professional development programmes to train teachers in understanding their role transformations and implementing roles effectively in DGBL environments.

Keywords: Digital game-based learning, digital game-based learning environment, reading skills, cross-linguistic transfer of skills, role of teachers in DGBL

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List of Abbreviations

ANCOVA	Analysis of Covariance
ANOVA	Analysis of Variance
ASEAN	Association of Southeast Asian Nations
CG	Control Group
CG	Control Group
CMC	Computer-Mediated Communication
CMG	Comparison Group
CMR	Complementary Model of Reading
COTS	Commercial-off-the-Shelf
CVC	Consonant-Vowel-Consonant
DGBL	Digital Game-Based Learning
EFA	Exploratory Factor Analysis
EG	Experiment Group
EGRA	Early Grade Reading Assessment
ELL	English Language Learners
ERAS	Elementary Reading Attitude Survey
FTF	Face-to-Face
FWR	Familiar Word Reading
GGUK	Graphogame UK
ICC	Intra-Class Correlation
ICT	Information Communication technology
I-CVI	Item-Content Validity Index
IT	Information Technology
KPK	Khyber Pakhtunkhwa
L1	First Language
L2	Second Language
LSS	Letter Sound Skills
MKO	More Knowledgeable Others
MMORPG	Massive Multiplayer Online Roleplaying Games
MoE	Ministry of Education
MoI	Medium of Instruction
NFE	Non-Formal Education
NGOs	Non-Government Organisations
NUST	National University of Sciences and Technology
NWR	Non-Word Reading
OSCS	Out-of-School Children
PA	Phonological Awareness
PEGS	Pedagogy, Educational, Game design, Skills and Knowledge

PPM	Pearson Product Moment
PR	Passage Reading
RCT	Randomised Controlled Trials
RDDG	Reading Development Digital Games
RQ	Research Question
SCT	Social Cognitive Theory
SDT	Social Development Theory
SLA	Second Language Acquisition
SVR	Simple View Reading
TYMTR	Teach Your Monster to Read
UK	United Kingdom
ZPD	Zone of Proximal Development

CHAPTER 1: INTRODUCTION

I belong to Pakistan, situated in the western part of the Indian sub-continent, sharing borders with India on the east, Afghanistan and Iran on the west, China and Russia on the north, and the Arabian sea lies in the south (Figure 1.1). Pakistan is a land of diverse landscapes and cultures. The northern and western borders of Pakistan are towered by Karakoram and Himalayas mountain ranges, with some of the world's highest peaks, K-2 (8,611 m) and Nanga Parbat (8.125m). The Balochistan plateau borders the west, and the sedimentary planes and Thar desert lies to the east. Planes of Punjab are the fertile lands of Pakistan, which take water from the mighty Indus river and its tributaries that flow from the Kashmir region in the north of Pakistan to the Arabian Sea in the south.

Figure 1.1

Map of Pakistan and Neighbouring Countries

Note. Adapted with permission under Creative Commons (CC BY-SA 4.0) from “Wikimedia Commons, (2020), https://commons.wikimedia.org/wiki/File:Afghanistan-Pakistan_border.jpg

My formal education in Pakistan started at the age of five and continued until I completed my degree with majors in Computing, Mathematics and Statistics. Throughout my schooling, I received traditional instruction with an expectation to memorise, practice and reproduce in exams. The medium of instruction had been English throughout my schooling; however, we were taught English using the translation method and rote learning. Later, I went to the UK to pursue a post-graduate degree, where I experienced student-centred learning for the first time in my life, which compelled me to reflect on the difference in ways of teaching in developed and developing countries. The biggest challenge I faced during my post-graduate degree in the UK was using academic language in English. Having memorised learning content during school years constricted my writing skills. I was able to read in English; however, I struggled to read critically and infer meaning to conduct literature reviews for essay writing. My journey from traditional learning in Pakistan to student-centred learning in the UK was a game-changer as it showed me how teaching should be contextualised, focusing on developing skills in students so they can reflect and co-construct knowledge with others. After completing my post-graduate degree and other professional teaching diplomas, I became a qualified teacher in the lifelong learning sector in the UK and taught for many years at the Tertiary level before returning to Pakistan. My return to Pakistan focused on training teachers at various levels on employing student-centred teaching methods using digital technology to conduct research and embedding Literacy and Numeracy skills in producing outputs.

1.1 Motivation for the Study

Prior to pursuing Doctoral level studies at the University of Waikato, I was teaching as a Lecturer in Masters in Innovative Technology in Education programme at the National University of Sciences and Technology (NUST), Pakistan. This was a replica programme of one taught at Harvard School of Education, USA and aimed to develop entrepreneurial innovations in educational practices and evaluate the impact of technology on quality, equity and access to education in Pakistan.

During my tenure at NUST, I had a chance to spearhead two funded projects based on digital games for development to improve quality, accessibility and assessment in education. The first project focused on developing a deeper understanding of Grade 5 students' science concepts with an interactive gamified digital storytelling learning application. The gamified app was deployed in four public primary schools in the socially disadvantaged outskirts of Islamabad. The second project aimed to address the issues of equity, quality and efficiency at the primary education level using a self-paced, "teacher-proof" stand-alone digital game delivered through tablet technology and to demonstrate interactive, individualised and customised learning for each learner of both genders belonging to low socioeconomic backgrounds. Both the projects yielded significant improvement in the achievement and engagement data of students. However, besides the positive results, the foremost issue highlighted was the lack of literacy skills in most students. Effective game-based learning requires students to read, comprehend and follow the game instructions. It was observed during the first project that the students were in the habit of memorising information and applying the same memorisation concept to the game instructions. It took some time for them to get accustomed to the game environment, interact with the characters in the game and follow the instructions. The reason may be attributed to their lack of literacy skills and routine classroom practices of rote memorisation, which is quite common in Pakistan (Ahmad & Tsai, 2018). However, the bilingual guided narration was provided in both the games, which helped them understand the content better. Nevertheless, reflection and classroom discussion after playing the games could have been improved if they had better reading and articulation skills, hence the aim to contribute to the existing research.

1.2 Aim of the Research

Reading is an essential learning component and constitutes one of the first steps towards a child's educational attainment. Educational research suggests that reading fluency and comprehension are strong predictors of school achievement (Álvarez-Cañizo et al., 2015; Hulme & Snowling, 2011) and career development (Krumm et al., 2008). Students who can read fluently are more likely to complete high school in later years than those who struggle to read at primary grade levels (AECF, 2010; Krumm et al., 2008).

Inequality in literacy and numeracy proficiency is prevalent in developing countries. A recent report published by UNESCO (2017) states that one in four young people with low socioeconomic status in developing countries are unable to read a sentence at their grade level. Around 40% of those who learn to read are taught in a language that they do not speak. Since early grade reading competency is crucial for progression in the later years, children who do not read well likely make limited educational progress throughout their lives. The majority of such children tend to drop out after primary education and struggle to achieve economic and development opportunities as a result. This situation leaves a legacy of illiteracy in developing countries. It is estimated that 250 million children in the developing world do not acquire basic reading and maths skills, even though half of them have already spent four years in school (UNESCO, 2017).

Another pressing issue is the number of children still not enrolled in schools. Pakistan comes under the list of countries with appalling literacy rates and education quality. Despite efforts to provide universal primary and basic education, there are still 22.6 million children in Pakistan who, due to economic reasons, cultural norms, or geographic isolation, do not have access to basic education and are not enrolled in schools (ASER, 2021). These are referred to as out-of-school children. Since 2016, the country's literacy rate declined from 60 % to 58 %, and the net enrolment at the primary level dropped from 57 % to 54 % (ibid). However, at the same time, there has been a rise in teacher recruitment by 2.6%, and the number of schools has increased by 1.7% (Finance Division, 2021).

To improve the education outlook, many developing countries rapidly increase their teacher force by hiring unskilled teachers (UNESCO, 2017), which results in increasing enrolments, however, ultimately jeopardising education quality. The current education reforms in Pakistan are also focusing on two factors: first, increasing the number of teachers in schools; and second, improving maths and science education as an indicator of economic growth in the country (Alif Ailaan, 2017). The Medium of Instruction (MOI) for these subjects is English (MoET, 2017), which is a second or third language for most students in Pakistan. English is not widely spoken or understood by most students and their parents in a multilingual country like Pakistan, where English is sustained as the official language, and Urdu is the lingua franca and national language (Ashraf, 2018). Manan and David (2014) suggest a strong possibility that inexperienced teachers, not proficient in the English language, teach these subjects the way they were being taught and promote rote memorisation, thereby compromising education quality.

To address the aforementioned issues, self-paced digital game-based learning using low-cost tablets could provide a feasible solution (Ahmad & Tsai, 2018). The last decade has seen phenomenal growth in the use and adoption of digital game-based learning for quality and access to education. Despite the challenges of developing pedagogically effective games for language learning, games are being published at an exponential rate, albeit with limited scientific study on their impact and effectiveness (Perrotta et al., 2013). Several meta-analyses conducted to evaluate the effectiveness of digital games for literacy learning indicate the need to explore game design elements and characteristics of the learning environments that may influence student learning in different contexts (Clark et al., 2016; Tsai & Tsai, 2018; Wouters & Van Oostendorp, 2013).

Building literacy skills requires reading practice, which involves acquiring the five reading component skills: phonological awareness (PA), decoding and word recognition, vocabulary knowledge, oral reading fluency, and reading comprehension (Kennedy et al., 2012; Nag et al., 2014). Digital games have the potential to engage children in ways that build skills and encourage reading practice (Acquah & Katz, 2020). Children in developed countries have access to digital games that build literacy skills in their own languages, but children in developing countries do not (Dede, 2018). Unfortunately, developers interested in making English language learning games in developing country contexts do not have evidence-based information that could facilitate this effort (Peirce, 2013).

The research aimed to investigate the role of digital games in enhancing reading skills in multilingual societies within a developing country context. This study investigated the use of digital games to address the issue of literacy learning, with a specific focus on improving reading skills in a second language in a developing country context, such as Pakistan.

The research also aimed to explore the factors crucial to developing reading games and guide instructional designers, game developers, teachers and other stakeholders about the factors that should be considered while creating and using games for English language learners (ELL). The expected outputs included developing a tool to evaluate digital games for developing reading skills in English language learners and empirical research investigating the impact of DGBL on early reading skills. The target audience of this research was expected to be teachers, educators, researchers, game developers, instructional designers, and international and national agencies involved in improving early reading instruction in Pakistan.

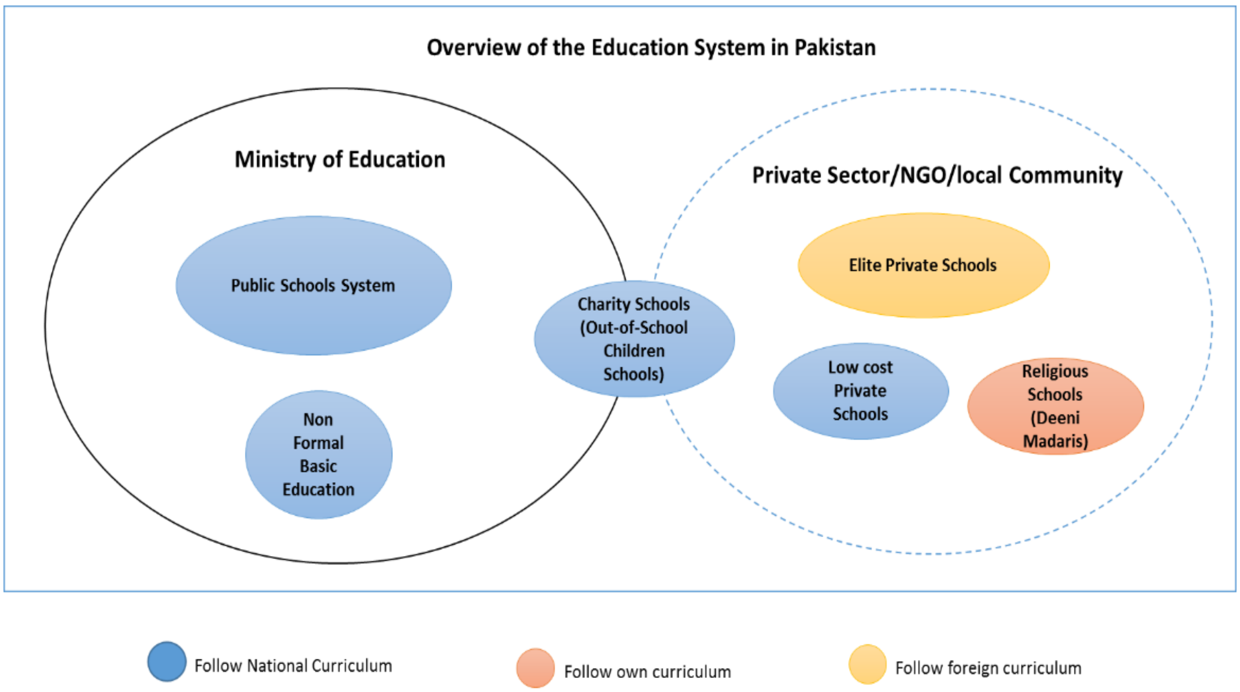
1.3 Education System in Pakistan

Pakistan is a developing country, transforming steadily from an agriculture-based economy to an industry and services sector. The major portion of the country's budget is expended on addressing national security challenges and interest payments on loans, which leaves a relatively small amount available to invest in infrastructure to boost economic development and enable social sectors to meet the basic needs of people, such as education, health and housing.

Multiple education systems run in parallel in Pakistan. These include public sector and Non-Formal Education (NFE) centres under the umbrella of the Ministry of Education (MoE) following the National Curriculum, and private sector and *Deeni Madaris* (religious schools) that follow their own curriculum (Figure 1.2).

Figure 1.2

The Education System in Pakistan



Note. This figure presents a distinction between different types of schools in Pakistan based on the curriculum taught in those schools

A brief description of each system is presented next.

1.3.1 *Public Sector*

The public sector is the largest education provider across the country, consisting of primary (Grade 1-5), middle (6 – 8), secondary (Grade 9-10), and higher secondary (Grade 11-12). Table 1.1 presents the recommended age range of students eligible to enrol in the public sector school levels:

Table 1.1

Recommended Age Range into Grade Levels

Age (Years)	School Level	Grade
6 – 10	Primary School	Grade 1 - 5
11 – 13	Middle School	Grade 6 - 8
14 -15	Secondary School	Grade 9 - 10
16 - 17	Intermediate (Higher Secondary School)	Grade 11 - 12

1.3.2 *Private Sector*

The private sector caters to the needs of around one-third of enrolled children from middle to high-income families in Pakistan. There are two types of private schools: elite or high-cost English-medium; and non-elite or low-cost private schools (Andrabi et al., 2008). The elite private schools are expensive but offer the best teaching and learning facilities, where trained teachers teach foreign curricula. On the other hand, low-cost private schools charge relatively modest tuition fees but offer better facilities than public schools (Manan et al., 2017).

1.3.3 *Deeni Madaris*

In addition to the public and private schools, another major stream of education provision is *Deeni Madaris* (religious Schools), offering free religious education with free boarding and lodging facilities. Local religious communities manage such institutions financed through charity and donations. These institutes follow the religious curriculum. Only a few *Deeni Madaris* adopting an integrated approach to delivering National Curriculum alongside religious studies.

1.3.4 *Non-Formal Education System*

In the mid-eighties, over fifteen thousand schools were established to provide free basic education to out-of-school children and children of varying ages dropped out of schools. However, political instability in the country forced the project to an abrupt closure by the late eighties (MoET, 2017). Under the current educational reforms, the government is again intending to reach out to the out-of-school children by setting up 75000 non-formal schools across the country to provide free basic education (Ministry of Education, 2009; MoET, 2017); however, the intended scope is not wide enough to reach out to the 22 million out-of-school children in Pakistan. To meet up the educational demand in the country, several Non-Government Organisations (NGOs) have started investing in reaching out to these children. An example of such an initiative in Islamabad is the system of Out-of-School Children School (OSCS) established to provide free quality education to children belonging to extremely low socioeconomic backgrounds who never had the opportunity to enrol at mainstream school due to financial constraints, being over age, or have been dropped out of mainstream schools for other reasons.

1.3.5 *Out-of-School Children Schools (OSCS)*

Out-of-School- Children Schools (OSCS) consist of a few dedicated rooms inside the public school buildings. Adapted National Curriculum and standard teaching practices are followed across all the campuses of these schools. However, besides providing a high level of ethical and moral values, these schools offer fast-track learning to prepare students to enter mainstream education as soon as possible. The fast-track curriculum is adapted from the National Curriculum to complete the syllabus from Grade 1 to Grade 5 in three years. The standard method of instruction is rote memorisation with little to no understanding of the necessary concepts (Ahmad & Tsai, 2018). The ultimate aim of such education is to enable students to pass the standardised exams and enrol in mainstream public schools. Additionally, children are also provided free lunch, books, stationery, uniform, shoes and other facilities related to health and hygiene. Orphan children in foster care also receive monthly school food supplies.

1.4 National Education Policy on Digital Technologies in Pakistan

Given the increased globalisation and diffusion of technology, many countries are taking educational measures to prepare students for emerging literacy, which includes digital literacy (Leu et al., 2004) and skills in joint research and knowledge-building (Chun 2007). At the same time, many Web 2.0 tools and Information and Communication Technologies (ICTs) are being developed and used by L2 learners to develop specific skills for effective reading. L2 educators play an essential role in helping students acquire skills to use new technological tools to participate effectively in global communities (Levy, 2009).

Introducing digital technologies within the curriculum is one of the foremost education-related agendas in the developed world, whereas the developing world is also adopting the tried and tested models of the developed countries to integrate digital technology in education (Dede, 2018). The focus of digital technologies as tools for learning is to prepare students to contribute effectively in a globalised world that would require collaboration, creativity and sharing of ideas (ACARA., 2018; Bolstade, 2017).

For the past two decades, governments worldwide have been promoting the use of digital technology tools in schools by establishing better infrastructure, programmes for professional development, access to resources and advisory sessions (Bolstade, 2017). However, many schools still face barriers to the effective implementation of such programmes due to a lack of high-quality digital content, instructional material (Dede, 2018; Liu & Pange, 2015), and pedagogical practices (Tsai & Chai, 2012).

In Pakistan, the initial organised efforts to integrate digital technology in education first appeared in the National Education Policy of 1998 (MoET, 2009), which focused on the use of ICT by enabling children to learn and think with ICT, learn about ICT, and prepare teachers to adopt ICT intensive pedagogies. However, lack of commitment, political will and funding resulted in the sporadic implementation of the policy where the elite private schools managed to incorporate some ICT resources in their curriculum. However, public and low-cost private schools struggled to acquire resources to incorporate ICT tools into the curriculum (Gull et al., 2020). Later, in collaboration with Microsoft Corporation, the government set up a chain of computer labs and teacher training institutes across the country to equip students and teachers with basic ICT skills (Ministry of Education, 2009). Due to the Pakistan government's lack of implementation plan and vision, the system is once again deprived of the opportunity for digital learning to flourish (ibid). The National Education Policy 2017 (MoET, 2017) has attempted to facilitate ICT integration in the curriculum by initiating one laptop per student, referred to as a 1:1 programme, specifically designed for the secondary school level. Moreover, the policy suggests collaboration of the government with big IT giants such as Microsoft, Oracle, and Cisco in developing certifications to train students and teachers in line with market needs. Other initiative taken by the government in collaboration with the private sector and international non-government organisations includes developing smart classrooms equipped with modern ICT devices and online learning solutions in Pakistan; however, the recipients of such technology-equipped classrooms are elite private schools (Knowledge Platform, 2022).

1.5 Context of this study

This study took place in randomly selected campuses of an informal charity school at the primary school level in urban Pakistan. It consisted of three phases, where the results from one phase informed the design of the next phase. In the first phase, the researcher aimed to find an effective reading development game that students could play in the study's second phase. In the second phase, the researcher focused on establishing a baseline for reading skills in English(L2) and Urdu (L1), which could be used to compare results on reading achievement and attitude towards reading after playing games. In the third phase of the study, the use of games was discontinued, and the study participants reverted to their traditional style of teaching and learning. The researcher aimed to measure students' retention of reading skills after the discontinuation of digital games.

The study adopted a mixed-methods paradigm to answer the research questions listed in Chapter 2 (Section 2.11). A multi-phase-mixed-methods-embedded research design facilitated the use of quantitative and qualitative data collection methods to answer the research questions. The study aimed to understand the impact of digital games on developing reading skills and the factors that contribute to the impact.

1.6 Overview of Thesis Chapters

This thesis is organised into nine chapters. A brief synopsis of each chapter is as follows:

Chapter 1	Introduction: This chapter briefly overviews the study and thesis document. This chapter provides the educational context of Pakistan, where the study was situated. It illustrates the problem concerning the literacy outlook in Pakistan and describes the aims of this study leading to the research questions this study seeks to investigate.

Chapter 2 Literature Review: This chapter reviews the literature related to three main aspects: Early literacy development, pedagogies to teach L2 reading, and the use of digital games to improve reading skills. Several learning theories allied with digital game-based learning (DGBL) are then reviewed. This chapter concludes with the significance and rationale of the study by identifying the gaps in the existing literature.

Chapter 3 Methodology: This chapter looks into the theoretical framework and methodology for this study. It also describes the three phases of the study, methods for data collection in each phase, and processes used for data analysis. A discussion surrounding the ethical considerations and trustworthiness of the study follows. This chapter concludes with an outline of the research activities conducted for data collection.

Chapter 4 Phase 1 Findings: This chapter presents and discusses the results of Phase 1 of the study. The chapter highlights the gap in the availability of a tool to evaluate the effectiveness of reading development games. The chapter develops a PEGS framework followed by the PEGS tool to evaluate Commercial-off-the-shelf (COTS) digital games for developing reading skills. The PEGS framework and the development and testing of the PEGS tool is an original contribution of this study. This chapter also discusses the validity and reliability of the PEGS tool. This chapter concludes with a selection of a pedagogically balanced digital game which was used in Phase 2 of the study.

Chapter 5 Phase 2 and Phase 3 Quantitative Findings: This chapter presents the key findings and statistical analysis of the quantitative data collected during Phase 2 and phase 3 of the study. More specifically, this chapter reports on the findings that emerged from descriptive and interferential statistical tests used to test hypotheses concerning the research questions. It elaborates upon the assumptions complied to fulfil the validity of the statistical test applied to the collected data. The chapter concludes by drawing inferences using quantitative data from Phase 2 and Phase 3 of the study.

Chapter 6 Phase 2 and Phase 3 Qualitative Findings: This chapter presents findings of the qualitative data obtained using multiple data collection methods from Phase 2 and Phase 3 of the study. This chapter highlights two major themes: Students' and teachers' behaviours in DGBL and demonstration of skills and competencies in reading skills. Each theme is comprised of multiple sub-themes to give insight into the use of digital games in developing reading skills in a developing country context.

Chapter 7 Attitudes: This chapter presents mixed-methods results on students' attitudes towards reading. The chapter presents quantitative results of the English Reading Attitude Survey (ERAS) administered across the three groups before and after playing games, followed by insights gained through qualitative data that contributed to changing attitudes towards reading.

Chapter 8 Discussion: This chapter synthesises and discusses the findings from Chapters 4 to 7, including quantitative and qualitative results in relation to reading achievement and attitudes towards reading due to digital game-based learning with the relevant literature. This chapter highlights four prominent themes that emerged from the interpretations and triangulation of meta inferences from quantitative and qualitative data. Each theme contributes to answering one or multiple research questions. The themes are sequenced in the order, to describe a story of the impact of digital games on reading development, the factors that may have contributed to the impact and how the skills gained through DGBL were transferred to the wider society. The four themes discussed in this chapter are: Reading development using digital games; design of DGBL environment; behavioural and attitudinal changes; and the PEGS tool for game evaluation.

Chapter 9 Implications and Conclusion: This chapter concludes the findings from this study by discussing the implications of key findings for teachers, educators, policymakers, game designers, as well as for students and parents. This chapter consolidates the discussion from the previous chapters and recommends a model of the DGBL environment for effective skills development. This model highlights different layers of the DGBL environment where teachers wear multiple hats to enact different roles at each layer. The implication for teachers is to design such layers for the DGBL environment and recognise and enact their roles at each layer to empower students by transferring skills to real-world scenarios. This chapter also lists the original contributions of the study, acknowledges the strengths and limitation of the study and provide suggestions for future research. This chapter and the thesis culminate on concluding thoughts that reflected growth in the researcher's '*dasien'* (being) and perceptions from using digital games as a teacher-free stand-alone solution to acknowledging the multiple roles of teachers crucial at different layers of the DGBL environment.

1.7 Summary

This chapter presented the background and rationale for conducting this study. The chapter started with an overview of the researcher's educational experiences, research interests and motivation for using digital games to develop early-grade reading skills, which could potentially transform the basis of literacy development and further education. The chapter then briefly explained the educational context of Pakistan and educational policy on digital technology in Pakistan, and established the context of the present study. Lastly, the chapter introduced a layout of this thesis and what each chapter would entail. The next chapter provides a review of literature relevant to the research questions and a theoretical framework that helped structure the research design of this study

CHAPTER 2: LITERATURE REVIEW

This chapter reviews the literature pertinent to this study and identifies the significant gap in the literature about the use of digital games for developing early reading skills in a developing country context. There are four aspects to this literature review. The first aspect builds a context to situate this study by reviewing the language-in-education policy in Pakistan. It also reviews the socio-linguistic situation in Pakistan, the impact of plurilingualism on language learning and the medium of instruction in schools.

The second aspect investigates literature in key areas of early reading development. It explores the terms like Second Language Acquisition (SLA), Cross-linguistic transfer, use of orthographies, Metalinguistic awareness in relation to reading development in a second language, as well as attitudes towards reading.

The third aspect of the literature review investigates the teacher professional development and the prevailing pedagogies to teach English as a second language. This section explores the issues in teaching L2 reading skills in the Pakistani context, including teachers' readiness to accept the use of digital technologies, especially digital games and understanding of the nature of roles within the DGBL environment. This section also investigates the literature on the transition of digital technologies from e-learning to m-learning in improving reading skills.

The fourth aspect of this chapter reviews literature relevant to digital game-based learning (DGBL) to improve reading skills in a second language. It considers the theoretical underpinning of DGBL in a social-cultural context and examines how the DGBL environment uses Scollen & Scollen's (2003) geosemiotic lens to utilise the affordances of pedagogically balanced digital games in improving reading skills. It also explores the impact of digital games on acquiring 21st century skills and enables the transfer of skills to a wider context. This section concludes by drawing together the ideas of using learning technologies with a specific focus on digital games as tools to support reading skills and improve education quality, access and equity in developing countries like Pakistan. Towards the end, this chapter lists the research questions that guided this study.

2.1 Language Policy

Language skills are considered crucial for educational achievement (Cummins, 2015) and for forming a civilised society that acknowledges the participation of all citizens (Vanbuel & Van den Branden, 2021). Therefore, governments worldwide strive to strengthen language education in schools as the language provides tools to communicate at all levels of society (OECD, 2012). The governments thus design generic macro-level policies with an expectation that local school stakeholders will tailor and embed them in practice according to their needs (Fullan, 2001). Scholars have recently started examining how schools embed macro-level language policies (Fischer & Miller, 2017). Studies indicated that most local school stakeholders interpret and action policies based on their personal ideologies and experiences, which sometimes excludes the diverse ethnic, linguistic and socioeconomic status of school children and their parents (Menken & García, 2010; Spillane et al., 2002). Studies have also shown that school contexts, the ethnic composition of students enrolled in schools, and pressures from external stakeholders may influence language policies (Menken & Solorza, 2014).

Pakistan is inherently a multilingual and multi-ethnic country located in the west of South Asia with six major languages and over 71 indigenous languages spoken by a few thousands of people in particular regions of the country (Manan & David, 2014; Manan et al., 2017; Rahman, 2005). The Federal Constitution of 1973 declares English as the official language and Urdu as the lingua franca and national language of Pakistan. Both languages are used in the power domains such as government, administration, education, corporate sector, judiciary, research and media (Ashraf, 2018; Rahman, 1996, 2005). The language hierarchy is based on power, of which English is the most powerful; Urdu occupies the second place with considerable institutional support, especially in education; regional languages except Pushto and Sindhi are excluded from all power domains (Mansoor, 2005; Rahman, 2004, 2005). The following subsections elaborate upon learning English as a second language (L2) in plurilingual societies of Pakistan, the language-in-education policy, and the impact of the medium of instruction commonly used in public schools in Pakistan.

2.1.1 *Plurilingual Societies and Learning English*

Recent literature draws attention to the effect of globalisation on an increasing number of children familiar with more than one language (Tucker, 1998; Unsworth, 2013). In multi-ethnic countries like Pakistan, people develop spontaneous communication and negotiation skills in more than one language simultaneously, where they are able to switch between the codes, syntax and structure between languages without following a uniform pattern (Ashraf, 2018). This phenomenon of codeswitching and borrowing words from one language to apply to another without a uniform structure is called Plurilingualism (Canagarajah, 2009) or translanguaging (Creese & Blackledge, 2010). Plurilingual speakers possess the ability to borrow lexicon from one language to integrate into another without being proficient in either of the languages (Ashraf, 2018). Such translingual practices (Canagarajah & Ashraf, 2013) have transformed the communicative practices in Pakistan and are evident from the talk shows on radio and television channels, official speeches, news reports, and television commercials that heavily use words interchangeably from English and Urdu language. Similarly, the sign boards, noticeboards, and marketing collaterals also represent a unique form of meshed scripts, translations, transliterations, and spellings, informed by the plurilingual repertoire of the society. Such patterns of languages represent a complex affinity where one language is embedded in the syntax of the other; however, the extent of which could be determined by the speaker's competence in one language over the other (Ashraf et al., 2014).

Plurilingual practices tend to be observed when individuals are not proficient in any of the languages and supplement their expression by borrowing suitable vocabulary from either of the languages (Ashraf, 2018). These translingual practices have also been observed to influence classroom communication between student-teacher and student-student interaction (Ashraf, 2018; Manan et al., 2017). English, the official language and the language of status and power, dominates the plurilingual repertoire. Hence, irrespective of educational background, the plurilingual speakers use the English repertoire according to their norms and values to shuttle between English and local languages for communication (Canagarajah & Ashraf, 2013). Studies in translingual practices have shown to have a negative impact on English and Urdu as discrete languages (Canagarajah & Ashraf, 2013; Manan et al., 2017). Students were found to be struggling in responding to various situations in a single language which is affecting their vocabulary for verbal communication and writing skills in English and Urdu a single language.

2.1.2 *Language-in-Education Policies*

Language-in-education policy and practice play a major role in promoting or restricting the teaching of languages. Thus, a desirable policy for promoting language learning is governed by factors such as the features of the policy and the degree to which it is adequately perceived, valued, resourced, and implemented effectively (Wiley & Garcia, 2016). A thorough analysis of the language-in-education and literacy situation in any country requires a suitable conceptual framework to analyse the impact of multilingual language policy on the ecology of languages (Hornberger, 2003) to understand language evolution, language environment, and language endangerment (Manan & David, 2014). To understand the impact of language-in-education policy on linguistically diverse students, all stakeholders, including educators, researchers, community members, and policymakers, are required to critically reflect on how the everyday use of plurilingual practices construct and maintain the supremacy of few languages over the other (Manan & David, 2014) and what impact will those have on the literacy practices.

The language-in-Education policy in Pakistan is inspired by three domains: power, religion and culture. It defines the language ecology, diversity and educational needs in relation to English for its global value, Urdu as lingua franca and national language, Arabic for religious affinity, and regional languages for their cultural diversity (Ashraf, 2018; Manan et al., 2017; Rahman, 1996). In the context of Pakistan, the language- in-education policy refers to the use of language for print materials, such as the language used in textbooks. However, the medium of instruction would be the language used by teachers to teach the subject content and to communicate with students. The National Education Policy of Pakistan (Ministry of Education, 2009) theoretically recommends a multilingual education policy at schools where English, Urdu, and one regional language are taught as a subject at the primary school level. Additionally, to facilitate Islamic education, Arabic learning is also made compulsory from Grade 6 to Grade 8.

2.1.3 *The Impact of Medium of Instruction (MOI) on Learning*

The phenomenon of English medium education is widespread across the world, especially in developing countries such as Africa (Garcia et al., 2006), India (Mohanty, 2006), China (Xiaoyang & Yangyand, 2014), and ASEAN countries (Ferguson, 2013), where parents choose English-medium education for their children. English has gained linguistic hegemony in academia around the world (Vila, 2021); people are more inclined to learn English as it is perceived as the road to success, employment, and economic prosperity (Manan & David, 2014; Mansoor, 1993, 2005; Rahman, 2004).

The Provincial Education Departments in Pakistan were given the right to choose the Medium of Instruction (MOI) up to Grade 5 (Ministry of Education, 2009), whereas English was employed as the medium of instruction for sciences and mathematics from Grade 6 onwards. The National Education Policy 2017 of Pakistan recommends Medium of Instruction for all subjects at the primary level be either local language or national language (Urdu); however, from Grade 6 onwards, these subjects will only be taught in the English language (Ministry of Education, 2009; MoET, 2017). The policy also stipulates providing equal opportunities to children from low socioeconomic strata to learn English, therefore introducing English as a compulsory subject starting from Grade 1. These policy recommendations challenge non-English speakers to comprehend the conceptual courses such as mathematics and science in English and discourage the adoption of Urdu or regional languages as the medium of instruction from Grade 6 onwards (Ashraf, 2018).

Considering the superiority of the English language over other languages at structural and system level, the textbooks of Science and Mathematics are written in English in Pakistan and students are expected to be assessed in English for these subjects. However, the medium of instruction practised by teachers in the schools is mostly Urdu or the regional language with purposeful adoption of general use formulaic English expressions such as 'be quiet', 'stop it', 'come in', 'is that clear?', ' stop talking', 'take out books' and so on (Manan et al., 2017).

Despite the policy statements, the actual policy in regards to teaching one regional language has not been implemented across the country except for the Sindhi language in parts of Sindh province and Pushto in some areas of Khyber Pakhtunkhawa (KPK) province (Manan et al., 2017). The indigenous languages are restricted to social ghettos in Pakistan (Rahman, 2005) and are carried within informal domains such as homes or small communities. The lack of proper implementation of a language-in-education policy in Pakistan and the inclination towards English as medium-of-instruction for economic gains has resulted in low motivation and low self-esteem in developing language skills in English, Urdu or the regional language spoken in the region (Asif et al., 2020), which could be one of the contributing factors of low literacy rates in Pakistan

2.2 Key Areas of Early Literacy Development

Research suggests that the period of early literacy development includes mastery of many fundamentals skills which include, but is not limited to, understanding phonemes, acquiring meta-language capabilities (e.g. analysing language, 'playing' with language), inventing spelling, echo reading, and letter and word recognition (Hammer et al., 2014; Kucrikova et al., 2017; Lesaux et al., 2008; NCFL, 2009). A review of these studies indicates that literacy-related competencies are alphabet knowledge, print awareness, written language, phonological awareness, decoding, vocabulary knowledge, oral reading fluency, reading comprehension, and listening comprehension. Research further suggests that literacy-related skills or competencies develop when learners have a positive interaction with instructional materials, people who support literacy learning, and when skills acquisition is closely related to their interests in communication, language, reading and writing (August & Shanahan, 2008; Dickinson & Neuman, 2014). Therefore, factors such as individual interests, literacy-rich experiences, instructional practices, and social and non-social aspects of the environment influence the learning processes (Bronfenbrenner, 1999; NCFL, 2009). These factors could be used in developing literacy learning practice guides and tool kits that include formal and informal literacy-rich experiences and opportunities through digital game-based learning. Since the proposed research focuses on developing reading skills, the subsequent sections of this literature review will focus on concepts related to reading development.

2.2.1 *Second Language Acquisition (SLA) and Impact of Cross-Language Skills*

Children start to learn from the day they are born, if not before (McLachlan et al., 2012). Their language and speech skills progress and become increasingly complex as they grow. They learn to express their feelings, thoughts, and ideas and communicate with others in their first language. During this phase, they acquire skills, knowledge and attitudes pertinent to literacy development, which is a stage known as emergent literacy (Roberts et al., 2005; Westerveld, 2014) and is considered a significant predictor of reading and writing success later in the school years (Lonigan et al., 2000). As children learn, they generally interact with print material and digital media in homes and early childhood settings well before starting their formal schooling. They start to recognise shapes, colours, and sounds at this stage and develop fine motor skills to hold the pencil and start scribbling. As they further develop, they can recognise environmental print, such as street signs or logos, play digital games, and name letters of alphabets. Gradually, they relate their knowledge of speaking and listening with what they know about print, thus, accumulating a range of knowledge and skills that assist them with the transition to formal instruction of reading and writing.

The developmental perspective of Perfetti (2003) and Perfetti and Dunlap (2008) regards reading as an active pursuit embedded in spoken language and its orthographies (writing systems), according to which, in learning to read, children must develop metalinguistic awareness of language structure by discovering how elements of spoken language are mapped onto the graphic symbols that encode them. Research suggests that formal reading instruction cannot successfully commence until children acquire sufficient verbal language competence in their first language (Dixon et al., 2012; Koda, 2007; Westerveld, 2014). Therefore, reading development requires substantial linguistic knowledge and metalinguistic awareness (Bialystok et al., 2014).

Studies into Second Language Acquisition (SLA) show a strong bidirectional correlation between the primary language (L1) and the secondary language (L2) of children (Dickinson et al., 2004), which suggest that skills like Phonological Awareness (PA) learned from one language are transferable to the other language. Theories of developmental interdependence (Cummins, 1979) in cross-linguistic transfer propose that competence in second language acquisition (L2) is a subskill of competence already developed in the primary language (L1) at the time of extensive exposure to L2. In a situation where students are not proficient in literacy skills of the primary language, the acquisition of a secondary language could be a challenge, which requires specialist instruction techniques and teachers' competence in L2 to support literacy skills (Manan et al., 2017). Therefore, understanding students' primary language proficiency (L1) and cross-linguistic transfer of early reading skills such as phonological awareness may assist teachers in making informed decisions regarding reading instruction (Ashraf et al., 2014).

2.2.2 *Frameworks for Reading Skills Development*

Research indicates that children with first language other than English often lack comprehension skills, and struggle to read complex texts in upper elementary grades (Farnia & Geva, 2013). Therefore, it is important to understand the underlying processes involved to develop reading skills and to gain insights into how children may be supported on developing better reading skills. Amongst the several reading frameworks, the two popular are the Simple View Reading (SVR) (Gough & Tunmer, 1986) and the Complementary Model of Reading (CMR) (Aaron et al., 2008) that explain the cognitive processes involved in reading.

The SVR proposes that reading comprehension is the product of two basic components: decoding and language comprehension (Gough & Tunmer, 1986; Proctor et al., 2005). According to this model, a reader's reading comprehension ability is determined by their proficiency in decoding (the ability to recognize words) and language comprehension (the ability to understand the meaning of language).

The CMR model (Aaron et al., 2008) provides a broader and comprehensive framework of factors explaining the complex process of reading. The CMR model comprises of three domains, namely, the cognitive, the psychological, and the ecological domains (Joshi & Aaron, 2012). The cognitive domain comprises two components, word recognition and comprehension (ibid) that essentially corresponds to the components of SVR model. The psychological domain consists of factors that might impact motivation to read, such as, teacher-student relationships, locus of control, learning styles, teacher expectations, perceptions and gender differences (Aaron et al., 2008). The ecological domain focuses on factors related to home and school environments, such as home literacy practices (Chiu et al., 2011), teaching practices and teacher beliefs (Sáez et al., 2011), and dialects (Ortiz et al., 2012).

The cognitive domain of the CMR model expands upon the SVR model by breaking down the two basic components into more specific cognitive processes. It suggests that decoding involves phonological and orthographic processing, while language comprehension involves semantic, syntactic, and pragmatic processing (Joshi & Aaron, 2012). Therefore, while the SVR provides a basic framework for understanding the relationship between decoding and language comprehension, the CMR provides a more detailed account of the cognitive processes involved in each component.

Li et al. (2020) indicate that the cognitive domain plays a crucial and significant role in developing reading comprehension in bilingual learners. Additionally, the cognitive domain highlights the importance of early reading instruction that supports the development of both decoding and language comprehension skills in children. Therefore, the present study adopts the cognitive domain of the CMR model to measure reading skills development through the measures that assess letter-sound knowledge, word recognition, oral fluency and reading comprehension. The present study also draws on evidence from the qualitative data, such as classroom observations, teachers, and student interviews, to gain insights into any psychological and ecological factors contributing to the development of reading skills in the target population.

2.2.3 *Theoretical Approaches to Teaching Reading in L2*

Acquisition of reading skills spans three phases: first is the *cognitive* phase, where students gain awareness of the tasks needed to become skilled readers; second is the *mastery* phase, in which students practice the skills until mastery is achieved; and the third phase refers to *automaticity*, in which students perform the skill without conscious effort. A variety of teaching approaches can help students gain automaticity in reading. Literature indicates three major approaches to teaching reading in L2 (Nunan, 2015; Shin & Crandall, 2018): phonics instruction, whole language instruction, and balanced reading instruction

Phonics instruction is a conventional approach to reading comprehension used by teachers in English as a second language (ESL) classrooms (Nunan, 2015). Phonics is a systematic approach to teaching reading comprehension, commencing with building phonemic awareness to help identify sounds for letters and establish a relationship between sounds and letters by decoding words (Shin & Crandall, 2018). Students are taught the sounds and names of alphabets, blending techniques to decode the word and then presented with meaning to comprehend the word (Rayner et al., 2002). Researchers believe that phonological awareness plays a vital role in reading achievement, as students who grasp the concept of letter-sound relationships read better than students who do not understand the relationships between letters and sounds (Dubeck et al., 2012).

The whole language instruction refers to teaching comprehension by reading the whole passage, understanding the word meaning and grammar rules, and memorising the high-frequency words as whole language pieces, for example, reading sight words without decoding into phonics (Goodman, 1997; Ling, 2012). The whole language approach emphasises memorising the word's pronunciation and associating it to the meaning rather than chunking it into phonics to read. Goodman (1997) argues that reading and writing skills develop side by side with listening and speaking skills; therefore, teaching strategies for reading comprehension should begin with a whole language approach before breaking it down to individual components of reading, writing, speaking and listening.

The balanced reading approach is a combination of phonics reading strategy and the whole language approach (Freppon & Dahl, 1998), which results in a positive and meaningful approach towards reading comprehension. It combines the two stages of reading, learning how to decipher print using phonics and understanding what print means using the whole reading approach (Gough & Tunmer, 1986; Hoover & Gough, 1990). Students who master the two stages are more motivated to read as they find reading less aversive, less time-consuming and more rewarding than those who do not (Adams et al., 1998). The balanced reading approach fosters emergent literacy skills of recognising the importance of print text and builds a positive attitude towards handling print materials. Second, it helps students to break codes with explicit attention to letter-sound relationships; and third, it develops word recognition skills by combining reading and listening comprehension (Centre, 2005). Research indicates that most reading problems occur when students struggle to decipher text fluently to be able to understand the meaning in a context (Freppon & Dahl, 1998). For second language reading, it might pose a further challenge to understanding the word's meaning in a new language.

2.2.4 *Impact of First Language Reading Skills on Second Language Reading*

To be able to read in a second language (L2), it is expected that students explore, interpret and extend the concepts presented in reading comprehension tasks (Ashraf, 2018). Although minority language learners may be able to decode the alphabet sounds and produce the word adequately, they often fail to interpret the word in a context since it does not belong to their lexicon (Morris, 1971). This implies that fluent reading and comprehension skills may not be achieved until the students fully understand the meaning of the words used in the comprehension text (Cummins, 1979). Comprehension skills largely depend upon a child's vocabulary-concept knowledge (Becker, 1977), as there has been a high correlation between vocabulary and comprehension. An investigation led by Zhao et al. (2017) on the relationship between vocabulary and word reading in Spanish-English bilingual children found a small cross-linguistic effect for Spanish (L1) vocabulary predicting English (L2) word reading. The study found that phonological awareness (PA) skills developed in the Spanish language accounted for reading words in English, which indicates that in phonetic language systems, phonological awareness in the first language may contribute positively to developing reading skills in the second language.

In another study, Atwill (2007) investigated the effect of L1 receptive vocabulary developed through listening skills in the first language (L1) on phonemic awareness in L2. Their investigation involved Spanish-speaking kindergarten bilingual students belonging to low socioeconomic families. The regression analysis found a significant positive correlation between phonemic awareness and receptive vocabulary. Their results further indicated a significant cross-linguistic transfer (CLT) of phonemic awareness from L1 to L2 in children with above-average L1 receptive vocabulary, whereas no CLT existed for children with below-average L1 receptive vocabulary. These results corroborate with (Dickinson et al., 2004) suggesting that L1 receptive vocabulary predicts phonemic awareness in the target language.

2.2.5 *Factors Affecting Second Language (L2) Reading Skills*

Transfer of skills have also been seen as a key theoretical concept in the second language (L2) reading. Research suggests that L1 reading competence, L2 linguistic knowledge and L2 print input transform L2 reading skills (Dixon et al., 2012; Koda, 2007; Westerveld, 2014). Hence, children possessing better L1 reading competence may be able to read better in L2. However, the linguistic distance (degree of similarity) between two languages is also considered a major factor responsible for children's varying rates of L2 reading skills development (Koda, 2012). Linguistic information processing is similar, if not identical, if two languages share similar structural properties. For example, alphabetic writing systems share basic orthographic representations, requiring similar decoding procedures for symbol-to-sound mapping regardless of the graphic form of the symbol. When the transfer occurs between two alphabetic systems, L1 mapping skills could still be functional in L2 decoding with minimum modification. However, in the case of two distinctive languages, transferred L1 to L2 skills must be substantially modified. Thus, language distance between the two languages determines the assimilation of L1 transferred skills in L2 reading. Cross-linguistic transfer is positively correlated in comparable orthographic languages (Verhoeven et al., 2019). For example, correlations between L1 and L2 Spanish-English alphabetic knowledge were greatest, for Hebrew-English bilinguals were moderate, and lowest for Chinese-English bilinguals (Bialystok et al., 2005).

Studies in the field of second language acquisition have mostly focused on the cross-linguistic transfer of skills from L1 to L2 (e.g. Gottardo et al., 2014; Kim & Piper, 2019; Piper et al., 2016). These studies have used regression analysis to assess the significance of correlation and causality of cross-linguistic transfer from one language to another, and have provided a wealth of insights to study literacy development in multi-lingual contexts. However, understanding the nature of transfer, bidirectionality or reciprocity of transfer of skills is under-researched (Kim & Piper, 2019). The present study aims to contribute to the literature by exploring the impact of English (L2) on Urdu (L1) reading skills in relatively non-comparable orthographic languages.

2.2.6 *Attitudes Towards Reading*

Attitudes towards reading is defined as a feeling that consistently prompts an individual to engage in or avoid a reading activity (Cooter Jr & Alexander, 1984; McKenna, 2001). A more recent understanding of reading attitudes refers to a positive self-concept as a reader, intrinsic desire and tendency to read associated with enjoyment of reading (Sainsbury & Schagen, 2004). Literature indicates that a positive attitude towards reading is correlated with high achievement (e.g. Lupo et al., 2017; Taboada et al., 2009; Wolters et al., 2014). However, recent studies that examined the impact of cultural variations on reading skills (Kim, 2011; Lim et al., 2015; McGeown et al., 2015) indicate that students' reading attitudes and motivation depend on the specific purpose of reading. The studies show that proficient readers may struggle to read if they are not motivated or do not have background knowledge about the text (O'Brien et al., 2008). Similarly, struggling readers may show proficiency in reading if they are motivated to read (Moje et al., 2008). This implies that reading attitudes may vary from personal interests in reading and can be distinguished between recreational and academic reading attitudes (McKenna & Kear, 1990). Studies have shown that students who engage in self-selected reading for pleasure develop positive attitudes towards reading and acquire broad vocabulary and grammar skills

(Clark & Rumbold, 2006; Cremin & Moss, 2018; Vanden Dool & Simpson, 2021). Students may also possess a positive global attitude towards reading all kinds of texts, as well as a positive attitude towards reading specific texts, for example, science fiction (McKenna et al., 1995). Students who enjoy reading tend to invest more time in reading-related activities, which appears to positively impact their metacognitive awareness and critical thinking (Ulu, 2019).

The attitudes towards reading begin to develop during children's early formative years, way before they start schooling and are influenced by regular exposure to reading-related activities (McLachlan et al., 2012) and their direct and indirect reading experiences (Strommen & Mates, 2004). A direct reading experience may involve a child's shared reading with a parent, while an indirect experience might include children hearing ideas and feelings about reading, such as enjoyable, satisfying, challenging or boring, from their parents or other adults. Other factors, such as parental education, socioeconomic status, access to reading materials, knowledge and parents' attitudes, are also instrumental in developing children's reading attitudes (Chen et al., 2018).

In the context of Pakistan, students’ attitudes towards reading are not highly positive (Abro & Qaisrani, 2017), as reading skills are not given primary importance in the school curriculum (Awais & Ameen, 2013). One of the factors of unfavourable attitude towards reading is the teaching method (Kush & Watkins, 1996; Lim et al., 2015). The focus of teaching in public schools is to complete the curriculum using rote learning. The students are expected to memorise and reproduce the content in the examination (Abro et al., 2021), which leaves no space to use critical thinking by applying reading strategies like visualising, predicting, making connections and inferring (McCormack & Pasquarelli, 2010). Another factor that appears to shape the attitudes of students in Pakistan is access to reading materials and the reading culture within the society (Awais & Ameen, 2013). Due to the lack of public libraries and almost non-existent reading culture, especially in disadvantaged factions of society, most children have no role models who could inspire them to read (ibid), which results in unfavourable attitudes towards reading. However, the ubiquitous use and penetration of low-cost mobile technology have somewhat resolved the issue of access to reading resources (Levratto et al., 2021). Having access to mobile technology, children and adults use social media to read and communicate (Alzubi, 2019). The affordance of digital technology to include visuals as cues to reading may change children’s attitudes towards recreational reading and positively influence low SES families' home literacy practices (Chen et al., 2020).

2.2.7 *Classroom Environment for the Second Language Reading*

Classrooms are the spaces where students spend most hours of their school life. Classrooms are meant to be supportive and safe spaces where students engage in meaningful interactions to reflect, learn and grow (De Nobile et al., 2021). (Nuthall, 2007, p. 84) argues that " students live their lives in classrooms within the context of three different, but interacting worlds." The public world is created and managed by the teacher, where students do what they are told to do or what their teacher wants them to do by following the classroom rules and customs. The semiprivate world is the world of social interactions and ongoing peer relationships, which may go beyond the classroom. Lastly, the private world refers to the world of students' minds, where individual thinking occurs; self-beliefs and attitudes are formed and shape the conceptions about learning, consequently leading to knowledge growth (ibid).

Converting a classroom into a positive learning environment can be challenging for teachers who struggle to detach from industrial-era beliefs of knowledge transmission rather than knowledge construction (Cook et al., 2018). De Nobile et al. (2021) argue that positive learning environments need synchronisation between teachers' knowledge and understanding of curriculum, evidence-based student-centred pedagogies and assessments, which enable teachers to create opportunities to engage students in meaningful interactions whilst portraying best behaviours. However, the notion of best behaviours may vary as teachers' teaching philosophy varies in practice. Most industrial style teaching philosophy demands students to sit quietly and maintain strict discipline by refraining from peer interactions, whereas the 21stcentury style student-centred teaching philosophy may encourage student-discussions in small groups or pairs to solve problems (Chen & Chen, 2014) and teacher-student interactions in question-answer-evaluation sequences to develop critical thinking (Marzano & Simms, 2014). Regarding L2 reading skills, Kiili et al. (2012) and Huang (2012) claimed that a positive learning environment promotes collaborative reading and lets students develop new ideas by having discussions about the reading text, thus improving their reading skills and reducing anxiety and tension towards reading in a new language. In this regard, teacher discourse and dialogue are also crucial to developing a positive learning environment.

Research shows that teachers' use of language and the way they respond to students' queries and engage them in meaningful discussion hugely impact classroom culture (Claxton et al., 2011). In the context of Pakistan, conversational analysis of teacher talk and learners' involvement in an ESL classroom (Ahmad et al., 2021) indicates that teachers play an authoritative role in the classroom and use maximum class time in talking and asking convergent questions, which appeared to be obstructive to language acquisition. Using content-based convergent or closed questions requiring a limited response from students reflects rote learning techniques commonly prevalent in Pakistiani public schools (Manan, 2019), which negatively impacts L2 learning (Ahmad et al., 2021). On the contrary, there has been a growing interest in research concerning a pedagogy that exploits the power of talk to expand students' thinking, literate reasoning and problem-solving, such as dialogic pedagogy (e.g. Alexander, 2011; Burbules, 1993; Shor & Freire, 1987). Dialogic pedagogy seeks to engage students in the co-construction of knowledge through questioning, interrogation and negotiation of ideas using constructive criticism and feedback in a respectful manner (Lefstein & Snell, 2013).

Alexander (2011) suggested five principles to fortify the effective use of dialogic pedagogy: (a) *collectiveness*, where teacher and students discuss learning tasks together, in pairs or small groups; (b) *reciprocity*, to ensure teachers and students listen and respond to each other, share ideas and consider multiple viewpoints; (c) *supportiveness*, to create a low-stakes environment where students share ideas without being judged and facing embarrassment over wrong answers; (d) *cumulativeness*, to co-construct knowledge by building on each other's ideas and creating coherent lines of inquiry; and (e) *purposefulness*, to align dialogues and discussion to meet the educational goals. Kim and Wilkinson (2019) suggest that the first three principles of Alexander's (2011) framework contribute to establishing a classroom culture to maximise participation and potential of talk, while the last two principles address the content of dialogue in relation to the educational goal.

The conceptions of dialogic pedagogy varied over time in terms of epistemological and ontological stance but shared many features that offer an understanding of how the adherence to the principles of dialogic pedagogy creates a classroom culture conducive to authentic learning (Kim & Wilkinson, 2019). In the present study, it is assumed that the use of modern teaching tools such as digital games may influence the classroom culture, which could also change the nature of teacher talk in a gaming environment. Presently research is scarce in examining the role of classroom culture in a DGBL environment on learning to read in L2 in the context of Pakistan. The present study also aims to explore the role of teacher facilitation in developing L2 reading skills in a DGBL environment. The next section presents a review of the pedagogical beliefs of teachers in Pakistan and the challenges they face in teaching English as a second language (L2).

2.3 Teachers’ Pedagogical Beliefs and Challenges in Teaching English as a Second Language (L2)

Despite various languages spoken in Pakistan, studies have found Urdu to be the default medium of classroom interactions (Ashraf et al., 2014; Manan et al., 2017). Teachers’ limited competence in spoken English is seen as a significant deterrent to adopting the English language during classroom practices. Inadequate language skills restrict them from expressing their views in English and compels them to provide explanations of the topic content in Urdu (Manan et al., 2017). Westerveld and Barton (2017) suggest that teachers' L2 proficiency potentially contributes to second language teaching.

In Pakistan, teachers are plurilingual; therefore, they are prone to deliver lectures by mixing English, Urdu or a regional language (Ashraf, 2018; Manan et al., 2017). Teachers’ lack of English speaking skills may not allow students to build English vocabulary (Asif et al., 2020). English is mainly taught by using the translation method at the text level (Imran & Ain, 2019), which may help students understand the meaning within a context but may not increase their lexicon to use the words out of the classroom context. Limited reading opportunities, mostly restricted to textbook reading, may enable them to read from the textbook, but they may still not be able to read outside the textbook or apply their reading skills outside the textbooks.

When students do not possess sufficient L1 skills (Ashraf, 2018; Manan et al., 2016), transferring them to learn an L2 presents a challenge. Teachers’ competence in L2 and content-specific pedagogical beliefs are crucial in designing instructional strategies to teach the L2 (Ashraf, 2018; Ding et al., 2019; Manan et al., 2017; Westerveld, 2014). English language teachers’ pedagogical beliefs can be understood using Johnson’s (1992) framework, categorising pedagogical beliefs as rule-based, skills-based, and function-based. The rule-based beliefs originate from the essentialist view of teaching that there are attributes, rules or processes, such as understanding of grammatical rules in language learning, that must be followed. The rule-based beliefs view L2 teaching as a rule-governed activity using teacher-centred instructional strategies (Imran & Ain, 2019). The skill-based orientation refers to recognising and memorising language patterns, e.g. phonemes, graphemes, and morphemes. Instructional strategy for skill-based orientation may require repetition, practice, mimicry, and memorisation using the drill and practice, which could be student-centred (Ding et al., 2019). The function-based orientation refers to language learning in a communicative context underpinned in a social interaction context using dynamic student-centred approaches situated in real-life contexts (Johnson, 1992).

Another factor that plays a crucial role in learning to read is self-efficacy and adaptive motivation. Bandura (1977) defined self-efficacy as students' belief that determines how well they can adhere to a plan of action under different situations. In simpler terms, self-efficacy refers to a student's ability to succeed in a particular situation. Adaptive motivation refers to students' willingness and perseverance to believe that they can apply effective strategies to tackle a challenging task, such as identifying unfamiliar words (Henk & Melnick, 1992; Stanovich, 1986). Chapman and Tunmer (2003) posit that successful readers possess high self-efficacy and motivation to use stragies to develop rapid decoding skills in reading. Chapman and Tunmer (2003) argue that unreliable word identification strategies are associated with poor reading skills and negative reading-related self-efficacy beliefs. Their study found that students with sufficient phonological recoding skills hold positive self-efficacy in reading and perform better on reading achievement than those who did not possess sufficient phonological coding-decoding skills. Hence, the adoption of teaching strategies plays a vital role in changing student behaviours towards reading and may be considered a significant predictor of learning to read.

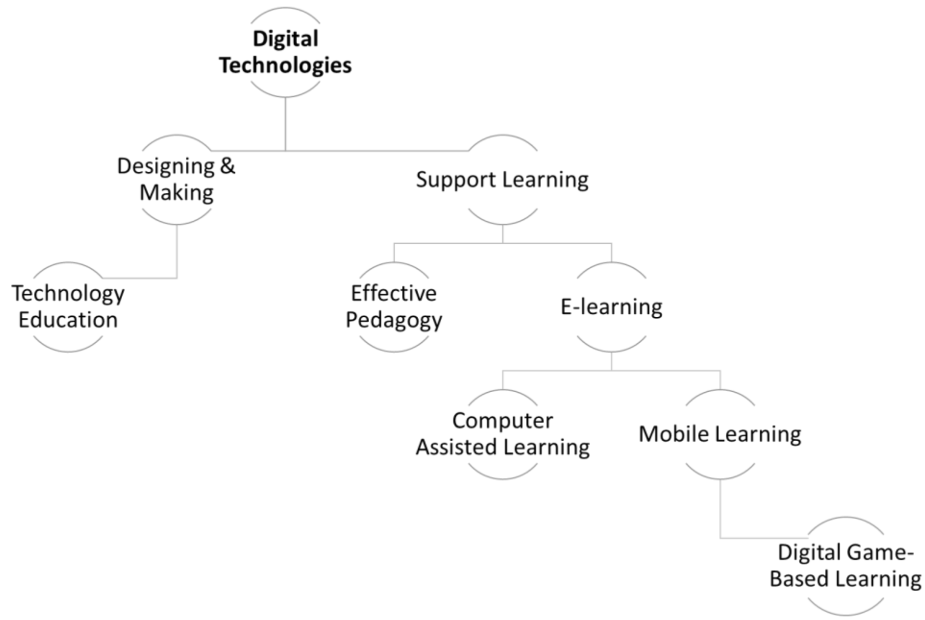
The literature review has indicated a gap in research on using strategies to equip plurilingual students with effective skills of coding and decoding unfamiliar words and learning the use of such words in a particular context. The present research explores effective reading strategies using technology, particularly digital games, to investigate the impact of such games in providing access to less privileged children and developing reading skills, especially in the second language context. The research also investigates the transferability of such skills from L2 to L1. The following sections will review the literature on using digital games as a pedagogical tool to develop reading skills and improve student motivation.

2.4 Digital Technologies in Teaching and Learning

Digital technologies in teaching and learning are premised under the broader term of e-learning (Pegrum, 2014) and are defined as the use of Information and Communication Technology (ICT) devices, such as computers, laptops, mobile devices (tablets, iPads, smartphones), netbooks; web-based tools, learning management systems, and software or applications that encourage active student participation, collaboration with peers and teachers, and knowledge construction through sharing of ideas, within, as well as, outside the geographic boundaries of the classroom (Bolstade, 2017; Hsin et al., 2014; The Scottish Government, 2015). This extended concept of technologies recognises their use from mere information delivery systems to information creation. There are two dimensions of using digital technology in education, as shown in Figure 2.1.

Figure 2.1

Digital Technologies in Education



One dimension is using digital technology for design and making (Mackey et al., 2015), and the other is to support learning where students acquire general capabilities about using digital technology and applying knowledge of ICT across a broad range of domains (Hsin et al., 2014). Evidence from literature purports that using digital technologies as a tool to support learning provides appropriate means to improve basic literacy and numeracy skills, especially in primary school settings, provided teachers have sufficient knowledge and understanding of the technology and are able to identify the use of digital tools to achieve better learning outcomes (The Scottish Government, 2015). Hence, the present research aimed to explore the use of digital game-based learning (DGBL) as a learning tool for enhancing reading skills within a plurilingual setting.

2.5 Using Digital Technologies to Improve Reading Skills - from E-learning to M-learning

E-Learning is an established field of cost-effective learning with extensive scholarship built around the educational use of digital technologies such as desktop and laptop computers and web 2.0 tools for accessing information anywhere and anytime without the need for dedicated teachers, facilitators, and potential travel to access learning (Pegrum, 2014). However, due to increased portability and processing capabilities, mobile devices such as smartphones, tablets, netbooks, iPads, and kindles have become an important part of the learning industry, especially in the developed world. The affordability of such devices due to the price drop in the developing world has encouraged educational use compared to traditional desktop computers and laptops (UNDP, 2012). Mobile learning, also known as m-learning, shares common grounds with e-learning yet presents a different learning experience through the unique use of mobile devices, application design and assessment strategies. It also offers a social dimension that encourages users to collaborate through specifically designed applications to construct new ideas (Heflin et al., 2017). Mobile learning also helps increase student autonomy, participation and communication (Dunn et al., 2013; Hamm et al., 2013; Junco et al., 2011). Researchers have hypothesized that the use of mobile devices in learning enhances participation by providing instant access to information and feedback, as well as providing enhanced practical learning (Domingo & Garganté, 2016), but warn that portable devices are best suited for learning when instructions are pedagogically designed to achieve learning outcomes along with the optimal use of technology (Cheng et al., 2016).

Improved affordability and functionality of mobile devices have enhanced their educational use, but more research is needed to develop appropriate guidelines for digital curricula and teaching methods to support and evaluate the use of mobile technology in schools (Falloon, 2013). Research reveals that student engagement varies from app to app, with higher engagement in using learning skills apps such as story-making apps or drawing apps, compared to the learning content apps (Domingo & Garganté, 2016). This trend suggests that sustained use of content-based applications may lead to student disengagement and eventually to low achievement as engagement is one of the predictors of achievement (Irvine et al., 2007).

2.6 Digital Game-based Learning (DGBL)

Trends in contemporary educational research show interest in how digital games may influence L2 reading (Qian & Clark, 2016; Tsai & Tsai, 2018). For the scope of the present study, DGBL is referred to the use of explicitly designed educational or learning-oriented digital games in which game design, game content and game mechanics enhance knowledge and skills acquisition and where game activities encourage players to solve problems and take on challenges with a sense of achievement (Perrotta et al., 2013; Qian & Clark, 2016). Most games are based on scenarios similar to real-world situations and allow user interaction and some control to make choices to achieve goals. Unlike simulations where a user has limited control over presented situations, digital games are governed by clear goals and rules, along with well-defined outcomes in challenging scenarios embedded in an intriguing storyline (McClarty et al., 2012; Perrotta et al., 2013). Digital games offer feedback and rewards to measure and acknowledge a player's progress in the game, whereas players can influence the results through their actions and choices (Dede, 2018). The current study is limited to the aforementioned definition of digital games and therefore excludes the use of 'gamification', which is the application of gaming strategies to improve motivation and engagement (e.g. leader boards, points, and badges), in non-game situations (e.g. mobile apps) or in traditional classroom learning.

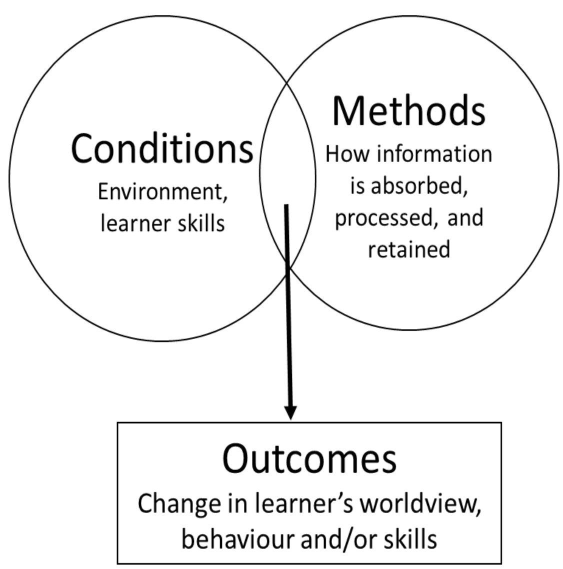
The last decade has seen enormous growth in using digital games for language learning and developing reading skills in L2 (e.g. Calvo-Ferrer, 2017; Chen et al., 2019). The studies show that digital games can develop L2 skills and improve learning experiences by engaging students in game-based challenges within a safe and low-stake game environment (Hung et al., 2018). However, the studies indicate the need to examine the game characteristics, the role of teacher facilitation and specific teaching strategies that impact the language development outcomes in a DGBL environment (Acquah & Katz, 2020; Hébert & Jenson, 2019). A meta-analysis of DGBL for L2 learning shows a high effect size of game-based pedagogy compared to traditional instruction, especially on L2 vocabulary learning; however, the findings emphasised the educational value of digital games in meeting the pedagogical purposes and learner needs for L2 learning (Hong et al., 2009; Tsai & Tsai, 2018). The meta-analysis also reported a comparison of effect size for L2 vocabulary development studies using DGBL based on the research designs. Studies with experimental research designs (experiment groups playing digital games versus control group receiving traditional instruction) produced a large effect. A medium effect size was reported in studies where experimental groups play digital game with a feature added or changed compared to the control group playing the basic version of the game. A medium to large effect size was reported for studies where experiment group played digital games while the control or comparison group received the identical content through traditional instruction.

2.7 Theoretical Positions Linked to DGBL

In general, digital game-based learning is grounded in learning theories, design elements, and pedagogical considerations. Becker (2017) argues that learning through digital games consists of two perspectives; the first is the learner perspective, which looks at how learners learn from games, and the second is the teacher perspective, which considers how teachers can implement learning using games. Learning may occur at the intersection of these two perspectives (Figure 2.2). Therefore, at the heart of an effective educational game is the framework that places the gameplay on appropriate learning theories and instructional strategies (Amory, 2007; Arnab et al., 2015; De Freitas et al., 2010; Price et al., 2017). The learning theories conceptualise how the environment, current skills and beliefs of a person interact with the psychological and physiological functioning of the mind and body to transform that person's worldview, behaviours, or skills (Becker, 2017). More precisely, learning theories attempt to explain how people gain knowledge under certain conditions using particular methods.

Figure 2.2

Interaction of Environment and Instructional Methods on Behaviours



Note. Learning theories explain the interaction between conditions of learning and instruction methods to change learner's behaviours and worldviews. Modified from From "Choosing and Using Digital Games in the Classrooms: A Practical Guide, by K. Becker, (p. 28), 2017, *Springer*. Copyright 2017 by Springer.

Learning theories form the foundation of the instructional design strategies assisting the examination of how learning occurs in games; however, Turkay et al. (2014) state that none of these theories can be prescribed to develop a perfect game. An educational game can have multiple game pedagogies underpinned by multiple learning theories (Kiili et al., 2014; Turkay et al., 2014). The social and interactional nature of digital games and the epistemological stance of social constructionism for learning to read lead to examining social learning theories in the context of DGBL for reading skills development in the section below. Section 2.7.1 elaborates upon the use of social learning theories in DGBL, Section 2.7.2 discusses the use of motivational theories in developing reading skills using digital games, while Section 2.7.3 discusses how classroom environment, social interactions and digital games interact with each other to develop reading skills from the lens of geosemiotic analysis framework (Scollon & Scollon, 2003)

2.7.1 *Social Learning Theories Relevant to DGBL*

The primary focus of social learning theories in DGBL is the influence of peers and other social actors on a student's learning, which is, to some extent, an outward-looking approach to learning, as opposed to humanism that provides an inward perspective of focusing on self-learning (Becker, 2017). The social learning theories situate DGBL in a social phenomenon guided by the power of collaboration and cooperation using digital games so learners can play, interact, support and teach each other (Reinhardt, 2017). Several studies indicate that the use of multiplayer games positively impacts L2 vocabulary learning (Calvo-Ferrer & Belda-Medina, 2021; Jabbari & Eslami, 2019). A scoping review of DGBL for L2 studies conducted by Hung et al. (2018) reveals the potential of games situated in social learning theories to improve complex 21st century communication and collaboration competencies for acquiring L2 skills. This section elaborates upon the social learning theories which are most relevant to using digital games for L2 reading: Social Cognitive Theory (SCT) (e.g. Bandura, 1986), Social Development Theory (SDT) (Vygotsky, 1978), and social constructionism (Berger, 1967).

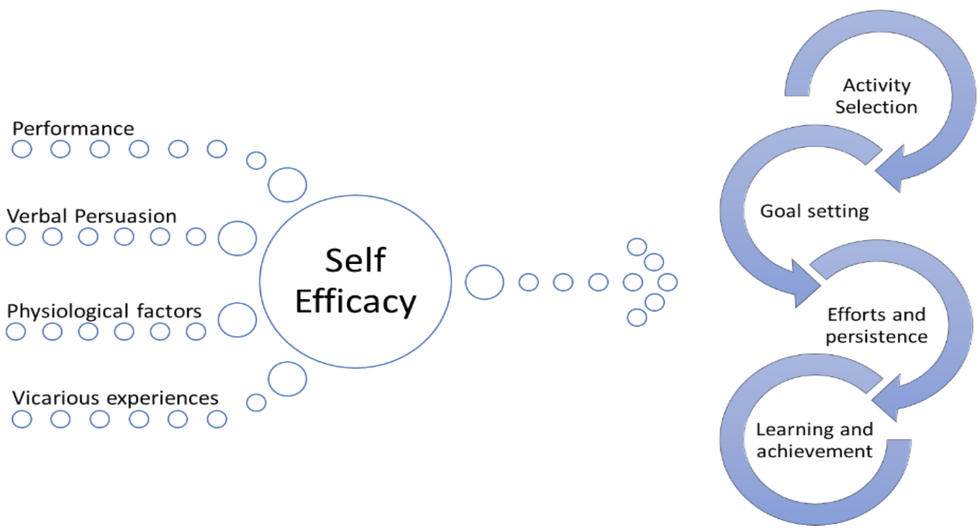
Social Cognitive Theory

Social cognitive theory (SCT) of Bandura (1986) postulates that learning occurs by observing other people's behaviours, attitudes and outcomes of those behaviours, both in person or indirectly through media such as books, television, or games. Active involvement in learning is not a compulsion in this theory; learning can be acquired passively by observing others as models. Social cognitive theory is grounded in behaviourism, but Bandura's SCT overlaps with aspects of cognitive processes and social aspects of learning; therefore, it serves as a bridge between behaviourist and cognitive approaches to learning (Becker, 2017).

Self-efficacy is one of the key features of SCT. According to Bandura (1997), a person's self-efficacy is influenced by four components (Figure 2.3). First is the performance, which may be the actual performance on the task or a past performance on a similar task. The second is verbal persuasion, when someone is cheered up and motivated to do the task. Third are the physiological factors, such as sweaty palms, racing heartbeats, or a sense of calm, which help determine whether a person can do the task or not, and finally, vicarious experience, which is the influence of role models on a person's behaviour to do the task. For example, if people see someone else doing a task, they think perhaps they can also do it. Self-efficacy, in turn, influences four factors, activity selection, goal setting, effort and persistence, and learning and achievement (Yu & Tsuei, 2022). The activity selection refers to people's choice of selecting a complex or easy activity; goal setting refers to the kind of targets people set; effort and persistence relate to the effort, and persistence people are willing to invest in completing the task, and learning and achievement show as how much people have actually learned or performed in achieving the task. The higher a person's self-efficacy, the more difficult tasks they will choose or the more challenging goals they will set for themselves. They would put in more effort, persist longer, and demonstrate better learning outcomes; thus, higher self-efficacy leads to better learning.

Figure 2.3

Components Influencing Self-Efficacy



Applications of SCT are commonly seen in the tutorial session of most digital games, where demonstrations of how to do something are provided to the players, and players are given a chance to perform actions after seeing the demonstration. In terms of reading development, Rasti-Behbahani and Shahbazi (2020) argue that the affordance of combining textual, pictorial, and auditory information in digital games helps students improve vocabulary by seeing the textual forms and pictures and simultaneously hearing the pronunciation of the target words. Sykes and Reinhardt (2012) argue that several effective characteristics of digital games, such as interactivity, goal setting, instant feedback and rewards, visual cues, and contextualised language use, are grounded in principles of SCT. Reinhardt (2017) suggests the affordances of adventure or simulation games for reading skills development as the goal of such games is not to develop vocabulary or grammar but to provide an action-oriented context that promotes meaningful use of the language. On the other hand, there is a growing interest in recent literature (e.g. Liang & Yang, 2017; Mahayanti et al., 2020) to investigate the characteristics of digital games and the learning environment that affects students' cognition, meta-cognition and behaviours, which is linked to another important feature of SCT, called self-regulated learning (SRL) (Bandura, 1991).

Self-regulation is the ability to regulate or control own behaviours and actions. Bandura (1991) categorised self-regulation into three phases: Forethought phase, Performance phase, and self-reflection phase. The forethought phase begins before the action, including goal setting, planning, and motivation. The performance phase includes self-control or self-observation. Finally, the self-reflection phase comes after the performance phase or doing the task. It involves self-evaluation and reaction to the self-evaluation, such as how well the task is done and the feelings on completing the task. This reflection leads to a new forethought phase that involves planning for new actions.

Students may not be able to do all these actions independently in a learning environment; they may need guidance from the teacher to model these behaviours or actions. Media, including digital games, may play an important role in mimicking behaviours and guide learners through timely and constructive feedback to reflect on their actions, set goals, assess their skills, and plan ahead to achieve them.

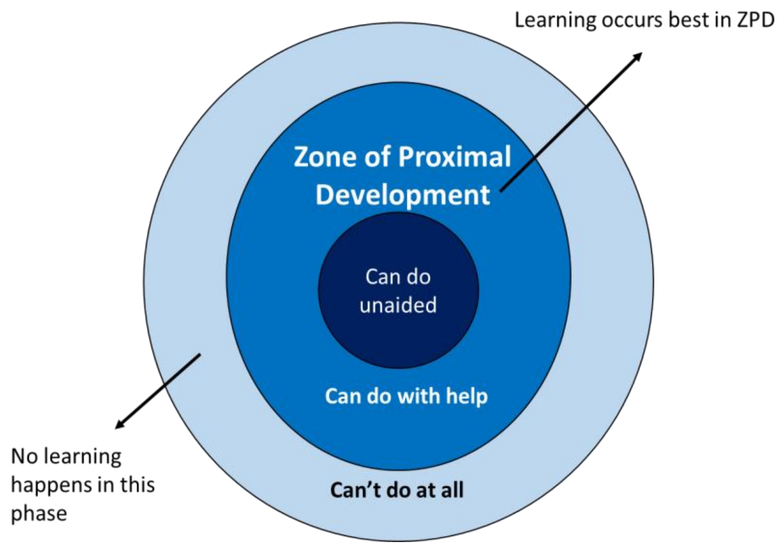
Social Development Theory

Vygotsky is the pioneer of social development theory (SDT), although his work was unknown until translated and published in English in the early 1960s. Vygotsky is best known for his proposition that social interaction plays a significant role in cognitive development, and learning happens best with the help of a more knowledgeable person (Vygotsky, 1978). Piaget (1936) was of the view that child development precedes learning. In contrast, Vygotsky argued that learning precedes development (Vygotsky, 1978) as every function appears twice during the child's development, first, on the social level, when the child learns a function in a social context, through people (inter psychological) and second at the individual level, when the child experiences the function at the personal level (intra psychological).

Through his theories of More Knowledgeable Others (MKO) and the Zone of Proximal Development (ZPD), Vygotsky proclaimed that the performance of a person is enhanced through the support of more knowledgeable other, be it a teacher, mentor, coach, adult, a peer or a younger person with more knowledge or expertise, or even a tool. Vygotsky defined ZPD as the distance between a student’s ability to perform a task with teacher facilitation or peer collaboration in relation to the student’s ability to perform the task independently (Figure 2.4). He maintained that learning occurs best within the zone of proximal development and that people with a larger zone of proximal development will perform better than those with smaller ZPD. Crook (1991) suggests that Vygotsky's theories of MKO and ZPD would also include computers (as tools of support) if these are programmed to provide feedback and instructions.

Figure 2.4

Zone of Proximal Development



Note. The second circle represents the Zone of Proximal Development introduced by Vygostsky (1978) where learners cannot complete tasks without help, but can complete them with support. From “Choosing and Using Digital Games in the Classrooms: A Practical Guide, by K. Becker, (p. 39), 2017, *Springer*. Copyright 2017 by Springer.

Based on the industrial model, most school environments in developing countries offer a traditional instructional of learning where information is transmitted from teachers to learners; however, this is not the case in much of the developed world (Ahmad & Tsai, 2018). On the contrary, the developed countries in the world tend to create a learning environment based on active student engagement through collaboration and student-centred approaches to learning (Dede, 2018). DGBL literature suggests that digital games may offer a collaborative and interactive environment through the game characteristics, such as artificial intelligence that actively supports Vygotsky's ZPD theory (Sun et al., 2011).

Digital games have the potential to offer support in second language learning, reading and listening activities as the games could offer situated learning within a context, interaction and feedback through game characteristics, challenge to solve problems using scaffolded instruction, and opportunities to practice tasks to develop competence. However, the greatest challenge within DGBL is the design and development of game pedagogy to provide appropriate scaffolds for knowledge construction and to decide when the scaffolds should be reduced (Sun et al., 2011). Research shows that digital scaffolding boosts motivation for learning and enhances game performance by bridging the gap between students' capabilities and target achieving, helping students to internalise knowledge from scaffolded instruction to become autonomous learners (Rogoff & Gardner, 1984). Nevertheless, overreliance on digital scaffolds may result in a lack of problem-solving skills and a barrier to knowledge internalisation (Sun et al., 2011).

Social Constructivism

Vygotsky's social constructivism is an extension of constructivist approaches to learning (Detel, 2001), which purports that knowledge is not only constructed but co-constructed through shared ideas and experiences (Bozkurt, 2017). Language and culture play a primary role in developing cognitive abilities in social interactions or collaborative activities, and therefore, cognition must be explained as an outcome of a social phenomenon. Learning does not simply mean assimilation and accommodation of new knowledge by learners. Learning is defined as a process where learners receive information, use prior experiences to process the information, co-construct meaning by sharing ideas and engaging in dialogues with others, and then disseminate information to generate new knowledge (Vygotsky, 1978).

Vygotsky's idea of shared knowledge construction and collaboration seems like a natural fit with digital games, not only with multiplayer online roleplaying games but also with single-player games (Becker, 2017). However, under social constructivism, the implementation of single-player games requires pedagogy to promote collaborations, reflection, and discussion in a classroom context to construct shared knowledge (Paraskeva et al., 2010).

Research into massive multiplayer online roleplaying games (MMORPGs) has established a potential value of using such games for developing real-time L2 interaction with varied interlocutors, including native speakers of different languages (Peterson, 2010). Such games provide a platform for culturally diverse learners to practice the target L2 and develop discourse management skills through communicative competence within a game environment (Peterson, 2012). The present study did not intend to use MMORPGs, but the idea of collaboration and interactions to co-construct meaning could replicate a multiplayer gaming environment and may have an impact on L2 reading skills.

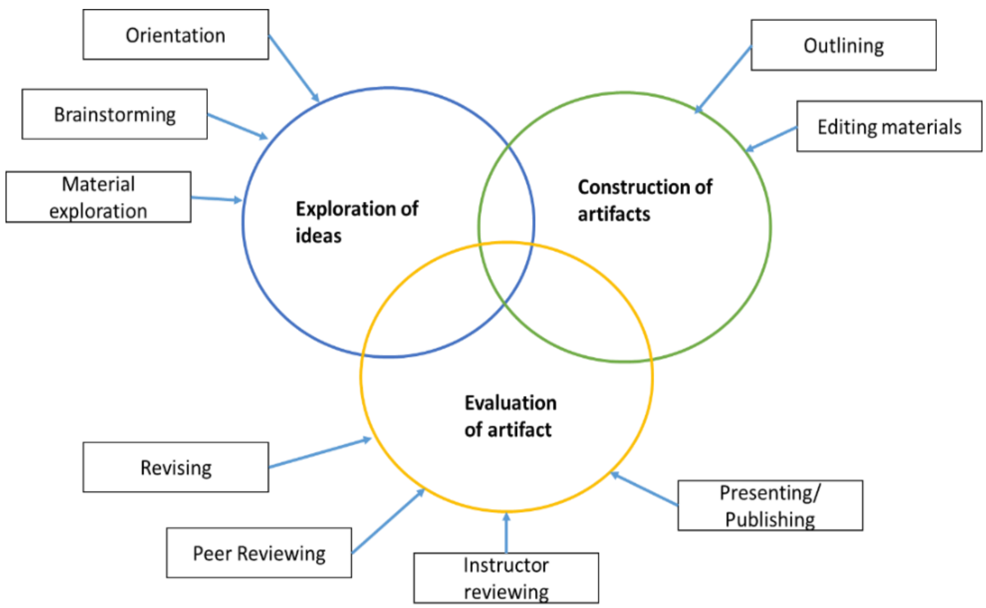
Social Constructionism

Social constructionism states that people work together to construct reality (Berger & Luckmann, 1966). If reality is assumed as an artefact, social constructionism focuses on the artefact developed through social interactions of people in a group within the boundaries of a specific culture or society (Berger, 1967). In contrast, social constructivism deals with an individual's learning taking place through the interactions in the group during the process of constructing the artefact (Vygotsky, 1978) . Burr (2015) and Berger (1967) believed that language and conversation are the means to communicate and co-construct thoughts and ideas to understand various worldviews. The present study anticipated that digital games could be linked to social constructionism as the games provide a social interaction experience for students in a classroom environment where interaction could happen at multiple levels, such as, student-game interaction, student-student interaction, and student-teacher interaction, if the games are played in a classroom setting. The DGBL environment provides a social space for interaction so that knowledge can be constructed. However, utilising the learning space depends on the teacher's philosophy on how well a teacher could create opportunities for knowledge construction (Molin, 2017).

Learning a new language to communicate in society is prefaced on social constructionism. Research into second language acquisition through digital games (e.g. Hitosugi et al., 2014; Reinhardt, 2017) indicates that games provide a context for players to interact and develop discourses to convey meaning effectively. Using digital games based on the social constructionism framework (Parmaxi & Zaphiris, 2015) can help students develop second language skills effectively by using the three dimensions: exploring ideas, constructing artefacts, and evaluating artefacts. These dimensions are further exposed to nine actions (Figure 2.5), orientation, brainstorming, material exploration, outlining, editing materials, revising, peer-reviewing, instructor-reviewing, and publishing (ibid).

Figure 2.5

Social Constructionism Framework



Note. Adapted from " Developing a Framework for Social Technologies in Learning Via Design-Based Research", by A. Parmaxi and P. Zaphiris, 2015, *Educational Media International, 52(1)*, p. 33-46

Digital language learning games have the potential to provide a platform to accommodate the three dimensions along with subsequent nine actions into the gameplay and let the learners develop language skills in the form of game levels. Within social constructionism, language development using DGBL in schools may be dependent on students' performance shaped by in-game feedback and scaffolding provided by the teacher in a classroom context. However, students' motivation to perform better is also an essential factor in learning to read using digital games. The next section reviews prominent motivation theories related to DGBL for L2 reading acquisition.

2.7.2 *Motivational theories in DGBL for reading in L2*

Motivational theories are grounded in Humanism, believing in the human agency and that people can achieve growth and improve performance if provided with opportunities (Kurtz, 2009). Motivation is an individual's attribute that leads to better performance (Woo, 2014). Motivation is defined as a desire that leads to target achieving behaviour. Motivation is related to performance; for example, a motivated student may be working hard to complete targets. However, only having the motivation to complete a task is insufficient; it needs ability, competence, knowledge, and skills to perform the task (Keller, 2010). Moreover, environmental factors, such as access to information, resources, support, scaffolding, and social interactions, may also be critical to determining performance (Woo, 2014). Literature indicates three prominent motivational theories: self-determination theory (Ryan & Deci, 2000), Maslow's hierarchy of needs theory (Maslow, 1987), and the flow theory (Csikzentmihalyi, 1975), which impact student performance in language learning using digital games. The following subsections present a brief account of the theories in relation to DGBL.

Self-Determination theory

Self-determination theory, proposed by Deci and Ryan (2012), refers to students' ability to make choices and integrate their experiences to master skills and achieve growth. This ability directly impacts motivation as students feel motivated and willing to take action when they feel their actions will have positive outcomes. (Ryan & Deci, 2000) posit that three psychological needs are central to self-determination for motivational growth: competence, autonomy, and relatedness (Figure 2.6).

Competence refers to optimal engagement in an activity to achieve mastery of skills. Within self-determination theory, competence is related to the need for pleasure gained by being effective in doing something (Ryan & Deci, 2000), which leads to internal satisfaction (intrinsic motivation) in individuals rather than achieving separable outcomes. *Autonomy* refers to making independent decisions by taking control of behaviours and actions (Deci & Ryan, 2012). In the context of self-determination theory, autonomy is related to the need for self-organisation and self-regulation to become independent and responsible in making informed decisions. *Connectedness* or *relatedness* refers to belongingness, a feeling of security and intimacy with other people or the environment (ibid). Within self-determination theory, connectedness defines an individual's need to belong to a place or a person.

Figure 2.6

Self-Determination Theory

Note. From "Self-Determination Theory and the Facilitation of Intrinsic Motivation, social Development, and Well-Being" by R.M. Ryan and E.L. Deci, 2000, *American Psychologist, 55(1),* p. 68-78

The self-determination theory explains that in an educational context, motivation is driven by students' psychological need for connectedness to the group of students or their environment that creates opportunities to foster competence by achieving mastery in skills and enable them to make independent decisions leading to further growth. Literature in DGBL for L2 establishes that digital games have the potential to improve student motivation by embedding elements of fun, enjoyment, challenge, curiosity, feedback and rewards (e.g. Acquah & Katz, 2020). However, not all games improve student motivation (Becker 2017). A game that might be too easy or too challenging may not be enjoyable, thus may lead to losing motivation to complete and gain competence. Similarly, games that provide excessive help or the ones that do not provide enough choice may not fulfil the need for autonomy and may lead to boredom (Abuhamdeh & Csikszentmihalyi, 2012). Although not all games are social, there may be elements of attachment with the game, or perhaps the sense of belonging comes from the environment, either the virtual game environment or the physical DGBL environment where the games are played. The notion of playing games in a physical or virtual environment suggests investigating the impact of environments on student motivation in learning to read in an L2 using digital games.

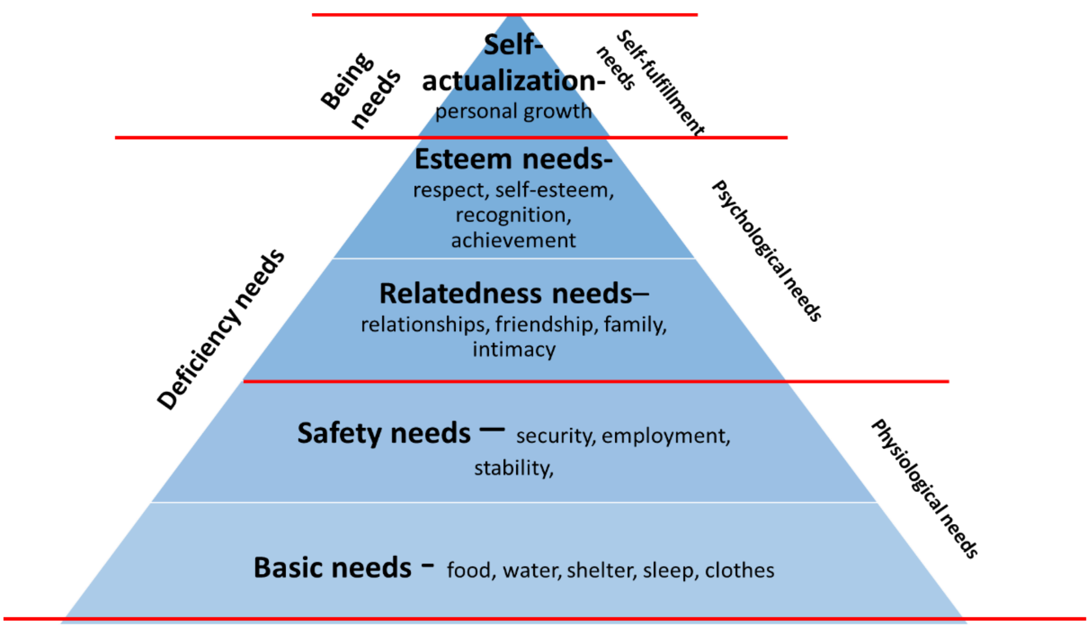
Maslow's Hierarchy of needs theory

Maslow's hierarchy of needs (Maslow, 1987) is commonly viewed as a motivational theory of human psychology popular in nursing (Hale et al., 2019), professional training in organisations (Stawasz, 2019), as well as in the education sector to examine the issues of resilience and retention especially in higher education (Abbas, 2020). It is presented as a five-tier pyramid model representing human needs at each level (Figure 2.7), in a hierarchy from bottom to upwards as physiological, psychological, and self-fulfilment needs.

The stages of the model can also be categorized as deficiency needs and growth needs. The first four levels of needs are the deficiency needs, while the top level is the growth or being needs. Maslow (1987) argued that deprivation leads to deficiency needs which motivate people to find ways to get out of deprivation. As people start to overcome deficiencies, they grow a desire to become a better person, which leads to 'being needs', also known as 'growth needs'.Also, the motivation to fulfil such needs

Figure 2.7

Maslow's Hierarchy of Needs



Note. Maslow's Hieracrcy of Needs (1978) as a five-tier pyramid model representing human needs at each level in a hierarchy from bottom to upwards as physiological, psychological, and self-fulfilment needs. Modified from "Maslow's Hierarchy of Needs", by S.McLeod, Simply Psychology. *1.* p. 1-18 becomes intense the longer the duration the needs are unmet. For example, a longer period without food would result in more hunger. Similarly, a longer period without shelter makes a person more insecure. Once the deficiency is met, it will motivate people to meet the next level of needs until self-actualisation is acquired. This concept of meeting deficiency needs can also be mapped to extrinsic and intrinsic motivation. Extrinsic motivation refers to a desire for engagement due to external indicators. Deficiency needs may be considered extrinsic motivational elements in Maslow's theory. Self-actualisation, the desire for personal growth, may be mapped to intrinsic motivation as it is not dependent on external factors.

In relation to DGBL, Maslow's theory may inform the use of extrinsic motivation (e.g. rewards, badges, scores) to engage in gameplaying, leading to fulfilling deficiency needs. Once the deficit is met, the game may generate an intrinsic desire to accomplish skills without external motivators. It may also be used to understand the motivators of the DGBL environment that may help teachers design the learning environments to generate intrinsic motivation (Lin & Lin, 2014).

Theory of Flow

The flow theory was conceptualized by Csikszentmihalyi (1978), featuring a concept called the 'flow experience, defined as a state of cognitive absorption in which the individual is fully concentrating on the task and loses the effect of time, thoughts and emotions unrelated to the task. Research in DGBL (e.g. Acquah & Katz, 2020; Kiili et al., 2014) indicates that digital games have the potential to engage students in a flow experience by reasonably integrating factors like clear goals, challenges, feedback, sense of control, and playability to improve the optimal user experience in the games. However, research also highlights that a balance of embedding such factors is required to ensure learner's success (Ebrahimzadeh & Alavi, 2016; Hong et al., 2017); overuse or underuse of these factors may break the flow leading to anxiety and boredom. Acquah and Katz (2020) argue that students' motivation and engagement in games are potentially due to a balance between skills and challenges in playing games. This is a direct representation of Vygotsky's (1978) Zone of Proximal Development (ZPD), that effective learning through games occurs when students are supported (e.g. through instant feedback and options to replay the game) but still challenged within their skills range (Kiili, 2005). Kiili et al. (2014) further extended the flow theory by presenting a flow framework to evaluate the quality of educational games for optimal learning and student experience. The flow framework may be useful in analysing the link between educational theory and game design; however, it does not provide the indicators to evaluate a complete game design for a language learning game (Kiili et al., 2014; Proulx et al., 2016).

The motivational theories described in this major section are different yet share common grounds. For example, Kowal and Fortier (1999) and Lee (2005) established a relationship between SDT and flow theory, arguing that students with better self-determination experience better flow to engage deeply in learning activities. Similarly, the psychological needs in Maslow's (1978) hierarchy of needs theory can be mapped to the components of self-determination theory, which suggests that educational games grounded in learning and motivational theories may engage students in effective learning. However, the challenge is to find effective games that yield meaningful learning and greater intrinsic motivation for language learning (Kolak et al., 2021; Lim & Toh, 2022) and, more specifically, developing L2 reading skills for students with diverse needs (Lämsä et al., 2018; Ronimus et al., 2019).

2.7.3 *Geosemiotic Analysis Framework*

Little is known about the impact of space and the use of materials on classroom interactions in L2 classrooms (Pierce, 2012). However, the research shows that learning spaces have an impact on classroom discourses, identities and social practices in the classrooms (Tian & Dumlao, 2020). To examine how classroom interactions are shaped by learning space and materials used to learn L2, this study used Scollon & Scollon's (2003) Geosemiotic framework. A couple of concepts need to be understood before using this framework. First, classroom interactions are defined as social interactions that occur when one agent (e.g. teacher or student) acts or causes a reaction to the other's action. Second, the design of the learning environment and the resources used for learning have no agency; however, they contribute to shaping the interactions between students and teachers (ibid). The present study used three elements: learning environment, students, and digital games to study the interaction between students and teachers. The emerging concepts were consolidated from three perspectives: cultural geography, sociocultural and sociocognitive perspectives, using Scollon and Scollon's Geosemiotics Analysis framework (2003), which examined how classroom culture was shaped in DGBL environments that empowered students with developing reading skills and 21st century skills.

A fundamental construct of cultural geography is the culture that is temporally and spatially grounded in real-life scenarios (Crang, 2013). From the lens of cultural geography, the present research intended to examine how digital games in a classroom environment influence the use of space, form identities and semiotic systems essential for the culture to construct meaning. Since cultures are influenced by politics and power (Crang, 2013; Higgins, 2017), the present research also aimed to examine the influence of teachers, their roles and power relationships on students' behaviours and motivation to reading in L2.

Social interactions could lead to the sociocognitive perspective of co-construction of knowledge (Atkinson, 2002; Davidson, 2010)

A sociocognitive perspective in geosemiotic analysis maintains that knowledge is jointly constructed through interactions with others and the learning materials (Atkinson, 2002). Therefore, meanings in the present research were constructed from students' understanding and interactions with digital games in developing reading competencies. The sociocultural view of second language acquisition considers reading as an interactive and communicative activity (Davidson, 2010). From this perspective, the present study examined the social and cultural context of the classroom in knowledge construction and problem-solving using digital games. The next section reviews the use of digital games in developing reading skills in L2.

2.8 Use of Digital Games in L2 Reading Development

The increasing popularity of digital games has inspired computer-assisted language learning (CALL) researchers and teachers to explore the potential benefits of games for language learning (Rachmawati et al., 2020; Zhang & Zou, 2022). L2 learning includes skills related to learning grammar rules and building vocabulary through reading, listening, speaking and writing (Mohamad & Rashid, 2018).

Recent research highlights the affordances and opportunities available for L2 learning through commercial-of-the-shelf (COTS) games and massive multiplayer online roleplaying (MMORPGs) (Chik, 2014; Reinders, 2012; Reinhardt, 2017; Sykes & Reinhardt, 2012). While exploring the pedagogical affordances of games in education, Reinhardt and Sykes (2014) distinguished COTS games into three pedagogical perspectives, ‘game-enhanced’, ‘game-based’, and ‘gamified’. Game-enhanced perspective looked into the usability and effectiveness of COTS games (not purposed for learning) within classroom pedagogy. The game-based perspective aimed to investigate the application of digital games explicitly designed for educational use, whereas the game-informed approach focused on exploring the gamification phenomenon within the formal pedagogy outside the game environment. Reinhardt and Sykes’s (2014) framework provides research perspectives into relationships between L2 acquisition and teaching focus through game-enhanced, game-based and game-informed teaching and learning environments. Among these perspectives, the game-enhanced focus needs more research on using the COTS game for developing L2 reading skills (ibid). Such research would be more valuable in developing countries that rely on hand-me-down games from the developed world (Dede, 2018) to improve literacy standards through L2 teaching and learning. The current study adopted the game-enhanced focus to use low-cost COTS games for reading development in an L2.

Previously, cognitive-linguistic and psycholinguistic approaches of SLA were most commonly adopted to study technology implications for L2 reading (Chapelle, 2009). More recently, researchers have adopted sociocultural theories to understand the role of technology in L2 development (Liaw & English, 2017). Sociocultural theories posit that learning occurs in a sociocultural environment where learners are effective constructors of knowledge (Vygotsky, 1978). From this perspective, the current study does not position reading as an individual skill but as a social phenomenon which requires active student participation and interaction, not only with the reading text to construct meaning but also with society, peers, and teachers (Lantolf, 2012; van Compernolle & Williams, 2013). Games underpinned by theory-based pedagogical principles provide personalised and active learning opportunities (McClarty et al., 2012), and authentic game design develops intrinsic motivation in players by evoking curiosity and creativity, offering a challenge with clear goals, and constant feedback (Reinhardt, 2017). Successful game designs provide learners with a simulated experience that scaffolds learning through interaction and practice (ibid). A good game design for reading learning games shares key principles of L2 learning, such as well-defined goals, interaction, contextualized language use, and instant feedback (Sykes & Reinhardt, 2012); therefore, games developed with such considerations are deemed to be effective learning tools in Second Language Acquisition (SLA).

A few literacy learning games have been developed for developing countries, such as Graphogame, developed for dyslexic learners (Ronimus et al., 2014), Antura and the letters, and Feed the Monster, developed for Syrian refugee children to improve Arabic reading skills (Norad, 2017). A review of the educational value of these games suggests to improve pedagogical and design considerations (Hong et al., 2009), such as using a phonics-based approach instead of a whole-literacy (letter naming) approach, improving student engagement by introducing an avatar or virtual game character to serve as a tutorial guide, provide opportunities of repetition and practice by introducing more game levels. Moreover, managing the game's difficulty level to prevent the risk of demotivation and improving the game interface by adding features for easy navigation suitable for multiple devices (Cornings, 2018) could also produce better learning outputs.

Gee (2012) argues that the association of words with images, actions, goals, or dialogues enables learners to better understand the text in a game context. Reading and following the game instructions provide learners to interact with game characters and comprehend information in an L2 game environment. Good games engage learners in game-playing and reading and writing activities (ibid). Hence, game designers, instructional designers, and teachers may need some guiding criteria to develop and use games for L2 teaching and learning based on language and literacy theory and research.

2.9 Relevance of Digital Game-Based Learning (DGBL) to Enhance Education Quality, Equity and Efficiency in Developing Countries

The effectiveness of a learning medium largely depends upon its adept or inept adoption by teachers as a pedagogical tool. The technology could not simply infuse children with knowledge unless proficiently and purposefully used to impart knowledge. The same may be true for digital game-based learning, which can have the potential to bring quality to education if first, integrated expertly, and second, spanned over an appropriate duration of time. Although DGBL is an emerging field, early interventions in developing countries have established the possibility of fostering positive behaviour, including increased motivation and engagement, achievement and access to education for students belonging to varying socioeconomic backgrounds, genders, and cognitive levels, either enrolled in schools or out of schools (Ahmad et al., 2018; Ahmad & Maqsood, 2017; Halloluwa et al., 2014; Kam et al., 2008; Khan et al., 2017; Kim et al., 2012).

Most of the DGBL interventions in developing countries have explored mobile technologies such as low-cost tablets and smartphones in the classroom, making it as a cost-effective solution to funds-constrained economies, generally with a limitation of using 2D games. These studies (e.g. Ahmad et al., 2018; Ahmad & Tsai, 2018) highlighted some useful results relating to accessibility, equity, quality and efficiency that could be considered in future projects for marginalized children of developing regions. The potential positive effect of DGBL on learner engagement suggests that all children can learn with handheld devices, but at different rates, which endorses DGBL as an equitable and accessible medium to provide quality education (Dede, 2018).

2.10 Role of Teachers in DGBL and Literature Gap in Pakistan

Recent research indicates that digital games are useful tools for self-paced learning with minimal teacher support (Ahmad et al., 2018; Ahmad & Maqsood, 2017; Pynnönen, 2019). The interactional nature of the games and immersion offered by effective game design (Gee, 2014), together with in-game feedback for self-corrections (e.g. correcting pronunciation in literacy learning games), make DGBL an exciting context where teachers lack language skills or where trained teachers are scarce (Pynnönen, 2019). Game design elements, e.g. Speech recognition, embedded in digital games with self-correction feedback features, exciting storyline, fantasy, challenge, and goal setting may advocate using digital games without teacher support (ibid).

Effective integration of DGBL for language learning requires trained teachers who can visualise and enact the changes in their traditional roles due to digital technology integration (Molin, 2017). The literature illustrates teachers' challenges and barriers to integrating digital games effectively. Some of the prominent challenges include: (a) limited time for planning, selecting and playing games before the session, (b) uncertainty about using games in the classroom due to low game literacy, (c) lack of support from school administration to help improve teachers' competencies in DGBL, (d) classroom dynamics, e.g. disturbances in classroom discipline, potential conflict with traditional teachers' beliefs or school management, and (e) poor technical infrastructure and high cost associated to game subscriptions, making it challenging to integrate games meaningfully in classrooms (Kaimara et al., 2021; Sánchez et al., 2017; Shapiro et al., 2014). Upon a close review of these studies, it was found that the common potential barriers have been insufficient time to use games in the classroom, low game literacy, difficulty in selecting games that match the curriculum needs, and lack of pedagogical skills to use games in teaching effectively. Molin (2017) argues that such barriers indicate that the role of teachers has been marginalised when it comes to using DGBL in the school context.

There is a lack of empirical research on using digital games for language learning in Pakistan and identifying the roles of teachers in facilitating DGBL sessions in a classroom context. Some research in the field of DGBL in Pakistan focused on studying the impact of games on student behaviours and learning outcomes in Science (e.g. Ahmad & Maqsood, 2017; Khan et al., 2017) and mathematics learning (e.g. Ahmad & Khan, 2017), and some aspects of literacy skills such as vocabulary building and pronunciation skills (e.g. Pynnönen, 2019). However, research on using digital games for reading development in L2 is scarce. The present research aims to fill this gap by studying the impact of digital games on early reading skills in a developing country like Pakistan, which struggles with eradicating illiteracy. The influence of teacher facilitation on students' reading skills and students' and teachers' perceptions of the changing behaviours and attitudes towards reading was also investigated. The research questions that guided this study are listed in the next section.

2.11 Research Questions

Overall, this research provides an appreciation of the potential impact of digital game-based learning for early literacy learners while emphasising the following overarching research question followed by sub-research questions:

How effective is digital game-based learning in developing reading skills in a multilingual developing country context?

The sub-research questions are:

1- What are the desirable characteristics of digital games for reading skills development in a second language?
2- How does digital game-based learning impact on reading skills development of primary school students of low socioeconomic status?
3- How do students and teachers perceive the use of digital games in changing behaviours and attitudes towards reading?
4- How are reading skills influenced by teacher facilitation when engaged in a digital game-based learning environment?

The research questions were crafted by identifying gaps in the literature. The focus of the questions was to design a study to help understand the educational value of pedagogically balanced digital games, which could positively influence reading skills even if the teachers lack expertise in second language teaching. The first question aimed to investigate the most desirable characteristics of digital games that may help develop English (L2) reading skills in a resource-limited developing country context. The second question was focused on finding the impact of digital games on achieving reading outcomes in both the languages English (L2) and Urdu (L1). Since most of the commercial-of-the-shelf (COTS) are developed in the English language, these questions are also intended to explore if the cross-linguistic transfer happens from English (L2) to Urdu (L1). The third question was posed to understand students' and teachers' experience of using digital games as a learning and pedagogical tool to develop reading skills and to find any attitudinal or behavioural changes resulting from the use of digital games. Digital games may be considered as a medium that encourages students to plan their own learning or initiate self-paced learning by following game levels or learning hierarchies embedded in the game design. Therefore, the last question looked for any differences in achievement outcomes between students playing games with and without teacher facilitation.

2.12 Summary

This chapter presented a review of the literature relevant to multiple facets of this study, which provided a holistic understanding of the potential use of digital games for L2 reading skills development. The relevant literature on key areas of early literacy development, pedagogical factors that could influence reading skills in a multilingual context and the relevant theoretical positions concerning digital game-based learning have been explored. The theoretical positions were mainly grounded in social learning, social cognition and motivational theories.to examine how social interactions in a DGBL environment contribute to developing reading skills and attitudes using digital games. Also, the role of teachers and the classroom learning environment conducive to developing reading skills have also been examined. The gaps in the existing literature were identified and tied into the research questions. This chapter concluded by outlining the research questions for this study. The next chapter presents the methodology, research design, data collection and analysis methods, and ethical considerations adopted for the present study.

CHAPTER 3: METHODOLOGY

This study employed a mixed-method research design to initiate the inquiry into the impact of digital games for reading development in a developing country like Pakistan, where English is the second language but is used as a medium of instruction in schools. This chapter explains the methodological approaches adopted to seek insights into the research questions (Section 2.11) that guided this study. In particular, it justifies the choice of mixed-method research design, data collection and data analysis methods used in this study.

This chapter begins with a research framework based on Crotty's (1998) elements of research that explain the epistemological and theoretical perspectives of research design. It then introduces the research design leading to the research setting and sampling procedures used to select a sample for different study phases. Following that, it explains the data collection methods in each phase leading to quantitative and qualitative data analysis methods to analyse data. A small section discussing methods for conducting meta-inferences through triangulation of quantitative and qualitative data is also included in this chapter. Next, a follow-up section highlights validity and reliability issues and ethical considerations pertinent to the study. The chapter concludes with a brief account of resources acquired for the study, followed by the research timeline and chapter summary

3.1 Research Framework

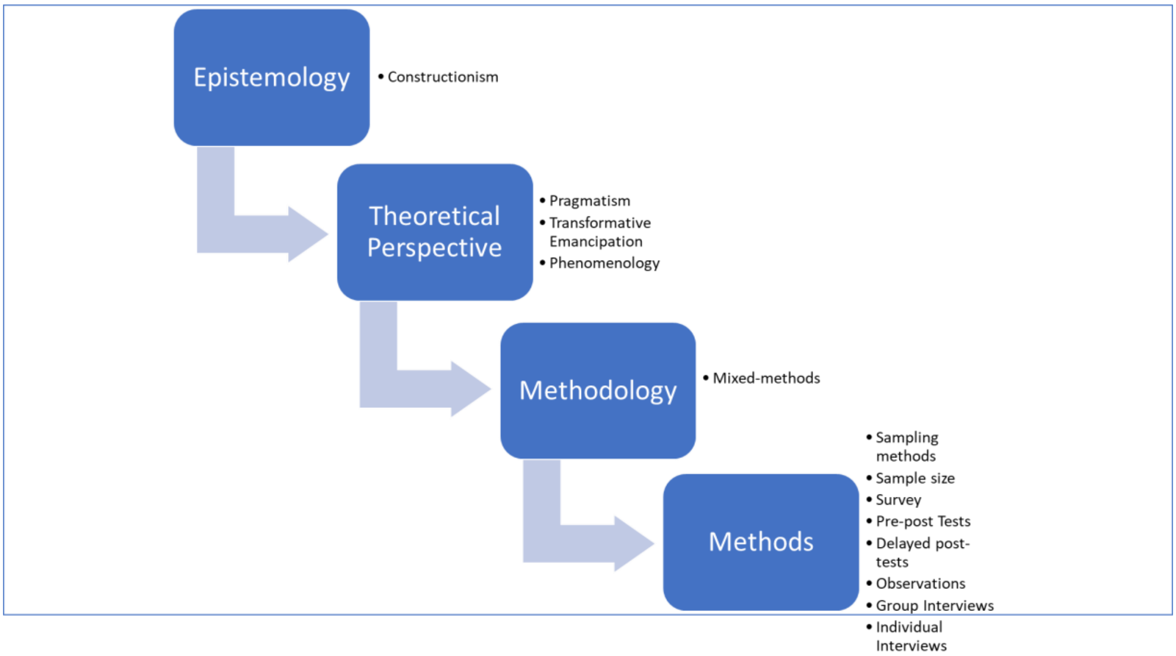
A robust research design is underpinned by a social research framework that sets the guidelines to initiate inquiry (Crotty, 1998). Using a research framework attains a sense of stability and direction in building a research process suitable for the inquiry. To conduct social research, Crotty (1998) suggested a framework that has four elements acting as scaffolds to the research process:

- Epistemology
- Theoretical perspective
- Methodology
- Methods

The elements of the framework represent a distinct hierarchical level of decision-making to shape the choices and use of methods and link them to the desired outcomes of the study. Figure 3.1 shows the four elements of research used to develop the framework for the present study. It was initiated by adopting an epistemological stance towards the nature of inquiry (e.g. constructionism) which informed the theory of knowledge; explaining how knowledge was created and how it should be viewed by the target audience. This stance governed the selected theoretical perspective (pragmatism, transformative emancipations, and phenomenology) to provide a context for the research. The theoretical perspectives are implicitly grounded in research questions and direct the choice of methodology, i.e. mixed-methods. Finally, the selected methodology informed the choices of methods used for data collection and analysis: pre-post-tests, surveys, individual interviews, and group discussions.

Figure 3.1

Four Elements of the Research Framework



The next section discusses the epistemology that informed the theoretical perspective, providing context to the adopted methodology.

3.2 Epistemology

Epistemology is "a way of understanding and explaining how we know what we know" (Crotty, 1998, p. 3). It provides a philosophical grounding for deciding upon a suitable research design to acquire adequate and legitimate knowledge. It is inherent in the theoretical perspective, which informs the methodical framework of the research design.

Crotty (1998) discusses three main epistemological positions: objectivism, subjectivism, and constructionism. Objectivism holds that meaning exists regardless of human cognisance, and knowledge is out there to be discovered. Subjectivism believes that the object does not contribute to meaning-making, but the subject generates the meaning. Constructionism rejects the epistemological stances of both objectivism and subjectivism and holds a view that meaning is not discovered but constructed through interactions between the object and the subject (Crotty, 1998). Merleau-Ponty (1962) argues that potential meaning may be there, but actual meaning only emerges when consciousness engages with the subjects and the objects. Constructionists believe that there is no meaning without the mind, and social researchers do not create meaning, they construct social realities through their interactions and their attributions of meaning (Crotty, 1998).

This study follows constructionism as an epistemology based on the assumption that children are active learners rather than passive recipients. They construct knowledge through interactions with others in a sociocultural environment (Vygotsky, 1978), particularly using conversational interactions to build their knowledge of a second language (Gass, 2002). In learning to read, children interact with the print material to figure out the relationship between sounds and letters and develop an awareness that speech can be segmented into smaller units of sound (Phoneme awareness), and those smaller units can be represented by printed forms (phonics) (NCFL, 2009). To construct such relationships, students need to interact in a social environment where they can mimic the sounds and establish relationships between sounds and letters.

Digital games may provide a medium for such interactions and active learning for language learning and reading (Reinhardt & Sykes, 2014). Therefore, a digital game is essentially used to develop the reading skills of the target population of economically and socially marginalised children. Also, the epistemological stance of constructionism allows the researcher to construct multiple social realities and help move research beyond the dualism of objectivism and subjectivism. It allowed planning a methodology to build a holistic reality by combining objective as well as subjective realities. The next section elaborates upon theoretical perspectives of pragmatism with some elements of transformative emancipation, which aligns with constructionism as epistemology.

3.3 Theoretical Perspective

Crotty (1998) describes the theoretical perspective of the research framework as “the philosophical stance for informing the methodology” (p.3). In essence, the theoretical perspective provides a context for the processes and procedures to conduct an inquiry. Developing a theoretical perspective early in the research is vitally important as it informs the selection of appropriate research design and approaches to data collection and analysis and also justifies any underlying assumptions in the selected methodology (Crotty, 1998; Heap & Waters, 2019). This is precisely why the theoretical perspective needs to be elaborated in detail, as it brings to the surface any underlying assumptions associated with the selected methodology and allows researchers to reflect and make a plan of action to address assumptions appropriately. The present study adopted pragmatism with some elements of transformative emancipation as a theoretical perspective in developing the appropriate methodology for the study. The following subsections explicate the use of pragmatism and transformative emancipation in the current study.

3.3.1 *Pragmatism and Transformative Emancipation*

Pragmatism presents the third research movement that shifts away from paradigmatic wars of positivism, post-positivism and interpretivism in studying reality (Johnson & Onwuegbuzie, 2006). It uses a pluralistic approach to study research problems by considering qualitative and quantitative methods to create practical solutions to social problems. Pragmatism is outcome-oriented and focused on finding the meanings of phenomena or practices (Johnson & Onwuegbuzie, 2006). It emphasises creating ‘shared meaning and joint actions’ (Morgan, 2007, p. 67) to develop practical solutions to the problems by complementing the advantages and disadvantages of qualitative and quantitative approaches. Pragmatism is based on the conviction that theories can be contextual and generalisable by analysing their transferability to other situations (Kemper et al., 2003). A pragmatic approach to a study helps to conceptualise the nature of the investigated phenomenon, write the research questions and then consider the appropriate methodological ways of inquiry (Arnon & Reichel, 2009). It also maintains subjectivity and objectivity through qualitative and quantitative data collection and analysis. The abductive nature of pragmatism facilitates triangulation by moving back and forth in data sets and allows the transferability of results to other settings (Shannon-Baker, 2016).

Transformative emancipation maintains that social reality is historically bound and is influenced by political, cultural, social and power-based factors (Neuman, 2011) within a constantly changing reality. The transformative-emancipation is oriented towards empowering marginalised factions of society by involving them in the research process (Mertens, 2003). The study intends to introduce the self-paced and interactive nature of digital games to empower children of marginalised factions of society to learn to read with a minimal teacher or parental support.

In the context of the present study, pragmatism with some elements of transformative emancipation was considered an appropriate theoretical framework. It sought to measure the effectiveness of digital games in developing reading skills for which meaningful data were planned to be collected using quantitative and qualitative methods. Pragmatism allows researchers to maintain subjectivity in their interpretations of qualitative data and objectivity in quantitative data analysis (Shannon-Baker, 2016). Moreover, this study was intervention-based; therefore, pragmatism was considered a suitable approach to measure practical solutions to identified problems, as suggested by (Morgan, 2007). The target population in this study was mainly marginalised children belonging to very low socioeconomic conditions who could not be enrolled in mainstream schools for various reasons. Hence, the transformative emancipation approach enabled the researcher to address social inequalities by exploring ways to empower individuals by potentially minimising inequalities. The researcher explored how socioeconomically marginalised children construct strategies to empower themselves as self-learners using cost-effective digital game-based learning. Phenomenological methods were used to describe and analyse the experience of using digital games for reading development in this study. A rationale for this selection is presented below.

3.3.2 *Phenomenology*

Phenomenological methods in qualitative research aim to describe how people perceive themselves after experiencing a certain phenomenon. The purpose of phenomenology is to uncover the essence of an experience, examine the core of the experience that participants share on common grounds, and understand the ‘thing’ without which it can never be the same experience (Giorgi, 1997; Strandmark & Hedelin, 2002). In doing so, participants will bring their subjective and objective experiences to the fore. Hence, data analysis will emphasise the essence and significance of those experiences within a context (Giorgi, 1997; Padilla-Diaz, 2015). This requires an understanding of the stories ‘told’ by the participants and to know what it actually means.

Phenomenology has its roots in the 20th century philosophical movements based on Husserl’s and Heidegger’s work seeking to understand the complex issues related to the lived experience of a phenomenon, which may not be implicitly known at a surface level (Heidegger, 1967; Husserl, 1931). It is recognised as a movement within which Husserl claims that humans consciously structure lived experiences to understand reality (Wrathall & Dreyfus, 2007). According to De Muralt (1974), Husserl refused to believe that reality exists independently in the outside world and that the truth about reality is reliable without experience. He believed that people could only be certain of how reality appears or presents to their consciousness. Anything that lies beyond direct experience must be ignored to reach this certainty. The outside world is condensed to the contents of personal constructs of lived experiences of consciousness. Realities thus created are treated as 'phenomena', and systematic descriptions of lived experiences are the absolute data from where to begin understanding the contents of the conscious mind (Giorgi, 1997; Mohanty, 1989). Husserl called this method of philosophy 'phenomenology' and the science of 'pure phenomena'(Eagleton, 1983). Hence, phenomenology aims to produce a descriptive, detached analysis of consciousness, in which objects and their links to consciousness are established (Zahavi, 2003).

Heidegger's (1967) interpretive phenomenology is a step beyond Husserl's encounter with consciousness and phenomenological reduction. Heidegger (1967) presented a powerful critique of Husserlian phenomenology, where instead of describing structures of consciousness pertinent to lived experiences, he presented his ideas of interpreting experience by explaining the meaning of 'being' (Dreyus & Wrathall, 2007; Horrigan-Kelly et al., 2016). Heidegger introduced the concept of 'Sein' (being) and 'Dasein (being there or existence of being) embedded in the ordinariness of everyday life, where he perceived 'Sein' as accounts or descriptions of self. 'Dasein' is the growth of being (Sein) through everyday experiences in life (Heidegger, 1967). In simpler words, it can be inferred that people are shaped by their experiences or encounters in everyday life. The more experience people get, the more 'modes of being' they develop. Heidegger believed that people could not detach themselves from pre-conceptions acquired through experiences. Hence, in interpretive phenomenology, researchers cannot be detached from pre-assumptions whilst studying a phenomenon on research participants. Instead, they invoke different 'modes of being' in research participants through appropriate questioning and engaging participants in reflecting on experiences.

The theoretical perspective of pragmatism and transformative emancipation adopted for the current research allowed the use of objective and subjective approaches to seek reality and empower study participants. In addition to statistical methods, the present study adopted Heidegger's interpretative phenomenology to describe and interpret lived experiences of study participants in using digital games to develop reading skills as it provided the flexibility to use prior experience and pre-assumptions to interpret the lived experiences of study participants.

In the present study, the researcher's prior experiences and pre-existing beliefs about using digital games in classrooms helped conduct interviews. Smith et al. (2009) claim that interpretative phenomenological researchers use their fore-conceptions (prior experience, preconceptions and assumptions) as lenses to interpret participants' lived experiences. The researcher in the present study activated various ‘modes of being’ in participants through questioning and understanding any new stimulus in the light of preconceived ideas or prior experience.

The strengths of interpretative phenomenology include uncovering unique perspectives of participants to understand the phenomenon to its true essence, which might lead to the development of new theories and have implications on policies and practices. Analysis of lived experience also exposes misconceptions pertinent to the experience, thus opening new possibilities to view the experience from a different perspective, with a potential to empower participants by activating their different modes of being, so their voices could be heard that might stimulate an action or at least challenge pre-conceived ideas about the phenomenon (Giorgi, 2012). The next section elaborates on the adoption of a mixed-methods research design for this study.

3.4 Methodology

This section outlines the methodology underpinning the study. Educational research follows three major paradigms: quantitative, qualitative, and mixed methods (Creswell, 2014; Johnson & Onwuegbuzie, 2006). The present study used mixed methods as the most suitable approach to measure the impact of digital games on reading achievement and gain insights into the elements of digital games deemed effective in developing reading skills in children. A mixed-methods approach was also effective in studying the way children and teachers experience this phenomenon of using digital games for reading in classrooms to empower economically and socially marginalised children to become self-learners.

3.4.1 *Mixed-Methods Research*

The essential purpose of using a mixed-methods research approach was to acknowledge the strengths and weaknesses of both the quantitative and qualitative methods. So, combining the two methods complemented the advantages of both methods whilst neutralising the disadvantages (Creswell, 2014) and enabled the triangulation of data to gain in-depth insights into the research questions. Four reasons compelled the adoption of mixed-methods research for this study. The first reason was the flexibility of integrating quantitative and qualitative characteristics of methods in a single study (Creswell, 2014). It allows researchers to investigate the phenomenon from objective and subjective perspectives, collect diverse types of data, use a wider range of analysis and triangulation techniques, and interpret findings through multiple lenses (Onwuegbuzie & Leech, 2006).

The second reason for using a mixed-methods research approach was deductive, inductive and abductive methods of interpretation. Mixed methods research allows studying complex educational research problems through a logic of inquiry that includes the use of deduction methods (e.g. testing of theories and hypotheses), induction methods (e.g. discovering themes and patterns), and abduction methods (e.g. uncovering underlying explanations for understanding complex phenomenon) (Onwuegbuzie & Leech, 2006).

The third reason was the possibility of using a multi-phase research design where the results of one phase may inform the design of the next phase (Creswell, 2014; Schoonenboom & Johnson, 2017). This requires establishing research questions before deciding upon the research design. The research questions guide whether the design should give equal precedence to quantitative and qualitative data or prioritise one data set over the other.

The last reason was data triangulation from both quantitative and qualitative methods. Triangulation improves the trustworthiness of results when data are gathered using multiple methods (Cohen et al., 2005). Mixed-methods researchers argue that mixing or integration of data occurs in diverse ways and at varying stages of the research (Creswell & Plano Clark, 2011; Schoonenboom & Johnson, 2017). Fetters et al. (2013) argued that the integration of quantitative and qualitative data can be implemented at various stages of the research, such as at the design stage, methods stage, and at reporting stage. The present study utilised multiple methods to integrate quantitative and qualitative data at different phases of the present study to answer the research questions (Section 2.11). The next section elaborates upon the research design used in the present study.

3.5 Research Design

Due to the complex nature of teaching and learning a second language, attention to the context is critical for understanding the extent to which theories and results may be generalised to other times and populations (Creswell, 2014; Morgan, 2007). This study utilised a mixed-methods research design to investigate the impact of digital games on reading achievement and gain insight into participants' experiences of the intervention and what aspects of the phenomenon affected participants.

Two critical decisions influence designing mixed-methods research – one is related to time orientation, and the other is emphasised by worldviews or paradigms (Johnson & Christensen, 2012). Time orientation indicates when and how quantitative and qualitative phases of data collection occur in the study, sequentially or concurrently. Paradigm emphasis means how much precedence should be given to one worldview (Creswell, 2014), for example, in deciding if a quantitative or qualitative paradigm should take priority over the other. Literature (Creswell, 2012; Teddlie & Tashakkori, 2009) indicates six types of research design pertinent to mixed methods research, including:

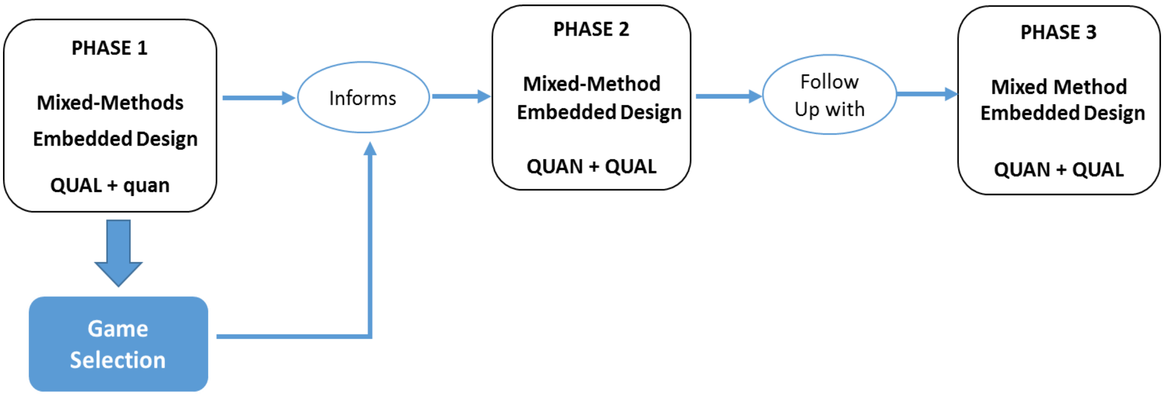
- convergent (or parallel or concurrent) design,
- explanatory sequential design,
- exploratory sequential design,
- embedded design,
- transformative design,
- multi-phase design.

The first four types are basic designs that have been commonly used for the past decade, and the last two are increasingly complex designs that are becoming more popular in recent mixed methods research (Creswell & Plano Clark, 2011).

This study employed a complex multi-phase mixed-method embedded design with three distinct phases using quantitative and qualitative data collection methods to generalise results to larger populations and different times and complement rich descriptions of participants' lived experiences. Figure 3.2 represents the multi-phase-mixed-methods-embedded design used for this study. Phase 1 of the study intended to find desirable characteristics of effective reading development games (RDDG), evaluate existing games and select the best suitable game for the next phase. Therefore, Phase 1 utilised a mixed-methods embedded design (QUAL + quan), which was mainly qualitative in nature with some quantitative methods to establish the reliability of the game evaluation tool developed during this phase. Results from Phase 1 informed data collection in Phase 2 that employed an embedded design with equal emphasis on quantitative and qualitative data collection methods (QUAN + QUAL) to investigate the impact of games on students' achievement on reading skills.

Figure 3.2

Research Design: Multi-Phase-Mixed-Methods-Embedded Design



Note. The letters 'QUAN' stand for quantitative, and 'QUAL' and 'qual' for qualitative; capital letters denote equally increased weight to both type of datasets; small letter denote less weight to the type of dataset; + sign represents concurrent while arrows represent the sequence of events

Phase 3 of the research also adopted an embedded design with QUAN+QUAL data collection to observe retention in the outcomes of Phase 2 data collection. The following subsections provide a description of each phase.

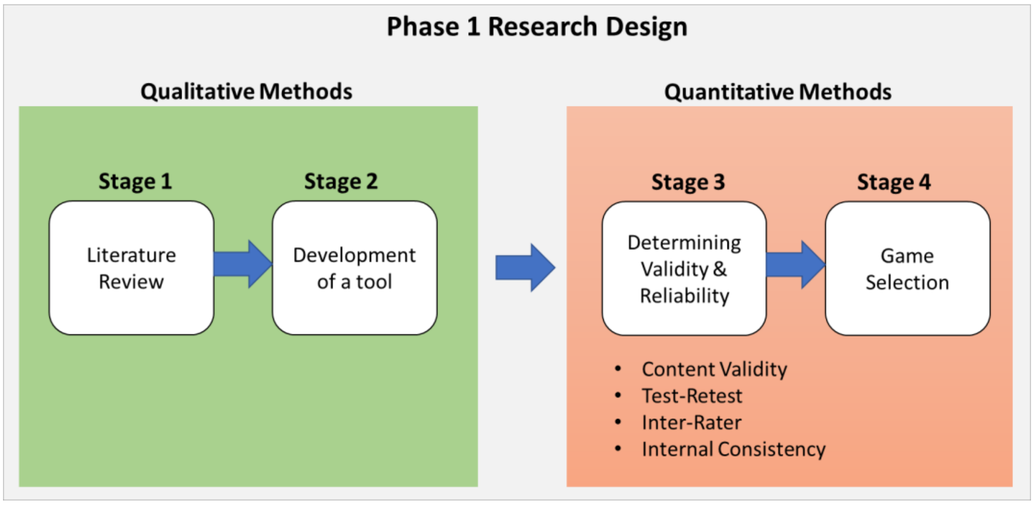
3.5.1 *Phase 1 Research Design: Game selection*

Phase 1 focused on identifying desirable characteristics of effective digital games for developing reading skills in a second language, primarily in a developing country context. Figure 3.3 presents the stages of Phase 1 data collection.

The first stage of Phase 1 comprised of a literature review to develop a framework for game evaluation. The literature review focused on existing gamed-design models, instructional models, and English reading strategies that could help evaluate reading-development-digital-games (RDDGs). The review of existing game evaluation frameworks was part of Phase 1 of the research; therefore, it is included in Chapter 4 (Section 4.2). The output of this stage was the development of a new framework to evaluate suitable digital reading games. The second stage developed a game evaluation tool based on the framework to evaluate existing reading games available on Google Play Store.

Figure 3.3

Stages of Phase 1 Data Collection



The third stage assisted in determining the validity and reliability of the tool. The validity of the tool was determined by calculating the content validity to ensure the relevance, clarity and meaningfulness of the indicators used in the tool (Almanasreh et al., 2019). Three methods were used to estimate reliability: (1) test-retest design with a three-week interval between measurements; (2) internal consistency of the entire tool and subsections by calculating Cronbach's ∝; and (3) inter-rater reliability to determine the consistency of responses from different coders. The fourth stage consisted of finding the best English reading game to use in Phase 2 of the research. The game selection also followed a rigorous process, resulting in the selection of 'Teach Your Monster to Read' (TYMTR) (available at https://play.google.com/store/apps/details?id=com.teachyourmonstertoread.tmapp&hl=en). This game was used in Phase 2 of the research. This game is a collection of multiple sub-games at different difficulty levels. Methods of data collection in Phase 1 are explained in Section 3.9.

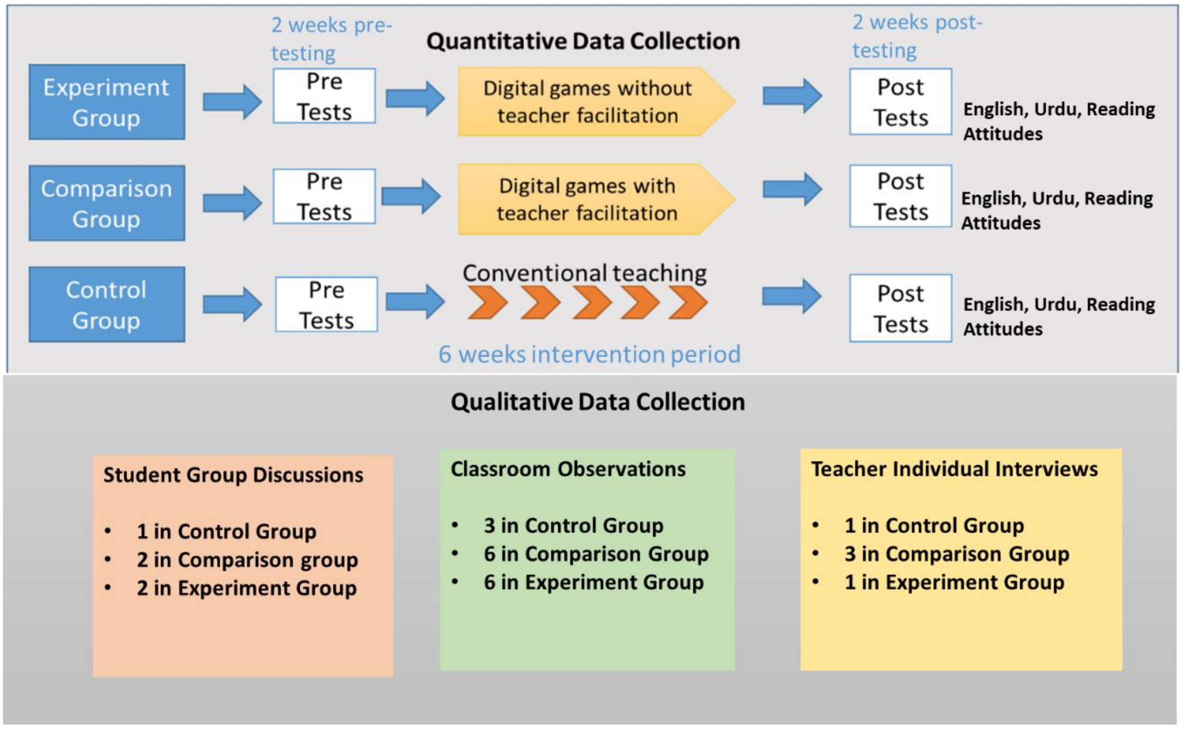
3.5.2 *Phase 2 Research Design*

The purpose of Phase 2 of the research was to examine the impact of pedagogically sound digital games on developing reading skills, and the transfer of reading skills from L2 (English) to L1 (Urdu). Phase 2 of the study consisted of a mixed-methods embedded design (QUAN + QUAL) with equal emphasis on quantitative and qualitative data. Figure 3.4 visually describes the stages involved in Phase 2 data collection.

The quantitative part of the study comprised a three-arm randomised, single-blinded intervention including the experiment group (EG), comparison group (CMG), and control group (CG) with an equal number of students in each group. Single-blindness was achieved by separating campuses for the EG, CMG and CG so the study participants from one group could not share their experiences with participants of other groups. Students in the EG were exposed to the TYMTR digital game without teacher facilitation for around 40 minutes each day for six weeks. The CMG students played the same digital game for the same amount of time as the EG students but with teacher facilitation. Teachers designed the learning spaces in the CMG and provided facilitation during gameplay. The CG students were exposed to traditional style reading sessions in addition to their routine English lessons.

Figure 3.4

Stages of Phase 2 Data Collection



Pre-tests on English (L2) and Urdu (L1) reading skills and attitudes towards reading were administered to establish a baseline of reading skills and attitudes. Post-tests administered at the end of Phase 2 determined achievement in reading skills and changes in reading attitudes.

Phase 2 spanned ten weeks in each group with two weeks for pre-testing, six weeks for intervention, and further two weeks for post-tests and qualitative data collection. The qualitative part of the study constituted student group discussions, in-depth individual interviews with teachers and classroom observations. One student group discussion and three classroom observations were conducted with CG students during Phase 2. The rationale was to establish a baseline of traditional reading practice for this study and to compare it against the existing literature. Altogether, four student group interviews and twelve classroom observations were conducted in the CMG and EG to gain insights into the effectiveness of RDDGs. Phase 2 of the study also utilised in-depth individual teacher interviews (one from CG, three from CMG and one from EG). The rationale for interviewing three teachers from the comparison group was the teachers' participation during DGBL sessions. Table 3.1 presents the distribution of weeks allocated to commence data collection activities across groups.

Table 3.1

Time Allocations of Phase 2 Data Collection Activities

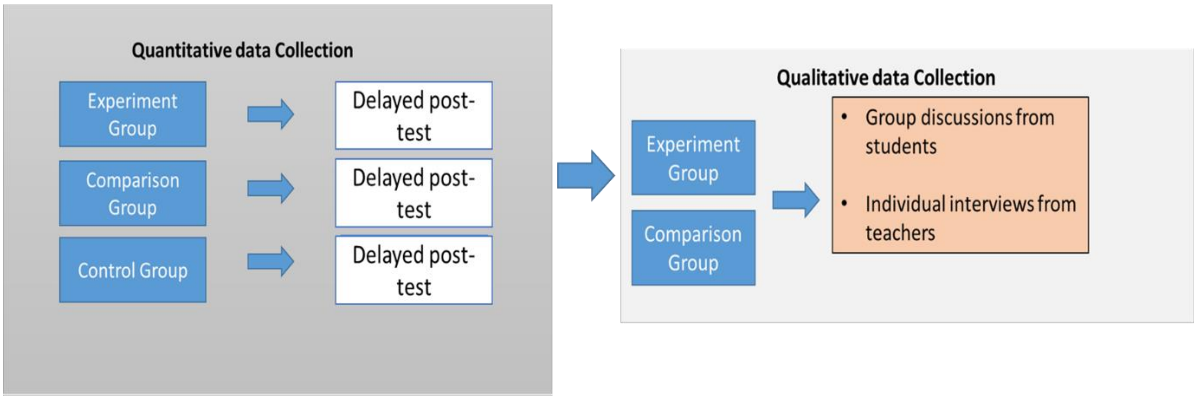
Groups	Pre-tests	Intervention	Post-tests, Interviews, Group discussions, Classroom Observations
Control group	2 weeks	6 weeks (Using routine reading instruction)	2 weeks
Comparison group	2 weeks	6 weeks (Using games with teacher facilitation)	2 weeks
Experiment group	2 weeks	6 weeks (Using games without teacher facilitation)	2 weeks

3.5.3 *Phase 3 Research Design*

Summer slide is a phenomenon of growing interest in research lately. It refers to a decline in reading development of children, especially those belonging to low socioeconomic status, when they are unable to maintain a reading habit after a period of inactivity or non-learning, for example, during summer holidays (Allington & McGill-Franzen, 2013; Coats & Taylor-Clark, 2001; Rasinski et al., 2017). Phase 3 of this study consisted of a mixed-method research design (Figure 3.5) aimed to measure the summer slide effect or reading retention ten weeks after digital game-based learning of Phase 2.

Figure 3.5

Stages of Phase 3 Data Collection



Quantitative data were gathered from CG, CMG, and EG students through delayed post-tests using similar tools previously used in Phase 2. The qualitative data comprised student group discussions and individual interviews with teachers of the CMG and EG only. The CG was excluded from qualitative data collection as they did not play the digital game. The target population for the study was socially and economically marginalised children who never had a chance to enrol on mainstream schools. The next section describes the research setting used in the present study.

3.6 Research Setting

The present study consisted of three distinct phases. Phase 1 aimed to select a digital game that could be used in Phase 2 to examine the impact of games on reading achievement, whereas the focus of Phase 3 was to examine the retention of learning gained by participants involved in the study intervention. Therefore, Phase 1 research setting was different from the Phase 2 and Phase 3 research settings. The following two subsections provide an overview of research settings used in different phases.

3.6.1 *Research Setting – Phase 1*

Phase 1 of the research was conducted at the National University of Sciences and Technology (NUST). NUST provided facilities, such as a seminar room, digital tablets and access to free Wi-Fi to conduct research activities. Phase 1 participants, including primary school teachers, game designers and game developers, were invited to evaluate digital games using tools appropriate for the study.

3.6.2 *Research Setting - Phases 2 and 3*

Due to the pragmatic and transformative-emancipation research perspective, the proposed study focused on marginalised children deprived of basic facilities and access to mainstream education. Phases 2 and 3 of the study were conducted at various Out-of-School Children Schools (OSCS) campuses in Urban Pakistan. OSCS are charity schools run by a Non-Government Organization (NGO). Overall, there are nineteen campuses of OSCS operational in and around Islamabad that come under the bigger umbrella of the same non-government organisation running these schools and hence follow the same curriculum, vision and teaching practices. Most of these campuses comprise a few rooms inside the building of a mainstream school. The OSCS campus is separated from the mainstream using dividers or allocating rooms on different floors within the mainstream school. The classrooms in the participating campuses were equipped with a blackboard and teacher's desk at the front of the class, portable desks and chairs for individual students arranged in multiple rows, and a lockable cupboard for teacher's use for safe keeping of stationary or assessment items for marking. The walls were decorated with posters created mainly by students and teachers portraying information from textbooks of each subject, e.g. displaying times tables, a drawing of the life cycle of a butterfly, and English and Urdu alphabets, to name a few. The school corridors were decorated with more informative and colourful printed posters about the landscape of Pakistan, native animals and plants.

These schools provide free education to children from extremely low socioeconomic backgrounds who could not be enrolled at mainstream schools due to financial constraints or age limitations. The majority of such children belong to the labour or working class. Besides studying in OSC schools, these children support their parents in earning a livelihood. OSC schools follow the National Curriculum (Ministry of Education, 2006) with an additional fast-track learning programme aimed to prepare students in a relatively short-duration compared to mainstream schools. The fast-track learning programme is designed to complete the syllabus from Grade 1 to Grade 5 in three years to eventually enrol students in mainstream schools to progress to lower secondary education. A traditional teaching style was followed on these campuses focusing on rote learning. Children of varying age ranges were enrolled at OSC schools. For example, in this study, Grade 1 comprised children from six years to 13 years of age. A wide variety of age distribution was also seen in other grades. Table 3.2 summarises the youngest to oldest students enrolled in various grades at OSC schools.

Table 3.2

Age Ranges of Students Enrolled in Each Grade

Grade	Youngest	Oldest
1	7 years	13 years
2	8 years	13 years
3	8 years	14 years
4	10 years	16 years
5	11 years	16 years

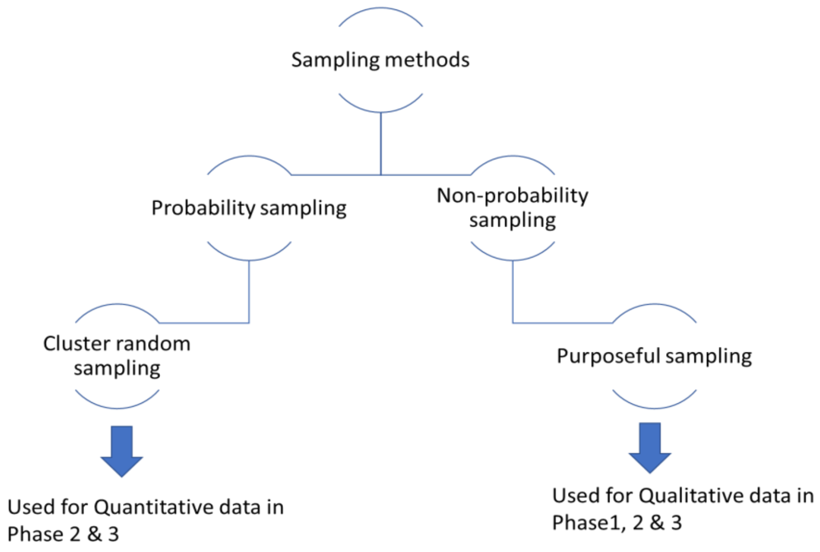
The remaining chapter explicates sampling methods and sample size used in the research, methods of data collection employed across three phases, data analysis methods, meta-inferences followed by a description of validity, reliability, and ethical considerations used for the study, resources acquired for the study and concludes with study timeline.

3.7 Sampling Methods

Mixed-methods research design requires a thoughtful combination of sampling strategies suitable for quantitative and qualitative data, which in turn is dependent on thorough planning, attention to detail, and creativity (Onwuegbuzie & Collins, 2007). The rationale of mixing sampling techniques is to establish a sample that is representative of the population and also provides meaningful information. Hence, in mixed-methods research, decisions regarding the sample are usually made before conducting the study (Creswell, 2014; Onwuegbuzie & Collins, 2007). Two major types of sampling methods are evident from the literature: probability and non-probability sampling (Cohen et al., 2005; Creswell, 2014; Gray, 2014). The present study utilised both the sampling methods to gather quantitative and qualitative data (Figure 3.6).

Figure 3.6

Sampling Methods to Gather Quantitative and Qualitative Data



A brief account of both types of sampling methods is as follows:

3.7.1 ***Probability Sampling.***

Probability sampling is mostly used for quantitative research to obtain the most suitable data to represent the population (Teddlie & Tashakkori, 2009). It refers to the selection of a sample from a larger population based on the theory of probability, where each person has an equal chance of selection (Creswell, 2014). Probability sampling improves the validity of the research by reducing sampling bias and providing a sample that is truly representative of the target population (Cohen et al., 2005). There are different types of probability sampling, such as simple random sampling, stratified random sampling, cluster random sampling, and systematic random sampling (Creswell, 2014; Field, 2009), which can be used to draw samples depending upon the nature of the inquiry. The present study used the cluster sampling method to gather quantitative data.

Cluster Sampling

Cluster sampling refers to drawing a probability or non-probability sample from naturally occurring pre-existing groups of the target population (Heap & Waters, 2019). The study utilised cluster sampling to select various OSCS campuses in Phase 2. All students enrolled in Grade 1 to 5 of the randomly selected campuses were included in the sample, representing the total number of marginalised children enrolled on all campuses of the OSC schools. The campuses were randomly assigned the status of EG, CMG, and CG, subject to the type of intervention. The same sample of students was used to gather quantitative data in Phase 3 of the study.

3.7.2 *Non-Probability Sampling*

Non-probability sampling methods are mostly employed to select participants who could provide meaningful data (Teddlie & Tashakkori, 2009). Non-probability sampling refers to selecting participants based on an idiosyncratic judgment of researchers rather than random selection (Cohen et al., 2005; Creswell, 2014). Therefore, in non-probability sampling, not all participants have an equal chance of being selected; instead, participants with certain characteristics are selected. Such a sampling technique is mostly used in qualitative or exploratory studies that aim to explore issues in more depth (Cohen et al., 2005). Different types of non-probability sampling techniques include convenience sampling, consecutive sampling, quota sampling, purposeful sampling, and snowball sampling (Onwuegbuzie & Leech, 2007). The present study utilised a purposeful sampling method to generate meaningful data during different phases of the research. A brief description of the purposeful sampling method used in this study is as follows:

Purposeful Sampling

Purposeful sampling is mainly used to identify and select information-rich cases based on idiosyncrasies considered best for the research (Patton, 2014). It involves identifying and selecting people with knowledge or experience pertinent to the phenomenon of interest (Creswell, 2014). Moreover, these people should also be able to express their thoughts and opinions (Palinkas et al., 2015). In Phase 1 of the present study, the purposeful sampling method was used to identify primary school teachers trained in ICT intensive pedagogies, game designers and developers with experience designing and developing educational games. In Phase 2 of the research, a purposeful sampling method was used to identify teachers and students from participating OSCS campuses to participate in interviews and group discussions.

3.8 Sample Size

In mixed-methods research, sample size and sampling methods are the predictors of power analysis of the research or the extent to which statistical and analytical generalisations or inferences could be made (Onwuegbuzie & Collins, 2007). Proponents of mixed-methods research (e.g. Creswell, 2014) suggest that sample size should be guided by the research objectives, research questions and research design. Hence, the research objectives, questions and design of the present research guided sample sizes for various phases of the study.

Determining an effective sample size, especially for quantitative data, requires certain information regarding population size, the margin of error (confidence interval) and confidence level. *Population size* refers to the number of people included in the target population, out of which a sample representing this population is to be drawn (Onwuegbuzie & Collins, 2007). The *confidence interval* decides how much error is allowed, as no sample may be perfect. It refers to the difference in the total population-mean and the sample-mean a researcher is willing to allow (Lynch, 2013). suggests a confidence interval of 5% as suitable to calculate an effective sample size for quantitative analysis. The *confidence level* provides a value, for example, 95% or 99%, showing the confidence of a researcher that the actual mean falls within the confidence interval (Lynch, 2013).

Sample sizes can be calculated using online calculators available freely online (Burmeister & Aitken, 2012). The present study drew a sample size using sampling methods discussed in section 3.9. The following subsections present an account of different sample sizes used in each phase of this study.

3.8.1 *Sample Size in Phase 1*

Phase 1 of the present study engaged a purposeful sample of 13 primary school English language teachers, game designers and game developers to evaluate digital games for developing reading skills. Participant teachers in this phase were previously trained on using ICT intensive pedagogies, including digital games in mathematics, science and literacy, in a teacher training workshop held at the National University of Sciences and Technology in 2016. The participant game designers and developers had prior experience in designing and developing educational games. The potential participants were contacted via email, and the email addresses were obtained from email lists maintained at NUST. Adhering to ethical considerations discussed in Section 3.15, participants were invited to participate in the study.

3.8.2 *Sample Size in Phases 2 and 3 of the Research*

Phases 2 and 3 of the research required drawing an appropriate sample for quantitative and qualitative data. The sample drawn in Phase 2 was also utilised in Phase 3 of the research. The sample consisted of students and teachers from various campuses of OSCS campuses. The following subsections provide a brief account of sample sizes utilised in Phase 2 and 3 of the research.

Students

A sample of 288 (*N*= 288) students between the ages of seven and sixteen, enrolled in Grade 1 to Grade 5 from random OSCS campuses, was selected for quantitative data in Phases 2 and 3 of the study. The sample size of students was calculated using an online calculator available at http://www.raosoft.com/samplesize.html. Overall, 900 students were enrolled in all campuses of OSCS. The sample size was calculated with a 5% confidence interval (margin of error) and 95% confidence level, resulting in an ideal sample of 270 students. However, the study utilised a sample size slightly greater than the calculated sample to address any data-related issues later, such as a student leaving school or not appearing in research-related activities. For qualitative data in Phases 2 and 3, a sample of 16-24 students was purposefully selected to participate in group discussions. These students also participated in the quantitative data collection and could articulate opinions during qualitative data collection. Table 3.3 presents a distribution of students across randomly selected CG, EG, and CMG at five campuses of OSC schools in Phases 2 and 3 of the research.

Table 3.3

Participant Distribution Across CG, EG, and CMG Campuses (Phase 2 & 3)

Groups	Campuses	Student sample size and ages	Total Student sample	Teacher sample size
Control Group	OSCS Campus 1	25 (8 – 14 years)	96	Teacher CN1
	OSCS Campus 2	29 (8 – 16 years)		
	OSCS Campus 3	42 (7 – 14 years)		
Experiment group	OSCS Campus 4 (Morning Shift)	48 (7 – 15 years)	96	Teacher EX1
	OSCS Campus 4 (Evening Shift)	48 (7 – 16 years)		
Comparison group	OSCS Campus 5 (Morning Shift)	48 (7 – 16 years)	96	Teacher CP1 Teacher CP2 Teacher CP3
	OSCS Campus 5 (Evening Shift)	48 (7 – 15 years)		
	Total Sample Size		288	5

Note. CN1: Control group 1; EXP1: experiment group 1; EXP2: experiment group 2; CP1: comparison group 1; CP2: comparison group 2; CP3: Comparison group 3

Teachers

A purposeful sample of five teachers was drawn from the participating campuses of OSC schools. Table 3.3 shows a summary of teachers who participated in the study. One teacher from the CG (Teacher CN1), one from the EG (Teacher EXP1), and three from selected campuses of the CMG participated in the study. Table 3.4 presents a summary of overall sample sizes allocated for quantitative and qualitative data collection during the three phases of the research.

Table 3.4

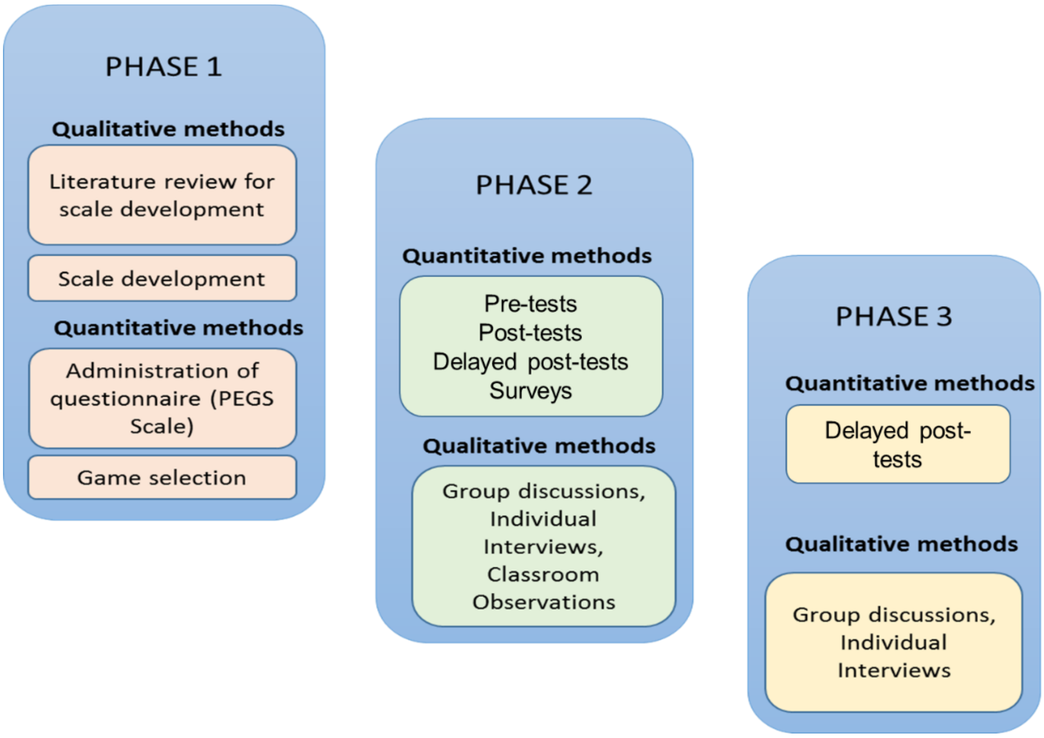
Overview of Sample Sizes for QUAN and QUAL Data in Different Phases of the Research

Phases	Methods (QUAN/QUAL)	Sampling technique	Sample size
Phase 1	QUAL + quan	Purposeful sampling	13 English language teachers, game designers, game developers
Phase 2	QUAN	Cluster random sampling	288 students
	QUAL	Purposeful sampling	16-24 students (4-6 students per group discussion)
		Purposeful sampling	5 teachers
Phase 3	QUAN	Cluster random sampling	288 students
	QUAL	Purposeful sampling	16-24 students (4-6 students per group discussion)
		Purposeful sampling	5 teachers

Figure 3.7 presents an overview of multiple data collection methods employed across different phases in this study, including surveys, pre-and post-tests, individual interviews, group discussions, and classroom observations. The next three sections will talk about each of these phases separately related to the theoretical and practical aspects of the methods.

Figure 3.7

The Data Collection Methods Adopted in Different Phases of the Research



The next section elaborates on the data collection methods in Phase 1 of the study, followed by sections detailing data collection methods pertinent to Phase 2 and 3.

3.9 Methods of Data Collection in Phase 1

The focus of Phase 1 was to select a reading development digital game that could be deployed in Phase 2 of the study. Therefore, Phase 1 utilised methods to select a pedagogically balanced reading development digital game (RDDG) used in Phase 2. Data collection in Phase 1 consisted of selecting a pool of the most appropriate commercial-of-the-shelf (COTS) reading development games available on Google Play Store. The final game was then selected using a game evaluation tool. The section below indicates the methods of scrutinising COTS games suitable for reading development which were later evaluated using the game evaluation tool.

3.9.1 *Methods of Game Selection.*

The study focused on including a cost-effective, pedagogically sound and effective RDDG that closely aligned to the literacy curriculum followed at the schools. The game selection followed a rigorous multi-step process. The first step was to determine a pool of potential RDDGs from Google Play Store. The screening criteria for game selection included keywords search: phonics games, phonics learning, English reading games, and literacy games; rating above four stars; free of cost or at less than 10 NZD; and compatibility with Android 4.1 and above the platform. The search criteria returned around 245 literacy games, out of which only seven games were selected that most closely matched the curriculum outcomes at Grade 2 and 3 levels. Selected games were either free or low cost (under 10 NZD) and had a reasonable playtime spanning over five weeks if played in a class time of 30 to 40 minutes. The seven initially identified games were: Feed the Monster, Sound to Words, Starfall Learn to Read, Teach Your Monster to Read, Graphogame UK, Oxford Phonics World, and Read with Phonics. Table 3.5 lists the URLs of the selected games.

Table 3.5

List of Games and URLs Selected for Initial Screening in the Study

Game name	URL
Feed the Monster	https://play.google.com/store/apps/details?id=com.eduapp4syria.feedthemonsterENGLISH&hl=en
Sound to Words	https://play.google.com/store/apps/details?id=au.com.parrotfish.phonemic.lite
Starfall Learn to Read	https://play.google.com/store/apps/details?id=air.com.starfall.ltr&hl=en
Teach Your Monster to Read	https://play.google.com/store/apps/details?id=com.teachyourmonstertoread.tmapp&hl=en
Graphogame UK	https://play.google.com/store/apps/details?id=com.graphogame.gg_english_uk&hl=en
Oxford Phonics World	https://play.google.com/store/apps/details?id=com.oup.elt.phonicsworld
Read with Phonics	https://play.google.com/store/apps/details?id=uk.co.fonics

The next step involved the researcher evaluating seven identified games for effectiveness using the game evaluation tool. The results yielded the two best games: Graphogame UK (GGUK) and Teach Your Monster to Read (TYMTR).

The final step involved participants of Phase 1, including primary school teachers, game designers and game developers, to evaluate the two games selected by the researcher using the game evaluation tool developed by the researcher. The participants were invited to attend a seminar leading to data collection. The rationale for arranging a seminar was to develop an awareness of participants on the use of the tool to evaluate RDDGs. A seminar room was reserved at NUST, and email invitations were sent to the potential participants (Appendix A). Informed consent was taken from the participants prior to data collection. Tablets with installed games and PEGS tools were handed over to the participants to commence game evaluation activities.

There were two stages of game evaluations. In stage one, participants were handed over the game evaluation tool (Appendix B) to individually evaluate the given games. In stage two, participants were paired up or set in a group of three to review their responses. The purpose of the paired evaluation was to highlight any variances in opinions whilst evaluating games and arrive at an agreed score for game attributes. This strategy helped in identifying the best possible game to be deployed in the next phase of the research. Paired or group discussions were audio-recorded. Insights into decisions on the effective game characteristics were gained by conducting an analysis of recorded discussions and the paired evaluations of the games. The day ended by formally thanking the participants for their contributions to the study, and as a token of thanks, the participants were presented certificates of appreciation (Appendix C) signed by the chief supervisor and researcher of the present study. The final best reading development game was then used in Phase 2 of the research.

3.10 Methods of Data Collection in Phase 2

Phase 2 data collection focused on examining the impact of digital games on reading skills and transfer of reading skills from L2 (English) to L1 (Urdu). Therefore, Phase 2 employed quantitative and qualitative data collection tools to examine the outcomes and gain insights into participants' lived experiences in using games as a learning and pedagogical tool. Since the data collection process for Phase 2 and Phase 3 spanned many months (Appendix: D) therefore, it was practically impossible for the researcher to collect data all by herself, as in doing so, she would have jeopardised her domestic visa status in New Zealand. Phase 1 data were collected by the researcher, whereas two experienced data collectors (Appendix E) were recruited for data collection and resource management during Phase 2 and Phase 3 of the study. The following subsections describe the methods and tools used for data collection in Phase 2 of the research.

3.10.1 *Questionnaire*

Quantitative data collection is often carried out using questionnaires and survey scales (Creswell, 2014, Hittleman & Simon, 2006). Questionnaires are self-reporting data collection instruments used to gather data from a large sample of the population where interviews could be impractical. Questionnaires can be effective in gathering information pertinent to participants' thoughts, feelings, beliefs, values, perceptions or behaviour intentions (Johnson & Christensen, 2012) and provide valuable information if the participant is knowledgeable about the area of research and competent to answer questions appropriately (Creswell, 2014; Preston, 2009). The following section describes the questionnaire used in Phase 2 of the study:

ERAS (Elementary Reading Attitude Survey).

Several studies have indicated that attitudes towards reading correlates with achievement in reading (Askov & Fischbach, 1973; Diamond & Onwuegbuzie, 2001; Lungley & Lynch, 2017) and reading achievement is related to a desire to read (Ley & Trentham, 1987). Vaknin-Nusbaum et al. (2018) claim that intrinsic motivation is one of the determinants of success or failure in reading. Therefore, Phase 2 of the present research investigated students' attitudes towards reading using Elementary Reading Attitude Survey (ERAS) (Appendix F)) developed by McKenna and Kear (1990). ERAS was administered before and after the DGBL intervention to compare any changes in students' reading attitude after the DGBL intervention.

ERAS is a public-domain instrument developed with an aim to enable teachers to estimate attitudes towards reading efficiently and reliably (McKenna & Kear, 1990) and has widely been used in research (Kazelskis et al., 2005; Kush & Watkins, 1996; Worrell et al., 2006). It is a 20-item survey instrument designed for all elementary years ranging from Grade1 to Grade 6. It yields three types of scores: (1) recreational reading, (2) academic reading, and (3) total scores. The first 10 items evaluate attitude towards recreational reading (e.g., "How do you feel about reading instead of playing?"), while the remaining 10 items measure attitude towards academic reading (e.g., "How do you feel about reading your school books?"). The instrument uses a four-point response scale using a picture of Garfield, a cartoon character, as pictoral response systems. The most positive picture shows Garfield with his hands in the air and a big grin on its face. The most negative picture shows a grumpy Garfield frowning with clenched fists by its sides. The less positive picture in the middle shows Garfield smiling with arms crossed, and the less negative picture in the middle shows an unhappy Garfield with arms crossed. For calculating scores, 4 points are allocated to the happiest Garfield face, 3 points for the less happy face, 2 points for the unhappy face, and 1 point for the grumpiest Garfield face. For each of the 20 items on ERAS, students were expected to choose a

Garfield picture that best represented their feelings. Scores on two sub-scales (recreation and academic) ranged from 10 to 40 points, and scores on the total scale ranged from 20 to 80 points.

The target population was those not proficient in English; therefore, ERAS instrument was translated into Urdu using a rigorous process (Chang et al., 2014; Willgerodt et al., 2005; World Health Organisation, 2019). The translation process began with a forward translation in Urdu by bilingual experts in Urdu and the English language, backward translation into English by another set of bilingual experts, followed by a test for translation equivalence to evaluate semantic and content equivalence. Minor discrepancies were resolved through a panel discussion of language experts. In this study, translated ERAS in the Urdu language was administered to students in targeted campuses.

The rationale behind using ERAS in this research was the high validity and reliability established across various reliability studies and its wide use in previous studies (Kazelskis et al., 2005; Kush & Watkins, 1996; Worrell et al., 2006) and ability to quantitatively measuring two important aspects of children's reading attitudes, i.e. attitude towards recreational reading and academic reading. These scores were helpful in triangulation with qualitative data obtained through group discussions from students and individual interviews taken from the teachers. The results had implication for reviewing current instructional practices at schools.

3.10.2 *Pre- and Post-Tests*

In addition to questionnaires, the study also used pre-and post-tests in Phase 2, to assess students' reading skills. Scores of these tests showed students' performance against pre-defined goals in reading English and Urdu. Pre-tests were used prior to the digital game-based intervention to determine a baseline of students' existing reading skills in both languages, and Post-tests were used to determine the change in reading skills after the intervention. Hittleman and Simon (2006) claim that an assessment that includes students' work or product of their learning is an authentic assessment and has increasingly replaced other forms of test data in educational research. This study used the Early Grade Reading Assessment (EGRA) tool as an authentic assessment for pre-and post-tests as EGRA was a true representation of assessing reading-related activities of students in the classrooms. The section below describes and justifies the use of the EGRA tool in this study, followed by a description of pilot testing and administration of pre-and post-tests across groups of students.

Early Grade Reading Assessment (EGRA)

EGRA is an open-source tool available to download from www.globalreadingnetwork.net. It includes guidelines for adaptations in other languages based on the characteristics of the given language. EGRA is a test administered orally as a one-to-one interaction between a child and the assessor. It consists of a collection of time-based sub-tasks to measure reading fluency in one-minute instances. Sub-tasks are related to knowledge of letter-sound, non-sense word reading, familiar word reading, passage reading, and comprehension questions which essentially examine a child's pre-reading or reading skills (Gove & Wetterberg, 2011).

The present study utilised pre- and post-tests in Phase 2 using EGRA in English (L2) (Appendix G) and Urdu (L1) (Appendix H). EGRA is a valid and reliable assessment tool that has been previously used in different studies worldwide (Davidson et al., 2011; Dubeck & Gove, 2015; Gochyyev et al., 2019; Gove & Wetterberg, 2011; Mejia & Pouezevara, 2011; UNESCO, 2017). However, the researcher developed EGRA-Urdu to assess Urdu reading skills in collaboration with experts in the Urdu language, following the guidelines to adapt EGRA to other languages (RTI International, 2015).

In Pakistan, 58% of fifth-grade students in public schools are unable to read sentences in English, and 54% of fifth-grade students are unable to read short stories in Urdu at Grade 2 level (ASER, 2017); therefore, the use of EGRA at Grade 2 level was deemed appropriate to establish a baseline of reading skills acquisition. Moreover, the rationale for using EGRA for the present study was also driven by its strengths. Wagner et al. (2012) recommended using EGRA because it focuses on early grade learning interventions, is flexible, and can be adapted to any language and orthography irrespective of comparability between systems and countries. Hence, the Urdu version of EGRA was developed and used in the current study. In addition, EGRA is designed to be used as a monitoring tool to evaluate small samples rather than high-stakes assessments designed for large populations. The adaptive nature of EGRA to use in different languages, cost-effectiveness and efficiency in training teachers or data collectors was an added benefit of using EGRA as a pre-and post-test tool in the present study.

Pilot testing

A pilot testing was done prior to the commencement of Phase 2 of the study. The aim was to evaluate EGRA procedures to determine usability and effective administration. Seven students of a similar background as the actual study participants were included in the pilot testing. These students were accessed at a local tuition centre in Islamabad following the ethical practices of access and consent procedures. Participation in the pilot testing was on a volunteer basis. EGRA English and

Urdu tools were administered to these participants. Pilot testing of the EGRA English and Urdu tool yielded no change in the planned administration process.

Pre- and post-test administration process

Pre-tests were conducted by two trained recruited data collectors whilst ensuring minimum disruption to regular classes. Therefore, one student at a time was invited to participate in tests and survey activities. To improve the trustworthiness of the research process, the researcher observed the data collection sessions using video conferencing to ensure if data collectors complied with test procedures. The researcher and the data collectors collaborated online regularly and communicated via WhatsApp group video chat to discuss data collection progress, challenges and potential solutions.

After completing pre-tests, the EG and the CMG students were introduced to the tablets and some random games. The majority of students had never used a tablet or a smartphone before. The data collectors provided a brief 40-minutes training to the students and teachers on the use of tablets. This training aimed to familiarise them with the technology and give them a feel of playing games on tablets. After the training, participants appeared confident in using the tablets. The CMG teachers were asked to play the selected game, TYMTR, completely before the intervention. As all the teachers had smartphones, the TYMTR was installed on their phones so they could familiarise themselves with the game prior to the DGBL lessons. After a 6-week DGBL intervention, post-tests were conducted using the same tools and procedures as used in the pre-tests in all groups.

Intervention Sessions

The intervention sessions were timetabled during a 40-minute activity period, five days a week across six weeks. Students from both game groups played games in allocated timeslots. On the first day of game playing, the researcher had a brief video conferencing session with the whole class where students were introduced to the routines of game-based sessions. This discussion helped develop a rapport between students and the researcher. Students were handed over the tablets with their name tags at the beginning of the period. The EG students were told the procedures for collecting and handing over tablets to and from data collectors. The role of data collectors was non-participatory. They ensured the availability of tablets to the groups and resolved any technical issues. Students were not given any specific instructions about establishing their learning environment or the seating arrangements; they were given the freedom to let it emerge according to their needs.

On the other hand, the CMG students were escorted to the activity area by their teachers, who instructed them to sit in a specific layout. Decisions regarding establishing learning environments were entirely up to the teachers. Again, the role of data collectors was non-participatory, with support provided on technical issues.

3.10.3 *Interviews*

The most common data collection methods used in qualitative research are interviews. Interviews involve the collection of verbal or non-verbal data obtained through direct interaction and conversation between the researcher and the research participants being studied (Gall et al., 2010). Interviews are useful when a researcher plans to collect rich descriptions of lived experiences to gain insights into understanding perceptions, experiences, attitudes, behaviours, and processes in a particular research context (Gray, 2014; Rowley, 2012; Smith et al., 2009). Various interviewing methods are found in research, such as one-on-one interviews, focus groups, group discussions, email interviews, and telephone interviews (Creswell, 2014; Gray, 2014; Johnson & Christensen, 2012). The present study utilised two types of interviews: individual in-depth interviews with teachers and group discussions with students.

All interviews and group discussions were conducted using video-conferencing technology. The research setting was established in Pakistan, whereas the researcher was based in New Zealand. Due to the visa limitation of the researcher, the researcher could not conduct face-to-face interviews in Pakistan. Therefore, appropriate video-conferencing technology using Whatsapp video chat on iPad was used for this research. For the last decade, video-conferencing has been popular in social research as a cost-effective and time-efficient means of synchronous nature of real-time communication via distance as an alternative to face-to-face interviews (Hanna, 2012; Hooley et al., 2012; Nehls et al., 2015). Synchronous communication using video-conferencing software is considered better than telephone interviews as they develop a face-to-face interaction between the researcher and the participant without compromising visual and interpersonal aspects of their interaction (Evans et al., 2008). The interactions were video recorded by downloading recording software on devices used for video conferencing. A major concern of using video-conferencing technology for conducting computer-mediated communication (CMC) as an alternative to face-to-face (FTF) interviews is the participants' prior experience of using such technologies, a reliable internet connection, and access to a computer or a tablet (Nehls et al., 2015). The present research, participants were familiar with the use of video conferencing due to their prior experience of using WhatsApp video chat feature on smartphones. The availability of high-speed, reliable internet was another motivator to conduct interviews using video-conferencing. All interviews were recorded using another digital camera as a second layer of safeguarding data. Detailed procedures for conducting individual in-depth interviews and group discussions are discussed in following two subsections.

Individual In-depth Interviews

Individual in-depth interviews are a type of face-to-face purposeful, structured or semi-structured conversations held between the researcher and the teacher participants, allowing participants to share their stories in their own words (Lichtman, 2006; Smith et al., 2009). It is a time-consuming approach but yields rich data for analysis (Creswell, 2014). The purpose of such interviews is to listen to participants' stories, opinions, and perceptions in their own words (Lichtman, 2006) with a minimal interruption from the researcher because if the researcher controls the interview process too rigidly, the participants may get distracted and may not be able to tell stories in their own words (Smith et al., 2009). Such interviews are suitable for participants who are not hesitant to share their stories, articulate their perceptions and air their voices comfortably (Creswell, 2014). The major advantage of using individual in-depth interviews is their adaptability to facilitate participant-led discussion. This study deployed semi-structured interviews, which helped avoid interview bias. A semi-structured interview schedule comprising a few leading questions was used, serving as a loose agenda for the discussion (Gray, 2014). Smith et al. (2009) purport that as the discussion progresses in the semi-structured interviews, researchers may adapt questions or ask more probing questions to facilitate rich descriptions of participants' lived experiences. Another advantage of semi-structured interviews is their richness of descriptions which maynot be obtained through other measurement instruments; for example, more structured questionnaires tend to produce shallow information as they fail to probe deeply to elicit rich descriptions of participant's feelings, perceptions, and experiences (Gall et al., 2010).

Since the qualitative methods of the present study are premised on phenomenology, interview techniques for interpretative phenomenological analysis were adopted. Semi-structured interviews were conducted with selected teachers during Phase 2 and Phase 3 of the research. A loosely structured interview schedule (Appendix I) was created with a few leading questions and probing prompts. The research supervisors of the present study reviewed the interview questions for clarity and the use of unbiased language. Following the interview procedures suggested by Smith (2010), research questions were not directly posed to the participants, instead were pitched at an abstract level to facilitate discussions on the relevant topics, which allowed research questions to be answered subsequently via interpretations. In the present study, the researcher's pre-conceptions helped in activating participants' lenses to view the phenomenon of DGBL from different perspectives. Once participants' modes of being from various perspectives were activated through initial questioning, they were then encouraged to reflect on the processes and experience of DGBL, which generated rich descriptions for analysis. Researcher involvement was kept at a minimal level during participants' reflections of experiences. All interviews were video-recorded to be transcribed at later stages. Before recording the interviews, consent was obtained from participants (Appendix J). Video recordings enabled the researcher to repeatedly watch the interviews to observe non-verbal cues and interpret participants' experiences with more accuracy. Transcriptions were transcribed verbatim for analysis.

Group Discussions

The other method of gathering qualitative data in Phase 2 and Phase 3 in this study was group discussions. Their aim was to gather views from a small group of students about the use of DGBL to improve their reading skills. Group discussions and focus groups are terms often used synonymously in research referring to planned group discussions (Gibbs, 2017; Punch & Oancea, 2014), however, several authors are of the view that although group discussions and focus groups are powerful tools for data collection, they are not identical (Gibbs, 2017; Gray, 2014; Patton, 2014). In focus groups, a small group of people talk about a distinct phenomenon and share their opinions with some directions taken from the researcher (Gray, 2014); the role of the researcher being a passive mediator that observes people discussing a particular issue (Smith et al., 2009). Whereas, in group discussions, the researcher has a more prominent role in asking a group of people specific questions pertinent to a phenomenon (Gibbs, 2017). A common pitfall in focus group discussions is that dominant individuals may sway the discussion in a particular direction; if such a dominant individual expresses a perspective, others may agree even if they disagree, which may overshadow their judgements (Brown & Edmunds, 2011).

Group discussions were selected for the present study due to their nature of facilitating discussions and listening to multiple views at the same time and setting. The group discussion technique allowed the researcher to keep asking probing questions from the participants until their ideas got saturated and they keep repeating the same ideas. A major criticism of using group discussions is the difficulty of inferring phenomenological aspects of lived experiences from multiple voices (Smith et al., 2009). However, in some situations, group discussions may elicit better discussions through more experiential reflections than one-to-one interviews (Palmer et al., 2010). In the present study, group discussions encouraged students to think about the phenomenon from different perspectives and elicited collective reflections on the experience of using digital games for reading development.

Phase 2 of the present research utilised four group discussions with groups of four to five students with an aim to understand their experiences of learning to read using digital games. An interview schedule (Appendix K) was used to lead the discussion. In Phase 3, four group discussions guided by a schedule aimed to gauge students' retention of reading skills once students returned to traditional teaching methods with no tablets.

Process of conducting group discussions and interviews using video-conferencing

The data collectors arranged the resources for group discussions in the school. A digital camera was placed at the school to video-record the session and capture real-time discussions between participants and the researcher, where the researcher's presence was online through an iPad. Real-time digital recording helped the researcher in transcribing the interviews and group discussions at a later stage. Students participating in group interviews sat in a semi-circle in front of the iPad at an appropriately audible distance. A wireless speaker was also used to enhance the researcher's voice so it could be captured on a digital camera for transcriptions at a later stage. Group discussions with four to five students in a group began with brief introductions to adjust students to the idea of talking in front of the camera. Moreover, to engage students in discussions and develop rapport with them, a small ice-breaking activity was also conducted where students had to put a paper on their heads and draw a picture of their faces depicting their feeling. They also had to share a word to describe their feeling. Participants developed a rapport with the researcher, which improved the communication between participants and the researcher. The biggest challenge in conducting discussions with students was their lack of language skills to articulate ideas. Ideally, there should have been minimum researcher's input whilst conducting phenomenological discussions (Smith et al., 2009); however, due to their lacking skills, the researcher had to ask more probing questions to get a detailed account of their experience. On the other hand, the benefit of conducting group discussions was sharing ideas within groups against any interview questions that helped interpret their collective experience in game-based learning sessions. The length of group discussions varied depending upon the quality of responses, ranging from 60 minutes to 90 minutes per group.

Individual interviews with teachers in Phases 2 and 3 followed the same practice as in group discussions with students. Each teacher was allocated an agreed timeslot to participate in interviews. Arrangements were made in a quiet room with an iPad, a wireless speaker and a digital camera to record the sessions. Teacher interviews varied in length ranging from 45 minutes to 90 minutes, depending upon the richness of descriptions of their experiences. No major challenges were faced whilst administering interviews with teachers other than one being disconcerted by responding to questions that did not align with her teaching methods. The interview session with that teacher was suspended immediately, and she was reassured that she could choose not to answer any questions if she was uncomfortable. However, the teacher requested to continue the interview the next day when she was more relaxed and provided great insights into the questions asked.

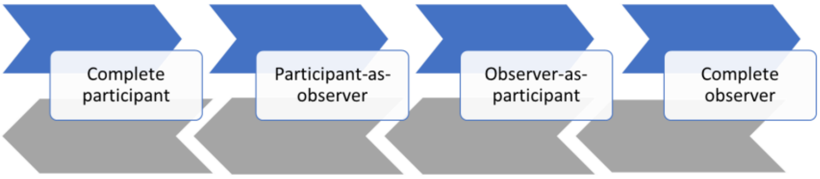
3.10.4 *Classroom Observations*

Observations are defined as the act of witnessing patterns of individual behaviour(s) or interaction(s), in relation to a phenomenon of interest, from 'live' situations in natural settings (Cohen et al., 2005; Johnson & Christensen, 2012). In qualitative research, observations usually gather first-hand data to understand the complexity of human attitudes and interactions and move beyond perception-based data by discovering things that participants may not talk freely about in interviews (Cohen et al., 2005; Creswell, 2014; Lichtman, 2006). Therefore, observations allow the researcher to observe what is happening *in situ* rather than second-hand through interviews (Patton, 2014). Kinds of observations range from fully structured to unstructured depending upon the nature of the inquiry. Structured observations follow a framework or a coding scheme, for example, patterns of participants' behaviour during the observation and are mostly quantitative in nature that requires researchers to test a pre-developed hypothesis , whereas, unstructured observation allows researchers to observe every aspect of the situation without a clear picture of what is expected (Cohen et al., 2005). Therefore, the significance of unstructured observation is established after it is done and enables researchers to generate a hypothesis rather than testing a hypothesis as in structured observations; thus, more likely to be suitable for a qualitative inquiry (Cohen et al., 2005).

As a form of data collection method, observations have both strengths and limitations. Strengths include capturing the richness of information in the natural setting, recording actual behaviours and interactions, and studying people who cannot articulate their ideas, e.g. young children (Creswell, 2014; Johnson & Christensen, 2012). Moreover, it allows the researcher to discover more about participants that they are unwilling to share in interviews (Patton, 2014). The most prominent limitation is the observer's effect on participants, also known as reactivity (Liang, 2015). Reactivity or observer's effect is a phenomenon in which participants change their behaviour when being observed, which may lead to errors in the analysis of the experimental research (Merrett, 2006), such as randomised control trials (RCTs). Other limitations include access to the observation site and difficulty building rapport with research participants who may view the researcher as a threat or someone invading their personal space (Johnson & Christensen, 2012; Miltenberger, 2008). Conducting observations can be labour-intensive, particularly when they yield a massive amount of data that requires considerable time and energy to analyse. Determining the length of observation is also a challenge, especially for novice researchers, as they tend to observe everything (Spradley, 2016).

Figure 3.7

Continuum of Observer Roles



Depending upon the factors like rapport with participants, comfort at the observation site and purpose of observation, researchers should adopt a particular role on the continuum of a complete participant, moving on to participant-as-observer, thence observer-as-participant, and finally to complete observer (Cohen et al., 2005), as depicted in Figure 3.7.

The present study used unstructured observations using online video conferencing technology. The role of the researcher was sub-covert, where participants were aware of the virtual online presence of the researcher but did not see the researcher on the camera. A rationale for conducting unstructured observations using video conferencing technology is presented below:

Observations using video conferencing technology

The development of live video technology has transformed the conventional methods of classroom observation and generated new possibilities for using remote observations using video conferencing technologies (Conole & Dyke, 2004; Grant & Kline, 2010; Liang, 2015; Lo Iacono et al., 2016; Wang & Wiesemes, 2012). A study conducted by (Dyke et al., 2008), including twenty-five lessons observed through digital live video observation, established the feasibility of synchronous (real-time) online video observations. Their study suggested that synchronous video observation is a viable alternative to in-person face-to-face observation. Moreover, using video conferencing for observations is cost-effective, time-efficient and overcomes the limitation of research due to geographical distances (Coyle, 2004; Liang, 2015) and above all, it reduces reactivity or observer's effect in the observations (Liang, 2015).

Considering the advantages and effectiveness of video conferencing, the present study utilised unstructured observations using video conferencing during Phase 2 of the study. The researcher’s limitation of visa conditions was the driving force behind conducting online observations. An iPad installed with the Apple FaceTime app was used to observe twelve 40-minutes sessions of the EG and CMG students playing digital games. The iPad was placed at an appropriate position in the class so the researcher could observe classroom dynamics, students' and teachers’ actions, body language, and facial expressions during the game-based learning sessions. The observed sessions were also video recorded using a digital camera placed at an appropriate place in the classroom to capture participants’ movements, body language, facial expressions and any loud voices or discussions. The major challenge was the assistance with setting up and managing resources at the schools. Therefore, the two data collectors helped set up an iPad, a digital camera and a fast and reliable wireless connection in the classroom. The researcher was in direct contact with data collectors to ensure that full classroom view was captured through the FaceTime app during video conferencing. The researcher’s role was primarily sub-covert due to the virtual presence as a complete observer. In the present study, video conferencing helped reduce the reactivity effect since the virtual presence of the researcher through an object (iPad) was not seen as threatening. Students seemed to forget about the presence of recording equipment and behaved normally in an authentic natural setting. Field notes were gathered as observations were conducted. Recorded videos were transferred to the researcher via Dropbox to transcribe full descriptions soon after the observations. Transcriptions followed Bailey (2008) guidelines to include details of classroom dynamics, room layout, seating arrangement, students interactions with the tablets and with others, facial expressions, gestures, and any louder comments or discussions that were captured in recordings.

3.11 Methods of Data Collection in Phase 3

Data collection in Phase 3 was pertinent to the retention of learning that happened in Phase 2. Therefore, Phase 3 occurred 10 weeks after the completion of the intervention. Both quantitative and qualitative data were gathered to examine retention in primary school students of participating schools. Delayed post-tests were conducted using the same EGRA English and EGRA Urdu tool to measure the retention of reading skills of the same students who participated in Phase 2 of the research. Qualitative methods consisted of student group discussions with the CMG and EG students (Appendix L) and in-depth individual interviews with the teachers of CMG. Group discussions and interview processes used the same protocols as in Phase 2 (Section 3.10.3). The next section explains the data analysis methods used in this study.

3.12 Data Analysis Methods

Data analysis refers to organising and treating raw data into manageable units, synthesising and searching for patterns, and seeking out meaningful information, which helps answer the research questions set out for the study (Bogdan & Biklen, 2007). Data analysis software could be used to analyse quantitative and qualitative data. Each software and approach to analysing data has its merits and demerits (Arthur, 2012; Bogdan & Biklen, 2007); however, the primary aim of these techniques is to transform quantitative or qualitative data into meaningful findings (Arthur, 2012; Creswell, 2012). The findings or inferences determine the credibility of mixed-method research by establishing relationships between variables with certainty that such relationships do not occur by chance and capturing the meaning of the phenomenon through participants' lived experiences (Teddlie & Tashakkori, 2009). This section outlines the methods used for the organisation and analysis of raw data in this study. The present study employed a range of quantitative and qualitative analysis techniques to analyse data collected in three phases of the study. The following two subsections describe the study's quantitative and qualitative data analysis methods and processes.

3.12.1 *Quantitative Data Analysis Methods*

Two primary types of statistics were used in analysing quantitative data across various phases: *descriptive statistics* and *inferential statistics.* The aim of using two types of statistics was to identify the trends in data and distribution of scores, and to infer the logical meaning of students' performance across all groups.

Descriptive Statistics

Descriptive statistics provides an overall summary of trends or tendencies in the data and gives insight into how scores are related to each other (Lynch, 2013). Three measures which are most commonly measured in descriptive statistics are the central tendency of data, including means, medians and modes; variability, which includes variance and standard deviation; and relative standing, such as percentile ranks or percentage of scores in a frequency distribution (Creswell, 2012; Lynch, 2013). In the present study, descriptive statistics provided an insight into the reading habits, attitudes towards recreational and academic reading, and pre-and post-test scores on English and Urdu reading skills of sample data, which can be generalised to the total population displaying characteristics similar to the selected sample.

Inferential Statistics

Inferential statistics refers to the random or purposive sample drawn from the target population and makes inferences and comparisons on essential characteristics of the population. The central idea of inferential statistics is to manipulate the sample data and draw inferences or predictions about the population (Creswell, 2012). In the present study, inferential statistics were used to analyse the reliability of the game evaluation tool in Phase 1 and testing null hypotheses to find the significant difference in means of scores along with effect size in pre-post tests in Phase 2 and Phase 3 of the study. Null hypotheses and alternative hypotheses were created (Sections 5.1, 5.2, 5.4 and 5.5). The significant difference between mean scores of the sample population shows which of the three groups (CG, EG, and CMG) were performing statistically better (Field, 2018), while the calculation of effect size represented the magnitude of difference between the mean scores of the groups (Gall et al., 2010). The following subsection presents the processes used for analysing quantitative data in the study:

The Quantitative Data Analysis Process

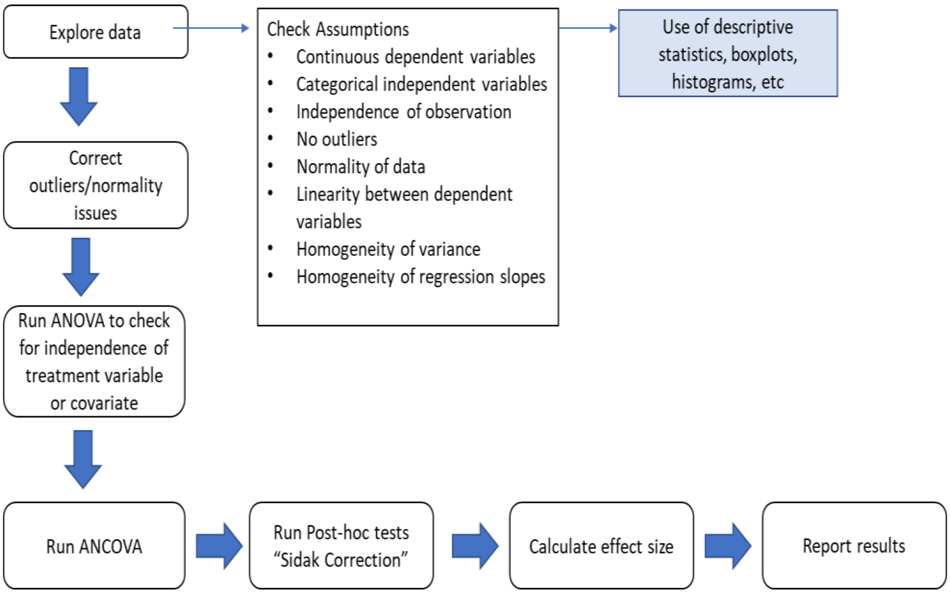
This section explains the processes adopted to analyse quantitative data using descriptive and inferential statistics. Creswell (2014) states that data analysis begins with the collection of data and developing a data management system that enables the systematic storage and tracking of data. Therefore, the first step towards quantitative analysis was managing and preparing raw data. A primary data management system enlisted file names and other details, such as participant ID, types of data collected, research sites, and data collection dates. Cohen et al. (2017) and Creswell (2012) state that data preparation includes decisions regarding defining variables, assigning types of scores for data, identifying data types and scales, selecting a statistical programme, and inputting data into the programme followed by data cleaning, e.g. looking for missing data. IBM's Statistical Package for Social Sciences Software version 26 (SPSS) was used for data input and analysis.

The next step was to create a codebook listing the variables, scoring data, identifying data types, and defining scales. Usually, three forms of scales are used in statistical analysis: nominal, ordinal, and ratio. A *nominal scale* is used for categorical data to label variables without assigning any quantitative value, such as male or female (Creswell, 2014). The nominal scale can be coded as 1= male; 2 = female. The purpose of the assigned numbers is to distribute the population into respective categories and not perform any mathematical calculations on the data. Therefore, this type of data can only be measured through the mode or frequency of occurrences (Cohen et al., 2017). *The ordinal scale* is also used for categorical data, which follows a natural order and informs about the order of choices, such as in a reading attitude survey. The prominent feature of ordinal data is that there is no specific distance between categories. Examples of ordinal data are Likert type scale such as 5= strongly agree, 4 = agree, 3 = undecided, 2 = disagree, and 1 = strongly disagree. Lastly, a *ratio scale* is used for continuous data that defines the order of intervals and the distance between the intervals, and they also have an absolute zero, which allows for performing a wide range of descriptive and inferential statistics (Field, 2018). Examples of ratio scales are height, weight, achievement scores, etc. The present study utilised all three types of data and scales. A codebook (Appendix N) was created prior to inputting data in SPSS, listing all the variables and questions that indicate how responses from the instruments will be coded or scored in SPSS; data files were created accordingly.

The third step was to verify data against pre-set assumptions pertinent to specific statistical tests used to draw inferences. The rationale for testing data against assumptions was to minimise error or bias in results (Creswell, 2014; Field, 2018). Appropriate statistical tests were applied to generate results once the data set complied with all assumptions. In addition to descriptive statistics, such as mean, median and standard deviations to explain the trends in the data, the study used one-way analysis of variance (ANOVA) to determine if there was no significant difference between the mean scores of pre-tests across CG, EG, and CMG. This also ensured the independence of treatment variables across groups, hence qualified for one of the assumptions for statistical tests. A t-test was also used to compare differences in attitude towards reading before and after the intervention across the three groups. The next step was to run an analysis on post-test scores. However, it was anticipated that pre-tests may act as confounding variables and may influence the outcomes of post-test results. Such continuous variables which may predict outcomes are known as covariates. Therefore, one-way analysis of covariance (ANCOVA) was conducted on post-test data (Figure 3.8) by keeping pre-test variables as a covariate and selecting “Sidak correction” as a post-hoc test to control Type I error (a false-positive result or the error of rejecting a null hypothesis when it is true) (Field, 2018)

Figure 3.8

Process of Conducting One-Way ANCOVA



Finally, effect sizes were calculated to determine the overall impact of the game-based intervention on students' learning. Effect size determines if the difference between groups was meaningful and has any practical implications for long-term intervention (Creswell, 2012). Results were presented using tables summarising statistical information, figures, such as charts or diagrams depicting relationships between variables, and detailed inferences of statistical results. Figure 3.9 shows a general procedure for conducting one-way ANCOVA.

3.12.2 *Qualitative Data Analysis Methods*

The present study also employed multiple qualitative analysis techniques to suit the nature of data and inquiry. Interpretative content analysis (ICA) was performed to analyse participants' exchange of views on the results of the game evaluation tool whilst evaluating two digital games in Phase 1, whereas, interpretative phenomenological analysis (IPA) was used for interviews, group discussions and classroom observations in Phase 2 and Phase 3.

Interpretative Content Analysis (ICA)

Interpretative content analysis (ICA) refers to searching latent content, recurring words or themes in interview transcripts or documents (Krippendorff, 2019). According to Krippendorff (2019, p. 27), interpretative content analysis surpasses the descriptive questions of "what' and "how" to make inferences on “why”, “for whom”, and “to what effect” of the situations, allowing researchers to explore, both the causes and effects of communications along with its explicit content. It also allows abductive interpretations of underlying meaning in the content (Drisko & Maschi, 2015). Hence, ICA was considered an appropriate data analysis strategy to analyse participants’ exchange of views pertinent to game evaluations in Phase 1 of the study as it allowed the use of connotative categories in the codes based on the symbolic meaning of the transcriptions instead of explicit words (Drisko & Maschi, 2015).

Interpretative Phenomenological Analysis (IPA)

Interpretative Phenomenological analysis allows detailed examination of personal lived experiences on their own terms rather than influenced by pre-existing theoretical preconceptions (Smith et al., 2009). When people share their lived experiences, they engage in the process of reflection on what was happening during the experience. The researcher aims to engage participants in reflections and make sense of their experiences (Smith et al., 2009). IPA was used to interpret teachers’ interviews and students’ group discussions in Phase 2 and Phase 3 of the present research. The aim was to gain insights into participants’ experience of using digital games for reading skills development and explain the totality of experiences with respect to time (past, present, and future) and interaction with others.

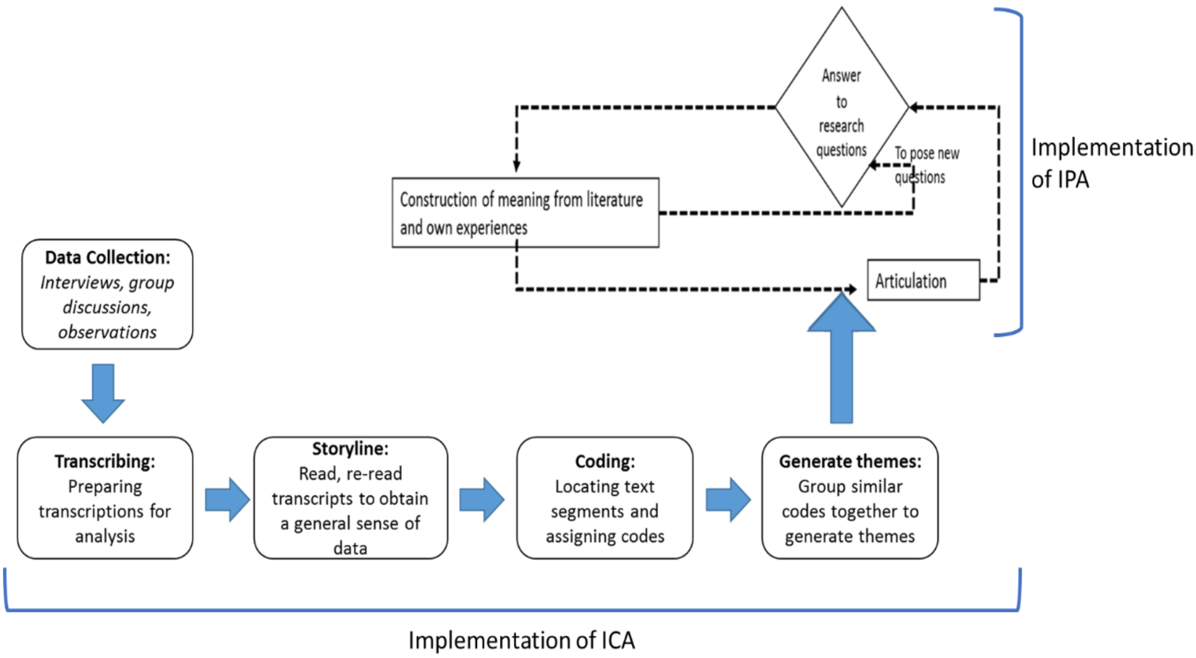
IPA researchers view participants as cognitive, affective, linguistic and physical beings and establish a connection between participants’ attributes of speech, thought and emotional state (Eatough & Smith, 2017). However, due to the complexity of connections between a person’s attributes, people may struggle to express what they are feeling and thinking, and there may be reasons why they do not wish to self-disclose and are unable to disclose (Smith & Osborn, 2003). The IPA researcher will then have to interpret people’s mental and emotional states from what they express. Therefore, IPA recognises the dynamic role of the researcher who is trying to get closer to the participants in understanding the insider perspective of their lived experiences (Smith et al., 2009). IPA involves a two-staged interpretation process where the participants are trying to make sense of their lived experience about a phenomenon, and the researcher is trying to make sense of what participant is trying to make sense of their experience (Smith et al., 2009; Smith & Osborn, 2003).

The Qualitative Data Analysis Process

Qualitative data analysis followed a systematic approach to implementing ICA, as suggested by many qualitative researchers (Campbell et al., 2004; Krippendorff, 2019; Smith & Osborn, 2003; Taylor & Bogdon, 1998) and IPA (Smith et al., 2009). Figure 3.9 explains the process of qualitative analysis, indicating the use of ICA and IPA. After data collection, the first step was to transcribe all the interviews, group discussions, and observations. Video recordings were watched, and transcriptions were read many times to have a holistic sense of the data and develop a storyline of the main ideas emerging from the data. Campbell et al. (2004) claim that a storyline emerging from transcriptions links major themes of the study to answer the central research question in a qualitative inquiry.

Figure 3.9

The Qualitative Data Analysis Process



The next step was to develop codes by identifying the text segments. A code describing the accurate meaning of the text segment was written in the left-hand margin on the transcripts. A coding list was developed for each type of qualitative data, i.e. interviews, group discussions, and observations (Appendix M). A frequency table was created to find recurring codes. Key themes were generated by grouping the most recurring and similar codes, while redundant codes were discarded. Themes were noted along the right-hand margin on the transcripts. Patterns and connections between emerging themes were determined (Appendix Q). Abductive reasoning was used to infer the best explanations, draw conclusions and make predictions. Narratives were articulated, and interpretations were constructed based on the researcher's preconceptions, experiences, and comparison with previous literature to draw inferences.

3.13 Meta-Inferences (Cross-Methods Analysis)

After drawing inferences from quantitative and qualitative analyses, the study drew meta-inferences by triangulating the results from quantitative and qualitative analyses into a coherent conceptual framework that answered the research questions. Meta-inferences are the overall inferences from the whole study and are defined as theoretical statements describing a phenomenon (Venkatesh et al., 2013). In practice, these inferences are conceptually similar to developing theories from observations. Generally, mixed-method researchers tend to switch between different modes of reasoning to develop inferences, i.e. deductive reasoning, inductive reasoning, a combination of inductive and deductive reasoning (Tashakkori & Teddlie, 2003), and abductive reasoning (Sætre & Ven, 2021). Since the present study used pragmatism with transformative emancipation and phenomenology as theoretical perspectives (Section 3.3), a combination of inductive and deductive reasoning was used simultaneously to address research questions. The study also used abductive reasoning by making logical connections between data and theory (ibid) to theorise unexpected results. Moving back and forth between theories and data to triangulate quantitative and qualitative findings is a common process used for abductive reasoning in generating meta-inferences (Morgan, 2007).

Teddlie and Tashakkori (2009) suggest that the validity of a mixed-methods study depends upon the quality of meta-inferences drawn from the study. However, the quality of meta-inferences is dependent on the analysis of the quantitative and qualitative parts of the study (Heap & Waters, 2019). More specifically, quality depends upon the study design of mixed-methods, intended purpose of using mixed-methods, explanatory quality of inductive or/and deductive inferences, and patterns of mixed-methods research findings: convergent, divergent or complementarity (Teddlie & Tashakkori, 2009). The integration of mixed methods may provide a good argument for inference quality if the results converge; however, if the results diverge, it is crucial to find and report the causes and re-examine the results (Teddlie & Tashakori, 2009). The present study integrated mixed methods to improve inference quality by converging analysis obtained from quantitative and qualitative data. The two analyses (QUAN and QUAL) were triangulated to gain insights if the data confirm or disconfirm each other, and also to provide richer explanations.

3.14 Validity and Reliability

In general, mixed-method research considers the validity and reliability issues of the quantitative and qualitative paradigms of research (Creswell, 2012). Essentially, validity and reliability are the central criteria to evaluate the quality and acceptability of the research (Neuman, 2011) as to whether the research is of high quality, low quality, or lies somewhere in between. Validity refers to internal and external threats to the quality that might occur during the research design, data collection, data analysis and interpretation stages of the research process (Onwuegbuzie & Johnson, 2006). The following factors were considered to maintain the validity of the present research:

3.14.1 *Content Validity*

Content validity refers to the adequate and effective measurement of different elements, skills and attitudes (Field, 2018). Therefore, valid and reliable instruments were used in the present research to gather effective responses. The elementary reading attitude survey (ERAS) and early grade reading assessment tool (EGRA) have a high-reliability coefficient and have already been used in previous studies. The field experts (supervisors of the present study) reviewed the qualitative questionnaires and advised the clarity for a few questions (Section 3.10.3). The unclear and vague questions were revised, and complex terms were simplified. Moreover, the questionnaires were translated into the Urdu language following a rigorous process of translation, as discussed in Section 3.10.2. The interview questionnaires were pilot tested on a group of people with similar demographics to the study participants; no changes were required after the pilot testing.

3.14.2 *Internal validity*

Internal validity refers to the congruence of the research findings with reality (Neuman, 2011). It is established that when research demonstrates a causal relationship between independent and dependent variables, there may be confounding factors that could affect the causal relationship between the variables and pose a threat to the study's internal validity (Creswell, 2014). The following methods were adopted to maintain the internal validity of the study.

Triangulation

Data collection through single tools may be questionable, weak and biased. Hence, data were obtained through different measures, such as survey questionnaires, pre-post-tests, interviews and group discussions, and observations in this study. Obtaining similar findings from various tools resulted in the validity of the data (Teddlie & Tashakkori, 2009). According to Creswell (2014), methodological triangulation occurs at the end of the study. In the present study, triangulation was done to gain better insights by combining quantitative and qualitative data inferences to form meta inferences to answer the research questions.

Member Checks

Member checks involve confirmation of data interpretation from the study participants to recognize and support the credibility and truthfulness of the information (Neuman, 2011). Therefore, the interview transcripts were shared within two weeks after the interviews with the study participants for confirmation and validation. Similarly, a verbal consensus was also taken from the participants after conducting group discussions.

Selection Bias

Selection bias usually arises in studies when more than one group is involved in experimental research and when the sample population is not representative of the target population (Showalter & Mullet, 2017). Well-calculated sample size derived from the target population and the random assignment of the sample to the EG, CMG and CG was used to minimise the threat of selection bias.

3.14.3 *External Validity*

External validity is concerned with generalising study results to a wider population or other relevant settings (Creswell, 2014). It emphasizes adopting appropriate research design, sampling techniques and sample size selected for the study. Therefore, in the present research, threats to external validity were minimised by the random selection and assignment of clusters to the groups (EG, CMG, and CG) with a sample size suitable for power analysis (Onwuegbuzie & Johnson, 2006).

3.14.4 *Reliability*

Reliability refers to the research's consistency, dependability, and replicability (Neuman, 2011). It suggests that similar findings will be achieved if the research is repeated on another occasion or if replicated by another researcher (ibid). Some certain errors or biases jeopardise the reliability of the research. These may include participant error referring to any factor that adversely alters how participants perform or respond; participant bias relates to factors producing false responses from the participants; researcher error concerns factors altering the researcher’s interpretation; and researcher bias concerning with researcher’s worldview of the reality. Therefore, to minimise such threats, reliable constructs were used for data collection and care was taken about the time and place of interviews to get truthful insights from participants on the qualitative data. Moreover, objectivity was maintained in recording the responses from the qualitative data to avoid the researcher’s bias.

3.15 Ethical Considerations

Research ethics are a set of principles or values that guide the conduct or designing of the research and the behaviours and actions of the people involved in research (Hammod & Wellington, 2013). Various ethical considerations were relevant to the present research, purposed to protect research participants and the researcher. This section outlines the ethical considerations adopted for the study. It discusses how participants and schools were accessed for various phases of the research and how their consent was gained

3.15.1 *Ethical Approval*

Before undertaking the research, ethical approval was sought and gained from the University of Waikato (Approval number: FEDU056/18) (Appendix AA). The following subsections present a range of measures taken to ensure appropriate ethical considerations were made.

3.15.2 *Gaining Access to Schools and Participants*

Field research requires meticulous planning, which involves negotiated access to the research site. A vital component of field research is careful access to the site and negotiations with gatekeepers or individuals who have the authority to control access to the research site and data (Høyland et al., 2015). Once these gatekeepers are identified, they can be approached professionally with a formal access request. In a school setting, access to the teachers and students must be gained through the principal (James & van Laren, 2009).

In Phase 1 of the research, participants, including teachers, game designers, and developers, were contacted via email. These participants had previously attended an ICT intensive pedagogy workshop held at the National University of Sciences and Technology (NUST) in October 2016. Their email addresses were obtained from the email lists maintained at NUST. The purpose of the research was clearly outlined in the participant information sheet (Appendix O) and was emailed to the potential participants. Interested participants were invited to attend a one-day seminar at the Department of Innovative Technologies in Education at NUST, where the researcher delivered a brief talk on the game evaluation tool and how it can be used to evaluate digital games for reading development. After the seminar, informed consent was sought from the interested participants, and they were asked to evaluate two digital games using the given game evaluation tool: Teach your Monster to Read and Graphogame UK.

Participants in Phase 2 and Phase 3 were mainly primary school students and teachers who were accessed at various campuses of OSC schools in Islamabad, Pakistan. An email and a formal letter were sent to the principal seeking permission to conduct the research (Appendix P). The importance of this research and potential benefits for the research participants were explained to the principal.

3.15.3 *Informed Consent*

Informed consent was sought from all research participants prior to data collection. Phase 1 participants received an invitation to participate in the research and the consent forms via email. Those willing to participate and attend the seminar at NUST were explained the process of informed consent, volunteer participation, and their right to withdraw from the study before the commencement of the next phase in May 2019.

A meeting was held with Phase 2 and 3 participants in participating campuses of OSC schools to discuss the consent procedures to make them aware of the purpose and data collection procedures, use of photographs and audio/video recordings, phases of the study, and the potential risks and benefits associated with the study. Participant information sheet and consent forms were shared with teachers, head teachers and students. The participants retained the information sheet, whereas the signed consent forms were returned to the researcher prior to conducting the research. Since most students were under the age of 18 years, consent was also sought from their parents/caregivers. Participant information sheets and consent forms were translated into the Urdu language to be read and understood by the parents (Appendix Q). Teachers in respective schools distributed and then collected the consent forms from parents allowing their children to participate in the research.

3.15.4 *Anonymity / Confidentiality*

Anonymity and confidentiality are two crucial ethical considerations, which means that research participants must not be recognisable in any conversation, reporting or publications. Therefore, pseudonyms were assigned to participants for the qualitative data for data coding and reporting on the study findings. For the quantitative data, participants were assigned a unique identifier number, the record of which was only held by the researcher. The rationale for assigning a unique identifier number was to track individual student progress throughout the study. Although data analysis considered the overall trend of results instead of individual student progress, some unique findings were identified from individual student records. Data were stored on a password-protected computer with no access to unauthorized persons in a lockable office at the University of Waikato. Study results were also reported maintaining complete confidentiality.

3.15.5 *Participant's Right to Decline to Participate and Right to Withdraw*

Participants' involvement in the study was on a voluntary basis. The participants involved in qualitative data such as interviews had a right to withdraw completely from the study not later than two weeks after reviewing and receiving their transcripts. Similarly, participants involved in quantitative data collection also had a right to withdraw from the study before the commencement of data analysis on 1 December 2019. Throughout data collection, few students withdrew from schools; their data were not included in the study if they had not completed the post-tests in Phase 2 and further post-tests in Phase 3 of the research.

3.15.6 *Arrangements for Participants to Receive Information*

Participants had the opportunity to verify the accuracy of what had been transcribed from their interviews. As soon as interviews were transcribed, transcripts were returned to the participants for member checking. This was a new concept for teachers involved in the research. Due to their busy schedules, teachers were a bit reluctant to review the transcripts; therefore, one of the data collectors read their responses and had a consensus on the accuracy of the information captured in the interviews. After each group interview, a summary of responses was verbally shared with students to have a consensus on recording the correct information. Moreover, participants will also receive a summary of the main outcomes after completing the study. A poster presentation highlighting the major outcomes will be shared with the participating schools and teachers.

3.16 Resources and Research Timeline

The present research was resource-onerous as it was intervention-based and required access to a lot of resources for data collection. The researcher arranged all resources without any financial support from the university. Appendix BB presents a list of resources, quantity and purpose for which these were acquired for the study.

The proposal for this research was submitted and confirmed in July 2018, with full enrolment occurring in August 2018. The primary data gathering commenced in December 2018 and lasted the whole next year until November 2019 (Appendix D). Luckily, no major challenges delayed the data collection process, which helped in following the actual timelines set out for the research. The actual timeline of the research is presented in Appendix CC.

3.17 Summary

This chapter introduced and justified the methodology used in this study. This is a multi-phase embedded design mixed-methods research that employed a combination of theoretical perspectives, i.e. pragmatism with transformative emancipation and phenomenology, to draw meta-inferences to investigate the impact of digital games in developing reading skills amongst children belonging to low socioeconomic status. The chapter justified the selection of participants, quantitative and qualitative data collection methods, and data analysis strategies to enhance the quality of inferences drawn from the study. The validity, reliability, and ethical considerations were also discussed as to how these have been implemented to ensure the study's quality and participants' integrity and safety. The next four chapters (Chapters 4, 5, 6, and 7) present quantitative and qualitative findings of different phases of the study.

CHAPTER 4: PHASE 1 FINDINGS

The results of the research undertaken in this study are divided into four chapters. Chapter 4 presents and discusses results related to Phase 1 - Game Selection. Results from Phase 1 led to identifying the digital game best suited for the digital game-based intervention implemented in Phase 2- Game Implementation. Hence, it is crucial to discuss the findings of Phase 1 before presenting the results of the next two phases to understand the validity and reliability of the game evaluation tool used to select the game and the characteristics of the chosen game for Phase 2 of the study.

During Phases 2 and 3, quantitative data were collected before the qualitative data. Therefore, Chapter 5 presents the results of quantitative data collected during Phases 2 and 3 pertinent to the impact of digital games on reading skills development and retention of reading skills. Chapter 6, informed by the qualitative data, mainly focuses on gaining insights into the lived experiences of the students who played digital games related to behavioural changes and skills acquisition of the CMG and EG students who played digital games during the six-weeks intervention period. The next results chapter, Chapter 7, presents quantitative and qualitative results on students' attitudes towards reading in all three groups (CG, CMG, and EG). As attitudes are quite different from behaviours and skills acquisition, combining quantitative and qualitative data in one chapter is logical. Attitudes are defined as hypothetical constructs that may be inferred from experiences, behaviours or verbal accounts (Adair, 2019). Hence, in Chapter 7, a survey to measure attitudes was utilised to form a preliminary analysis for the three groups, followed by gaining insights into the trends from the qualitative perspectives, which was then triangulated to form a holistic analysis of the change in attitudes towards reading intervention. Table 4.1 summarises the distribution of the results chapter for this study.

Table 4.1

Summary of Results Chapters

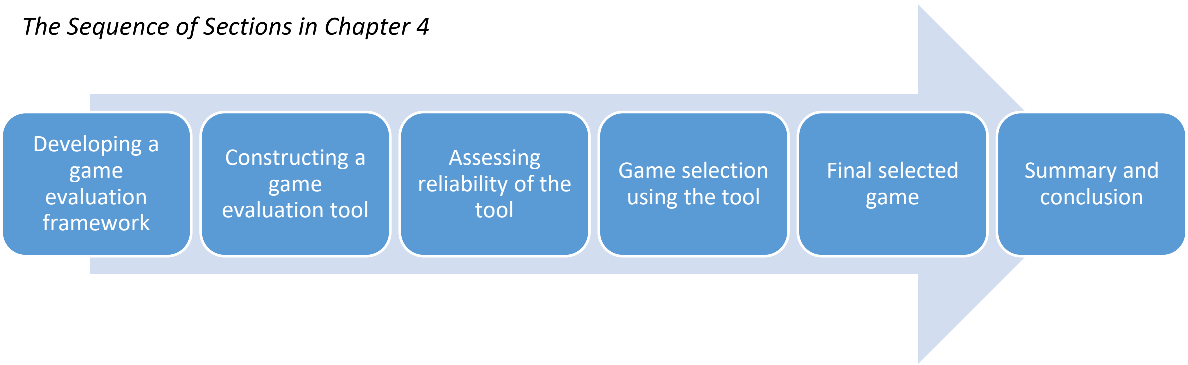
Results Chapter	Content	Study Phase
Chapter 4: Results of Phase 1- Development and application of game evaluation tool	Qualitative and Quantitative results (QUAL + QUAN) • Development of game evaluation framework and instrument (QUAL) • Establishing the reliability of the instrument (QUAN +QUAL) • Comparison of two games (QUAN) • Discussion and implications of Phase 1 findings	Phase 1: Game selection
Chapter 5: Quantitative findings-Development and transfer of reading skills	Quantitative results (QUAN) • Comparing English (L2) reading skills of CG, CMG, and EG • Comparing Urdu (L1) reading skills of CG, CMG, and EG • Estimating retention of skills in CG, CMG, and EG	Phase 2- Game Implementation Phase 3- Skills retention
Chapter 6: Qualitative findings – Behaviours and skills	Qualitative results (QUAL) • Behaviours and skills acquired by the CMG and the EG students after playing digital games.	Phase 2- Game implementation
Chapter 7: Attitudes towards reading	Quantitative and Qualitative results (QUAN + QUAL) • Change in attitudes towards reading of the CG, CMG and EG after the study.	Phase 2- Game Implementation Phase 3- Skills Retention

4.1 Phase 1 Introduction

Phase 1 of the study aimed to find a pedagogically balanced reading skills development digital game in English, which was distributed in schools during Phase 2. The internet hosts a plenitude of commercial-off-the-shelf (COTS) digital games to foster reading development; however, such games' effectiveness and educational value are unknown. Several frameworks are available in the literature to design and evaluate educational games (Arnab et al., 2015; Carvalho et al., 2015; De Freitas et al., 2010), but none of these focuses on the core constituents of reading skills such as phonological awareness, word decoding, reading fluency, vocabulary, or comprehension. Therefore, existing frameworks and game evaluation tools were inappropriate for selecting a suitable game for this study. This finding led the researcher to develop a tool to evaluate games for English reading skills. Figure 4.1 shows the sections this chapter entails.

Figure 4.1

The Sequence of Sections in Chapter 4



The chapter begins by presenting the data from Phase 1, which aimed to develop a framework to evaluate English reading digital games and select the most suitable game to use in Phases 2 and 3 (Section 4.2). A game evaluation tool was developed (Section 4.3). The validity and reliability study of the developed tool is presented in section 4.4. A comparison of selected games on the game evaluation tool indicators is reported in section 4.5. The games closely matched Pakistan's national curriculum for reading comprehension (National Curriculum Council, 2020). The best game was selected and distributed in participating campuses of OSCS in Phase 2 of the research. The chapter concludes with a summary of Phase 1 findings and establishes the game evaluation tool’s usability for future use.

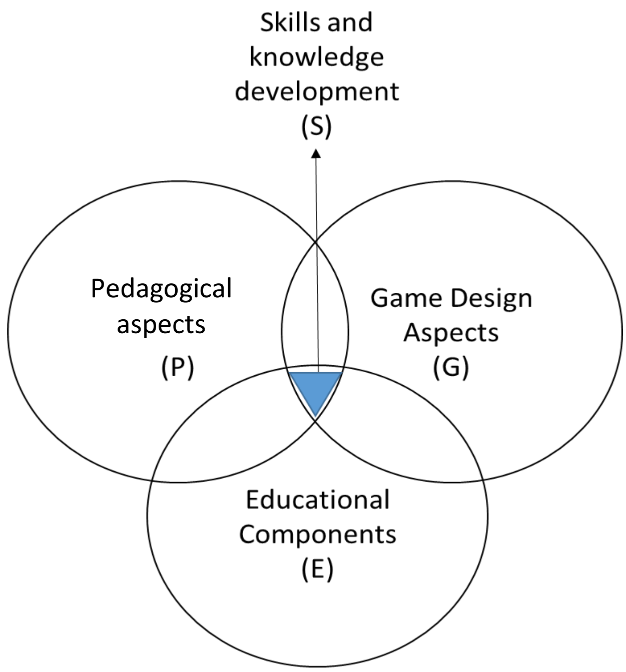
4.2 Game Evaluation Framework

A review of existing game development frameworks (Arnab et al., 2015; Carvalho et al., 2015; De Freitas et al., 2010; Lim et al., 2018; Roungas & Dalpiaz, 2016) highlighted aspects of instructional strategies, game mechanics and design considerations crucial for developing effective digital games. These aspects were common in most game development frameworks. Similarly, research in language learning highlights essential components of reading to foster early reading skills (NCFL, 2009). Sensitivity to sociocultural, linguistic, economic, educational and technological contexts is essential to consider the affordances of digital games, as most games available across different game platforms are developed for English-speaking countries (Dede, 2018; Koval-Saifi, 2018; Lim et al., 2018). Therefore, such games may not necessarily be effective for English language learners or non-English speaking learners. After an extensive search of relevant literature, the researcher concluded that no current research combined all these aspects (instructional strategies, game mechanics and design considerations, and English reading components) into a single framework to evaluate digital games to develop English reading skills. Therefore, the researcher developed a game evaluation framework that included the aspects mentioned above to evaluate digital games to foster early-grade English reading skills, especially for English language learners.

The developed framework combined effective instructional strategies to engage learners in the learning process with appropriate content aligned with the early grade reading curriculum and design principles for developing immersive games. The focus was to identify a pedagogically balanced game that could foster skills and knowledge as an output of game playing. The developed framework consists of three overlapping aspects (Figure 4.2): pedagogical considerations, educational components (in our case, these are English reading components), and game design elements. Since the main determining factor for a player's success is the player's skills level and knowledge, the aspect of skills and knowledge lies at the core of this framework. This proposed game evaluation framework was named PEGS **(P**edagogical aspects, **E**ducational components, **G**ame design elements, and **S**kills and knowledge development) framework.

Figure 4.2

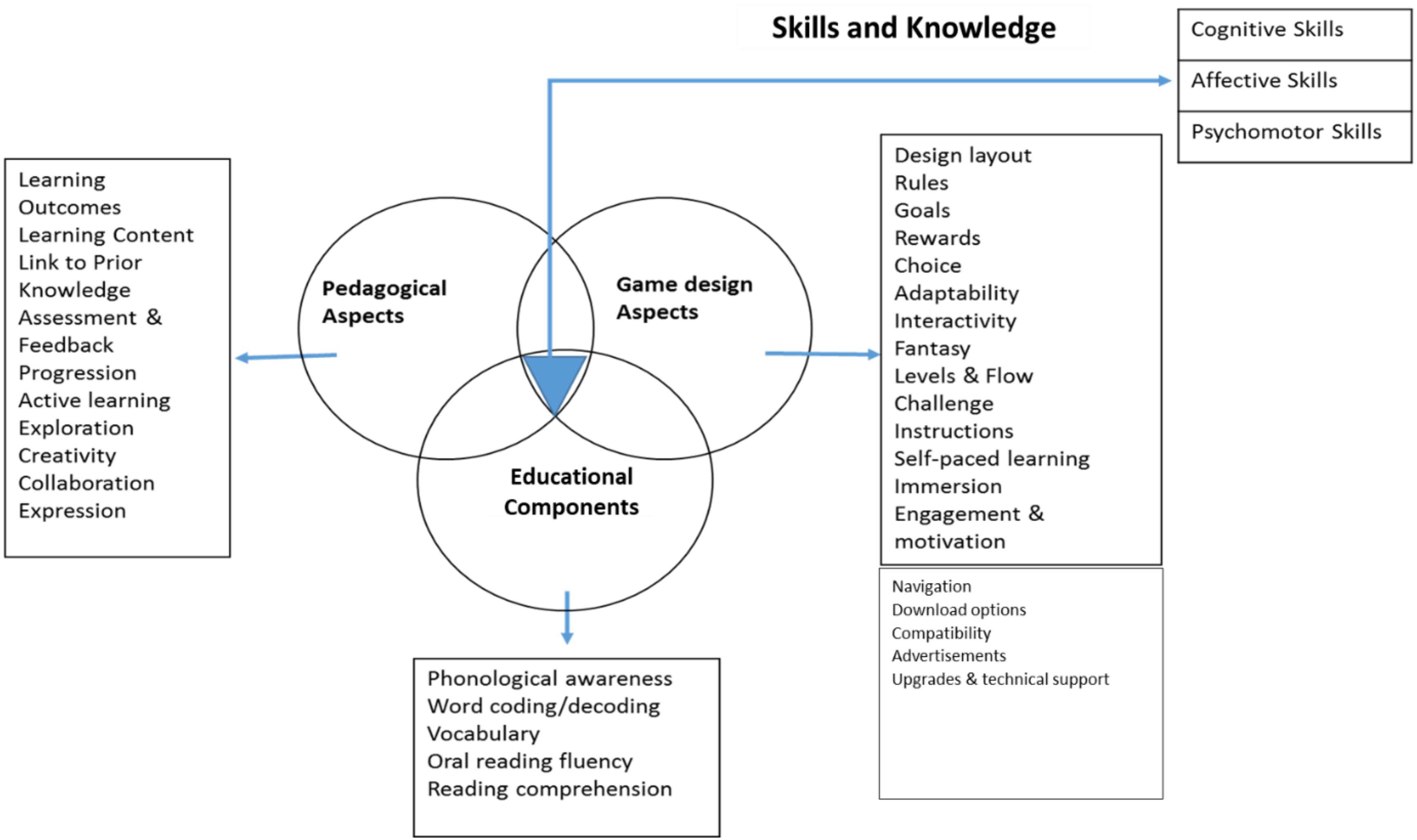
Key Aspects of the PEGS Framework



The subsections below present the findings inferred from the literature to identify the major aspects of the PEGS framework, i.e. pedagogical aspects, educational components, game design aspects, and skills and knowledge. Figure 4.3 presents an overview of the PEGS framework identifying three intersecting aspects along with their indicators to evaluate reading-development-digital-games (RDDGs). The indicators were drawn from the existing literature on game design models and frameworks. The core of the intersecting aspects presents skills and knowledge, the indicators of which were derived from Bloom's Taxonomy (Anderson & Krathwohl, 2001)

Figure 4.3

An Overview of the PEGS Framework



4.2.1 *Pedagogical Aspects*

The pedagogical aspects of the PEGS framework are grounded in a complex combination of instructional design theories, e.g. Gagné’s Events of Instruction (Gagné, 2005), and Merril’s first principles (Merrill, 2013), and major learning theories i.e. behaviourism, cognitivism, humanism, and constructivism (Becker, 2017), that lay the foundations for digital game pedagogy. These theory-based teaching and learning approaches result in powerful environments (Smeets, 2005) to foster authentic learning where learners actively construct meaning. However, none of these theories or learning approaches can be independently prescribed to develop a perfect game. Game developers may adopt multiple game pedagogies underpinned by multiple learning theories to inform the design and development of an effective learning game that would produce authentic learning (Becker, 2017; Lim, 2009). From a pedagogical perspective, effective learning happens within a flexible and open-ended environment that supports exploration, collaboration, and creativity when learners are actively engaged with the learning content (Lim et al., 2018). In the case of developing reading skills, learning through games is optimised when learners are cognitively active, motivated, and when their experiences are meaningful, interactive, and goal-oriented (Papadakis et al., 2018).

The pedagogical aspects proposed in the PEGS framework, as listed in Table 4.2, were extracted from existing research into digital game-based learning (e.g.Becker, 2017; Kiili, 2005; Lim et al., 2018). The first column of Table 4.2 lists crucial indicators of pedagogical aspects, while the second column provides statements to evaluate game pedagogies in RDDGs. These indicators were used to evaluate the pedagogical considerations in the digital game for reading development.

Table 4.2

Pedagogical Aspects in PEGS Framework

Pedagogical Aspects	
Learning Outcomes	Game activities are linked to the intended learning outcomes for language learning at the desired grade level.
Learning Content	Learning content is embedded in the story/fantasy/game challenge
Prior Knowledge	The game provides opportunities to apply prior knowledge to the game activities.
Assessment and feedback	The game embeds multiple types of assessments and provides opportunities to improve performance based on the feedback.
Progression	a. The game contains the feature of tracking the individual performance of learners. b. The game contains the feature of tracking the performance of the whole class.
Active reading strategies	The game provides opportunities for becoming active participants in learning to read, e.g. learners are actively involved in the process of reading.
Learning by exploring	The game provides opportunities for 'learning by exploring' resulting from exploring the hidden secrets of game-world.
Learning by being	The game design provides opportunities for 'learning by being' that results from examining identity and self, such as taking roles in the gaming world.
Learning by building	The game design provides opportunities for 'learning by building' that results from building artefacts or structures in the game environment or modifying the environment.
Learning by collaborating	The game provides opportunities for 'learning by collaborating' resulting from peer collaboration to solve problems or accomplish goals.
Learning by expressing	The game provides opportunities for 'learning by expressing' that result from presenting in-game activities or creations to an out-of-game audience (e.g. printing out the certificate of achievements or summary of results to share with parents)

4.2.2 *Educational Components*

The educational component in the PEGS framework includes intended learning outcomes that a game should aim to achieve. These outcomes need not be explicitly presented in the games but implicitly embedded within the storyline and instructional strategies. Since the present study is focused on evaluating reading development games, this section will inform what components are essential to developing good reading skills and what graphic designers should consider whilst design such games, especially for English language learners.

Reading is not a single skill in most languages but a collective combination of subskills: phonological awareness, word coding/decoding, reading fluency, vocabulary, and reading comprehension (NCFL, 2009). Reading fluency occurs when these subskills are mastered individually (Álvarez-Cañizo et al., 2015; Bigozzi et al., 2017), enabling readers to integrate these skills to read, print or digital text, comprehend information, answer questions and engage in discussion with others. Phonic-based languages have a predictable relationship between phonemes and graphemes; the sounds those letters represent in written language (Armbruster et al., 2001). Therefore, games for reading development must involve readers in practising phonological awareness and applying skills in a meaningful context that may vary across different languages. Developing phonological awareness leads to developing word recognition, reading fluency, and improving vocabulary and reading comprehension.

Lim et al. (2018) claim that children acquire reading skills best when they are given the opportunities to practice subskills of reading by completing tasks in an enjoyable and reasonably challenging way without being too difficult for beginner readers. Therefore, effective digital games should target developing such skills, starting from simpler to incorporating more challenging and complex reading tasks gradually. A digital game may develop one subskill before developing the other (Lim et al., 2018). However, the key to success is providing appropriate practice time to master and apply the newly acquired skills within a particular context.

Table 4.3 presents English reading components adapted from various international curriculums (e.g. Department for Education, 2013; FCRR, 2006; Ministry of Education, 2010) to evaluate digital games for reading development. Column 1 of Table 4.3 lists English reading components, whereas, Column 2 presents sub-components of each component essential to developing reading skills. The reading components listed in Table 4.3 form the basis for evaluating educational components in the PEGS tool.

Table 4.3

English Reading Components Selected for the PEGS Framework

Educational Components (English Reading Components)	
Phonological awareness	a. *Phoneme matching and isolating*: The game provides opportunities to practice matching and isolating initial, final and medial phonemes in words. b. *Phoneme segmenting and blending:* The game provides opportunities to practise segmenting and blending phonemes in words. c. *Phoneme manipulating:* The game provides opportunities to practice manipulating phonemes in words.
Word coding/decoding	*a.* *Letter-sound correspondence:* The game provides opportunities to practice matching phonemes and digraphs to letters. *b.* *Sight words:* The game provides opportunities to practise reading high frequency or sight words. *c.* *Syllable patterns:* The game provides opportunities to practice blending, segmenting, and identifying syllables in words. *d.* *Morpheme structures:* The game provides opportunities to practice forming compound words and identifying individual words in compound words, identifying base words with inflections, and blending base words with affixes and inflections.
Reading Fluency	*a.* *Letter-sound correspondence:* The game provides opportunities to use timed practices to recognise letter-sounds. *b.* *Words and Phrases:* The game provides opportunities to use timed practices to read words and phrases. *c.* *Chunked Text:* The game provides opportunities to practice reading chunked text with prosody.
Vocabulary	*a.* *Word knowledge:* The game provides opportunities to practice identifying contractions, synonyms, antonyms, homophones, and homographs . *b.* *Word meaning:* The game provides opportunities to practice identifying and producing the meaning of words.
Comprehension	*a.* *Narrative text structure:* The game provides opportunities to practice identifying story elements such as, characters, setting, sequence of events, problems, solution, plot, and theme. *b.* *Pre-reading strategies:* The game provides opportunities to predict some words that might occur in a text by looking at picture/title. *c.* *Text analysis:* The game provides opportunities to practice identifying and organising text, such as: • Locate specific factual information to answer short questions; • Predict what follows in the text using context and prior knowledge; • Use context to infer missing words.

Note: Adapted from *"English programmes of study: Key stage 1 and 2- National curriculum in England".* (2013). By Department of Education; *"Second and third-grade student centred activities: Teacher resource guide*". (2006). by FCCR. https://www.fcrr.org/curriculum/pdf/GK-1/TRG_Final_Part1.pdf

4.2.3 *Game Design Aspects*

The third aspect of the PEGS framework is game design, highlighting the crucial elements for designing effective games. The indicators for game design aspects were derived from existing research (e.g. Lim et al, 2018; Kiili, 2005; and Gunter 2008) and divided into two sections. The first section in Table 4.4 deals with design affordances, and the second is related to the optimal use of digital games in the context of developing countries constrained by limited technical resources and support. Design considerations may include sensitivity to the sociocultural and linguistic aspects of target populations as it may affect the game's narrative or gameplay. Table 4.4, adapted from Lim, et al, 2018, Kiili, 2005, Gunter 2008, presents a list of game design elements incorporated in the PEGS tool to evaluate game design aspects of reading development games. The first column lists major research-based design aspects, whereas the second column states evaluative statements to assess design aspects in games.

Table 4.4

Game Design Aspects Selected for PEGS Framework

	a. Game Design Aspects	
Section 1	Rules	The game rules and goals are clear and organised. It is easy for the player to figure out what to do.
	Rewards	The game provides rewards that come in varying forms and degrees of usefulness, such as new tools, an increase in points, access to new game spaces or unlocking levels.
	Choice	The game provides a number of options and decisions a player has prior to, or during playing the game.
	Adaptability	The game can be started from any point or any level as needed
	Graphics	The graphics are aesthetically appealing for the desired audience and immerse the learners in the experience but do not distract from the learning process.
	Interactivity	The game provides the opportunity to interact with the game environment as well as non-player characters (NPC) that can be used to advance the storyline or provide feedback to the player.
	Fantasy	The game has an intriguing storyline that provides motivating and exciting gameplay, and cohesion for different levels.
	Levels/Flow	The game provides progression through multiple game levels, pitched at appropriate difficulty, and gradually increases in intensity as learners acquire more skills.

	Instructions	In-game instructions are provided using a range of media (e.g. audio, text. graphical cues).
	Self-Paced Learning	The game activities enable learners to manage their own learning.
	Immersion	The game provides an immersive experience to learners through active participation and cognitive, psychological and emotional involvement with the game content.
	Engagement and Motivation	The game is engaging and motivating and provides extended gameplay periods or repeat-play options with opportunities to achieve complex learning goals.
	Navigation	The game is well organised, user friendly and easy to navigate. Students can clearly understand where they are and where to go next.
Section 2	Developing country context	a. The game is available for a free download. b. The game is available to download for multiple technologies, such as Android tablets/smartphones, iPads/iPhones, and laptops c. The game is free of advertisements d. The game hides any in-game purchase screens so these are not easily accessible to children but can be accessed by parents or teachers who would make purchase decisions e. Free upgrades and technical assistance is provided to game users

Note. Adapted from *Guide to developing digital games for early grade literacy for developing countries.* (2018). By K.Y. Lim, J. Comings, M.D. Hilmy, D. Chua et al., Copyright 2018 Foundation for Information Technology Education and Development, Inc. and World Vision, Inc; Digital game-based learning: Towards an experiential gaming model. 2005. *The Internet and Higher Education. 8*(1), 12-24 (https://doi.org/10.1016/j.iheduc.2004.12.001); G.A. Gunter, R.F. Kenny, and E.H. Vick. 2008. *Educational Technology Research and Development*. 56(5) 511-537 (https://doi.org/10.1007/s11423-007-9073-2)

In PEGS framework, game design aspects interact with pedagogical aspects and educational content to create an engaging gaming experience for players. This experience can be achieved if players know game rules and know to navigate the game environment to achieve the intended goals. The game does not explicitly teach this content on how to navigate and learn the game rules. It rather provides an environment of interaction and exploration to discover the rules for success. Players may learn experientially by trying out different options or learn through failures. Research into digital game-based learning recommends essential game design elements for effective educational games as design layout, rules and goals, rewards, choice, adaptability, interactivity, fantasy, game levels and flow of the game with appropriate challenge, instructions, elements of self-paced learning, engagement and motivation, navigation, compatibility, download options, and technical support (Lim et al., 2018; Reinhardt, 2017). Evaluating digital games in a developing country context must consider games' affordances within the sociocultural, linguistic, economic, educational and technological context of the target audience (Dede, 2018; Koval-Saifi, 2018; Lim et al., 2018).

4.2.4 *Skills and Knowledge*

PEGS framework presents a theoretical overlap of pedagogical aspects, educational components, and game design aspects. At the core of this overlap lies the acquisition of skills, knowledge and attitudes as outputs of game playing. The educational value of games may be determined by measuring these outputs. The insights to assess the educational value of the games are drawn from Bloom's taxonomy (Krathwohl & Anderson, 2009), introducing three learning domains: cognitive, affective, and psychomotor, along with a hierarchy of skills within each domain. PEGS framework was used to explore how these domains interplay in developing competencies through game playing, specifically in learning a second language. Table 4.5 presents a sequence of game activities in a hierarchy from simpler to complex for each of the three domains. These sequences of activities are adapted from Krathwohl and Anderson (2009), which may serve as indicative criteria to assess the educational value of language learning games.

Table 4.5

The Sequence of Game Activities Following the Hierarchy of Higher-Order Learning

Cognitive skills	**Affective skills**	**Psychomotor skills**
The game enables learners to:	The game enables learners to:	The game enables learners to:
recall information that has been learned. **(Remembering)**	be open to learning about a new value or attitude, e.g. listening to others with respect; following instructions carefully, etc. **(Receiving)**	watch a performance or skill, e.g. detecting non-verbal communication cues, estimating the game strategies by watching a demonstration, etc. **(Observe)**
interpret, translate or extrapolate information, for example, to summarise text by identifying in-text relationships, making inferences, etc. **(Understanding)**	respond to a new value or attitude, e.g. showing active participation, feeling motivated, feeling happy or engaged in game activities or reading and responding to the instructions, etc. **(Responding)**	copy or imitate the performance of the skill, e.g. displaying a readiness to perform the skill or follow the sequence of activities. **(Model)**

recognise patterns that can be transferred to new or unfamiliar situations. For example, knowing when or why to apply certain skills automatically. **(Applying)**	recognise that the new value or attitude is worthwhile, e.g. demonstrating problem-solving skill; making informed selections, valuing rewards and motivated to collect more points, etc. **(Valuing)**	identify the standards that are acceptable in relation to the new skill, e.g. identifying navigation keys or sequences, game controls, or provide step-by-step instructions to follow in order to solve a problem. **(Guided Response)**
break down information into parts and forms, and draw comparisons between a text and background knowledge data. For example, students are able to see connections and draw conclusions, etc. **(Analysing)**	value diversity and shows the ability to solve problems, e.g. compare different situations and be able to apply skills acquired in multiple situations. **(Valuing)**	recognise when the performance of the skill is different from the standard and correct the error, e.g. performing certain movements or skills with confidence and proficiency and recognising and correcting if these are not performed according to the game standards. **(Recognise Standards)**
evaluate the worth of the information, compare or contrast ideas while reading, identify core themes, form and support opinions, and assess the validity of the content/text. **(Designing)**	relate the new value or attitude to their current values or attitudes, e.g. collaborating with others and showing responsible behaviour in collaborative activities, etc. **(Organising)**	use the new skill in a new situation, e.g. displaying competence while playing a game, skilful performance of motor acts involving complex movement patterns, etc. **(Applying)**
link information to prior knowledge to develop new ideas, establish a new way of thinking, or create a new product. **(Creating)**	acquire the new value or attitude by making part of their identity, e.g. showing self-reliance when working independently, applying skills achieved in games to out-of-game situations, displaying ethical practices, etc. **(Internalizing)**	create new skills and support others to learn the new skill, e.g. creating new movement patterns or finding shortcuts to perform certain game actions transferring skills to others, peer learning, training others to acquire skills, etc. **(Coaching)**

Note. Adapted from *Taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives*. (2009). By D.R. Krathwohl and L.W. Anderson. Copyright 2009 Longman

To conclude, the PEGS framework presented in Figure 4.3 offers an overview of the aspects of each component identified in this section and forms the foundation to evaluate and compare two or more English reading digital games using the four aspects of the PEGS framework. The research-based indicators for each aspect were grouped together to form a game-evaluation tool known as the PEGS tool. The next section presents an overview of the PEGS tool.

4.3 The PEGS Tool

To implement the PEGS framework, a tool is needed to action its content. Therefore the researcher subsequently developed a tool using the contents of the PEGS framework. The PEGS tool is a closed-ended 63-item survey to evaluate digital games for developing English reading skills (Appendix B). It is categorised into four sub-scales: pedagogical aspects (P) containing 12 items, educational components (E) with 15 items, game design elements (G) with 18 items, and skills and knowledge (S) consisting of 18 items. A scale from 0 to 4 was used to evaluate game attributes, where 0 represents an attribute missing in the game, while 4 represents an attribute present to the optimum. The present study used the PEGS tool to compare RDDGs on indicators given in the subscales. Scores from each subscale were summed up and compared to decide which game could be balanced and effective for developing reading skills. The game scoring highest on most indicators within subscales (Section 4.5) was deployed in Phase 2 of the research. The next section presents the validity and reliability of the PEGS tool.

4.4 Determining the Validity and Reliability of the PEGS Tool

Validity refers to how suitable an instrument is for measuring the intended variables (Lynn, 1986). The present study established validity of the PEGS tool by measuring the content validity, which is a type of construct validity that refers to how well an instrument measures what it is intended to measure (Field, 2018). Initially, 97 items were adapted from the literature for the PEGS tool, which were subsequently scrutinised for suitability by the expert panel. The panel of seven field experts evaluated the PEGS tool using a rating scale of 1 to 4 (1= not applicable; 2= somewhat applicable, 3 = applicable, and 4 = highly applicable) on the indicators of relevance, clarity and meaningfulness. The field experts were professionals, including one assistant professor in game design and development, two game developers, one graphic designer, and three English language teachers, each with more than five years of experience.

An item-level content validity index (I-CVI) (Lynn, 1986) was calculated by averaging the experts' ratings on the items. According to Halek et al. (2017); Polit and Beck (2006), the value of I-CVI should not be less than 0.85 for a valid instrument. Therefore, the items with I-CVI value of 0.85 or above were retained whilst the remaining items were removed from the tool. The revised PEGS tool consisted of 63-items (Appendix B). Other measures of calculating the validity of an instrument may include the Exploratory Factor Analysis (EFA), which requires four times of sample size in relation to items included in the instrument (Hogarty et al., 2005). Accessing a very large sample from the target population was beyond the scope of this study; therefore, exploratory factor analysis was not performed for this study. Also, Field (2009, p. 12) states that ' to be valid, the instrument must first be reliable'; therefore, the reliability of the PEGS tool was calculated to a greater extent.

The reliability of an instrument is defined as the consistency or precision of measurement over a period of time (Benson & Clark, 1982). The reliability of the PEGS tool was calculated using three methods: (1) test-retest design with a 3-week interval between the measurements; (2) Cronbach α, the internal consistency of the responses for the entire scale and inherent sub-scales; and (3) inter-rater reliability to determine the consistency of responses from different raters. The following subsections present the reliability findings of test-retest, internal consistency, and inter-rater reliability of the PEGS tool.

4.4.1 *Test-Retest Reliability*

Test-retest reliability measure confirms an instrument's stability when tested on the same population at two different times and reflects the confidence given to the observed score on an attribute as reflecting the researcher's knowledge, attitude and skills. Seven initially selected games were evaluated using the PEGS tool for test-retest reliability. The process of game selection was described in Section 3.11.2. The seven selected games were: Feed the Monster, Sound to Words, Starfall Learn to Read, Teach your Monster to Read, Graphogame UK, Oxford Phonics World, and Read with Phonics

After three weeks, the games were re-tested by the researcher. Data were analysed and found to have a linear relationship between test and re-test scores (variables) with no outliers. Moreover, test and re-test scores were normally distributed. Shapiro-Wilk test confirmed the normality of test and re-test data (for test scores: p = 0.739; for consistency, re-test score: p= 0.990 at p > .05). Hence, the data were deemed suitable for applying the Pearson Product Moment (PPM) correlation test that estimates stability to predict an instrument's future behaviour. Generally, the reliability coefficient ranges between zero and one, where the difference between the observed reliability coefficient and

1.00 is attributed to marginal error. A Pearson correlation coefficient higher than 0.6 implies a stable instrument (Benson & Clark, 1982; Field, 2009). Pearson Product Moment correlation (r) was 0.792 at $p < 0.05$, suggesting a strong and positive correlation between test and re-test scores administered at two different times. Therefore, it implies that the PEGS tool is a stable instrument, which generated 79.2% strong positive correlations in the given data set, whereas 20.8% correlations occurred due to random errors.

4.4.2 *Inter-Rater Reliability*

Inter-rater reliability (IRR) is calculated when two or more people rate the same variables under similar conditions. IRR of the PEGS tool was calculated using mixed-methods to estimate the consistency of responses from multiple raters in evaluating the games. The first subsection presents the quantitative estimates of inter-rater reliability, followed by the next subsection presenting qualitative findings regarding variances in multiple raters' responses on a few items of the PEGS tool. The qualitative analysis provides an insight into the issues that led to the response error and differences in opinions between multiple raters.

Quantitative Estimates of Inter-Rater Reliability

The quantitative methods provided an estimate of agreement between multiple raters' independent responses using the PEGS tool to evaluate the games, whereas the qualitative analysis highlighted the potential disagreements on some of the responses while assessing games. The statistical measure of inter-rater reliability is the intra-class correlation coefficient (ICC) which represents the degree of agreement between multiple raters on the same items of the tool. The present study purposefully selected thirteen raters comprising of English language teachers, graphic designers, and game developers who evaluated English reading skills development games using the PEGS tool (Table 4.6)

Table 4.6

A Summary of Designations/roles of Recruited Raters (Phase 1)

	Designations/roles of recruited raters
Rater 1	Graphic designer
Rater 2	Graphic designer
Rater 3	Game developer
Rater 4	Game developer
Rater 5	Game developer
Rater 6	Teacher
Rater 7	Teacher
Rater 8	Graphic designer
Rater 9	Graphic designer
Rater 10	Game developer
Rater 11	Teacher
Rater 12	Teacher
Rater13	Teacher

The raters were given the two best games initially selected by the researcher using the same PEGS tool: Teach your monster learning to read (TYMTR), and Graphogame UK (GGUK) . The assumption of homogeneity of variance was tested as a prerequisite before estimating the ICC. Levene's test was conducted on each rater's evaluation of the two games. The test results revealed the equality of variance across 85% of raters for evaluating the two games. Table 4.7 shows that variances for Rater 5 and Rater 6 were not homogeneous since the significance, $p < 0.05$, but for the remaining eleven raters, the variance was homogeneous as the significance for F values is greater than 0.05 ($p > 0.05$). Therefore, it can be assumed that variances for the majority of raters were homogeneous, which allowed the estimation of intra-class correlation coefficient with confidence.

Table 4.7

Homogeneity of Variance of Multiple Raters in Evaluating Two Reading Games

	Levene Statistic (*F*)	df1	df2	Sig.
Rater 1	0.015	1	124	0.902
Rater 2	0.030	1	124	0.862
Rater 3	2.906	1	124	0.091
Rater 4	1.874	1	124	0.174
Rater 5	21.769	1	124	0.000
Rater 6	21.206	1	124	0.000
Rater 7	3.165	1	124	0.078
Rater 8	0.002	1	124	0.963
Rater 9	0.285	1	124	0.594
Rater 10	3.066	1	124	0.082
Rater 11	2.074	1	124	0.152
Rater 12	0.343	1	124	0.559
Rater 13	0.330	1	124	0.567

df = degrees of freedom, *F* =Statistic for Levene's test; *p* = significance at 0.05

Intra-class correlation (ICC) coefficient with a two-way mixed model with fully crossed design, consistency, and average measures as variants was used to estimate the agreement between each rater's responses evaluating the games using the PEGS tool. The inter-rater reliability result of the PEGS tool for the first best game (Teach your Monster game) was ICC = 0.834 [CI = 0.767, 0.889] and the second-best game (Graphogame UK) was ICC = 0.843 [CI = 0.779, 0.894] at 95% of confidence interval ($p < 0.05$). ICC values above 0.8 indicate that more than 80% of the observed variance is due to similarity in ratings between multiple raters, and less than 20% is due to error or difference in ratings.

Qualitative findings of disagreement between multiple raters

There is a paucity of information in earlier research on the reasons for disagreement between raters in IRR and how it can be resolved (Ashton, 2000; Lombard et al., 2002). The present study conducted a qualitative analysis to gain insights into variances in responses from multiple raters and arrive at a consensus decision on rating the games. In pairs or small groups, raters discussed their responses to each question of the PEGS tool. If they had a difference in opinion against a specific question, they discussed the response and agreed on a unanimous rating. The differences in opinions from multiple raters were categorised into four key themes: lack of focus and concentration, limited game exposure, lack of knowledge, and difference in perception. The following subsections present themes starting from the most recurring theme first.

Lack of focus and concentration

The most recurring theme that emerged from the data was lack of focus and concentration whilst evaluating games using the PEGS tool. Raters having higher ratings on questions had played the game to the optimum and seemed familiar with the game functions instead of the others who did not either play the game entirely or lost focus due to other reasons. Raters repeatedly admitted their lack of focus while evaluating games, which is exemplified in the following conversation extract:

Rater 3	I have scored it as a four
Rater 1	I also have scored it as a four
Rater 2	Let's see what have I scored it at?… I have scored it at zero… but, I don't know why I scored it at zero
Rater 3	Why have you scored it at zero? There wasn't any advertisement in the game… it was totally an advertisement-free game
Rater 2	I don't know what I was thinking... Let's agree with what you guys have scored it for.

In the above examples, it appeared that participants who did not play the complete game agreed with the scores suggested by their partners. Similarly, if the participants overlooked an aspect of the game, they agreed with other people's responses. Another interesting finding of lacking focus was due to boredom or fatigue. In the present study, the length of the questionnaire and continuous thought process for a sustained amount of time might have caused fatigue, thus affecting the quality of responses, as evident from the following conversations:

Rater 3	I have scored this at three
Rater 2	Mine is two
Rater 1	Mine is zero...
Rater 2	So, we have a lot of variance in this one.
Rater 3	I gave it a three because I think I was able to develop a new skill. Especially in the duck game… initially, I was taking ducks one by one to the pond, but later I realised that I could take them altogether. I, therefore, learned a new skill of how to drag all the ducks to the pond together

Rater 2	when was the duck game...? I can't remember playing it
Rater 1	hahaha
Rater 3	don't tell me!...hahaha, we are at the last question of the instrument, and you have already forgotten about the game
Rater 2	hahaha... totally have forgotten about it
Rater 3	you have such a short-term memory
Rater 2	I have a headache now.... So, what are we deciding about the score?
Rater 3	Let's score it at three
Rater 1:	Agreed, let's score it as three. I think I have overlooked this one earlier.

These findings accord with earlier studies concerning response error in inter-rater reliability. Rousson et al. (2002) attributed human error in inter-rater reliability to the fatigue effect, negatively influencing the decision-making due to prolonged exposure to the task. In another instance, during the present study, one of the raters volunteered to play the game again to get a confirmation of the rating score rather than just agreeing with the other participants. This shows the 'learning effect' of participation in reliability testing, resulting in a more accurate rating because the participant was engaged in deeper thinking to justify their decisions (LeBoeuf & Shafir, 2003), as shown in the following conversation:

Rater 9	I have rated it at four as there were no in-app purchases.
Rater 10	I have given it a zero
Rater 9	Did you see any in-app purchases?
Rater 10	Yes, I have seen it… Where it asks you to buy hats or something like that
Rater 9	But those were the rewards not the in-app purchases… I haven't seen any in-app purchases in the game, but I have collected all the gifts like hats, glasses, scarves, etc.
Rater 10	Ok let me check in the game then...
	[after playing the game again]
Rater 10	Ok, you are right... Let's make it four then.

Other reasons for response errors that were categorised under the theme of lack of focus were limited game understanding due to unfamiliarity with the game. Armstrong et al. (1997) purport that even if there is a large agreement between raters on key indicators of an instrument, some variance is inevitable due to the diversity of raters in terms of their knowledge, experience, cultural background and worldviews. In the present study, not all raters possessed knowledge of the disciplines included in the tool, which could have led to losing concentration while playing games resulting in random responses on game evaluation.

In the present study, the raters were given appropriate time to play and become familiar with the game before participating in the survey. However, data portrayed that not all raters played the complete game, as evident from the following conversations:

Rater 3	I have given it a four. what is yours?
Rater 2	Yours is four, mine is three, Umm
Rater 1	I have put it at zero as I was not sure… but yes, I think it was the rocket game... but anyway I was not sure, coz I didn't play the whole game, so I scored it at zero.
Rater 2	Let's make it four then, as there were activities of building something

In another example, the rater got muddled up between the two games that they played for evaluation and admitted a lack of familiarity with the game:

Rater 2	I have scored it at four…
Rater 3	I have scored it at zero
Rater 1	I also have scored it at zero…
Rater 2	but the game could be started from any point
Rater 3	No, it wasn't in this game… We had to make three characters in order to start the game from different instances...
Rater 1	There was no such functionality of starting the game from any point...
Rater 2	Ok, then I must have muddled it up with the other game. I didn't play it fully. Let's score it at zero then

One of the participants reported that she did not invest enough time playing the game and hence could not justify her ratings during the paired discussion. In another instance, the participants admitted that they relied on the game information link instead of exploring the game fully to know what learning components were included. Participants who played the game well reasoned with examples to justify their responses as opposed to the participants who were not fully aware of game functionalities. The results comply with earlier studies (e.g.Belur et al., 2018), suggesting that lengthy questionnaires could be more prone to human error due to fatigue and distraction.

Limited game exposure

The second recurring theme emerging from the data was raters' limited exposure to the games. The reasons for limited game exposure may be attributed to their attitude towards games, time constrictions, lack of game understanding, or inability to play the game fully (Molin, 2017). The variances in responses suggest that some participants had not played all the game levels. Such participants assumed that specific options might appear later in the game; hence, their ratings were primarily based on assumptions, resulting in a random error in the tool's reliability measurements. For example, instead of playing the complete game, some participants used the help section of the game to find what higher game levels would constitute. Following are example extracts showing limited exposure of the participants to the games:

Rater 9	I have scored it at two
Rater 10	I have scored it at three
Rater 9	Let's mark it at three because I did not play the complete game.
Rater 9	What level did you play the game up to?
Rater 10	I played till the ducks and then the rocket level… I guess, I have played more or less all the levels, But I played the game when I was installing these on the tablets a few weeks ago.
Rater 9	So does it covers the compound words? ... I just played until the first level, with single letter sounds
Rater 10	I think yes, the game includes compound words.
Rater 9	Ok, so for the next two questions, I have rated them at four.

This implies that, to some extent, participants relied on guessing techniques to rate the questionnaire items. These results are consistent with Belur et al. (2018), showing that participants interpreted questionnaire items based on their domain knowledge, background, and research experience. These results may have implications for selecting participants to conduct inter-rater reliability testing, as there is a chance of greater response error if participants do not possess sufficient knowledge and understanding of the nature of reliability testing.

In the present study, some participants appeared to have a positive attitude towards providing truthful responses for the tool evaluation. They put extra effort into finding and verifying information from the game website. On the contrary, some participants relied on guesswork and assumed that game functionalities, as asked in the questionnaire, may appear later or perhaps are absent from the game. Below is an example of such a conversation:

Rater 2	I have scored it at two as I was not 100% sure of it
Rater 3	No, the game provided access to free technical upgrades… it was mentioned on the website, although the game itself was not free.
Rater 1	I was not sure on this question, so I put zero on it
Rater 2	Let's score it at four as [Rater 3] says that she has confirmed it from the game website.

It is also evident from the above example that the participant who scored the game component at the lowest level agreed with other members' decisions without confirming the facts from the game. This implies that the participant may not be confident in their decisions on ratings, which could be due to a lack of familiarity with the game. The more they will play, the more familiar they will become with the game and gain greater confidence to use pedagogically balanced games as teaching tools (Molin, 2017).

Lack of knowledge

The third major theme that emerged from the data set was lack of knowledge, which may be related to pedagogical considerations, reading components, game design aspects, or knowledge or skills acquired through games. It is important to note that raters consisted of teachers, graphic designers, and game developers who were specialists in their individual domains but might possess limited knowledge of each other's domains. Some raters were not familiar with aspects of reading, such as chunking of text or contractions, which is evident from the following best example:

Rater 2	Timed practice was missing
Rater 3	*You have score it at two and I at zero*
Rater 2	What have you scored at…[Rater1]?
Rater 1	*four… Again, I looked at the help screen and assumed it would cover chunked text… Also, I was not sure what chunked text means*
Rater 2	*There were only some chunking of text included in the game... so let's score it at two.*

These findings comply with qualitative inter-rater reliability analysis (Campbell et al., 2013), suggesting expertise or lack of domain knowledge is one of the reasons of response bias in surveys. In the present study, the responses of graphic designers or game developers on questions related to game design elements were consistent across the survey compared to teachers with a greater variance in responses to such questions. Following conversations depict that graphic designers and developers were better able to assess game design elements in more detail, utilising their technical knowledge related to the field compared to teachers with limited gaming experience.

Rater 2	This is a question on levels and flows… What's your score?
Rater 3	Mine is three
Rater 2	What have I given…?
Rater 3	yours is four
Rater 2	four…. What's yours?
Rater 1:	1... Because, I couldn't find as such progression in it...and also I wasn't too sure
Rater 2	Levels and flows were fantastic in this game
Rater 3	I also like the levels and flow of the game... Let's score it at three then.

In another instance, it was interesting to notice the variance of responses from a teacher's and game developer's perspectives:

Rater 9	I have given it a three
Rater 10	I have scored at four
Rater 9	I found the instruction for rocket game difficult… I had to figure out myself what to do, the instructions were not very clear
Rater 10	It is the rule of the games to not provide direct instructions to solve a problem… the focus is to give player a hint or idea how to solve it without directly telling them how to solve... This builds problem solving skills and pose challenge for the player. So I guess, 4 is the right score for this one.
Rater 9	Ok, agreed

As per their expertise, both participants in the present study used different lenses to rate the question. The question was about the use of instructions within the game. The teacher was oriented to have clear instructions to do a task, whereas the game developer was concerned with the game mechanics used to embed the instruction within the game that would present an appropriate challenge and problem-solving skills for players yet maintain the entertainment aspect in the game. Both the participants individually rated the questions according to their beliefs shaped by their expertise, which raised an issue of response bias in the survey. Campbell et al. (2013) indicated that raters' behaviours due to differences in experience and knowledge could lead to response errors in inter-rater reliability testing. The raters with low status or expertise potentially agree with the opinions of raters with high status or experience due to intimidation or lack of confidence. In the present study, the PEGS tool embedded knowledge of multiple domains; the agreement with other raters' opinions could result from a lack of expertise in a particular domain. However, the paired discussion allowed them to share their justification of responses and let them agree upon a score that would genuinely represent the game's attributes. The conversations reveal that participants accepted their lack of knowledge about a particular area and admitted to selecting the most appropriate score per se. LeBoeuf and Shafir (2003) suggest that sometimes, shallow knowledge of raters may lead to overthinking, which could negatively influence the quality of decision-making, thus leading to response errors in IRR surveys.

Difference in Perception

The fourth recurring theme causing a variance in responses was the difference in the perception of participants. This may be due to their prior experience, cognitive abilities, and exposure to game playing. The following conversation best exemplifies this:

Rater 3	I scored it at four… What have you given to this question?
Rater 1	I have scored it at 1… because I think the rules were not very clear in some game levels, such as the rocket one… I had difficulty figuring it out as what to do.
Rater 2	I think the game rules were clear and organised...
Rater 3	I also found the rules fairly simple and easy to understand
Rater 1	I think for kids, it may be difficult to understand...
Rater 2	Ok, then let's decide 3 for this one.

The variance in responses in the above conversation occurred due to disparity in participants' perceptions. Teachers were prone to evaluate games from a pedagogical perspective, graphic designers from the design, user-friendliness and aesthetics perspective, whereas game developers were keen to analyse the game mechanics used to embed learning within the game. These findings highlight the difference in perception described as the "framing effect" by LeBoeuf and Shafir (2003), suggesting that disparity in raters' contexts, expertise and background may cause a response error in IRR studies.

From a graphic designer's perspective, visualisation through pictures could help to improve the vocabulary, whereas teachers purport that word meanings should be explicitly explained or used in any other form, such as making sentences to improve vocabulary. Similarly, participants who were more familiar with the game mechanics rated game rules higher than those who did not possess specialist knowledge of game mechanics. Hence, it is reasonable to infer that individual perceptions influenced by prior experience and cognitive accessibility were the cause of response bias which aligns with Armstrong et al. (1997) that even if there are broad agreements between raters, they "packaged" concepts differently depending upon their preconceived ideas, background knowledge and worldviews. This implies that the way raters frame and package the game activity concerning the question asked on the questionnaire would influence their decision-making.

The qualitative results in this section highlight the subjective nature of the decision-making of individual raters. Triangulating quantitative and qualitative findings for reliability in this section suggests that the PEGS tool demonstrated high interrater reliability of more than 80% with only less than 20% response error, which may be attributed to attitudes, perceptions or knowledge of the raters.

4.4.3 *Internal Consistency*

Internal consistency is related to the inter-connectedness of items in an instrument and describes the extent to which all the items measure the same concept. Cronbach's alpha (α) determines the internal consistency expressed as a value between zero and one. Generally, an alpha value above 0.7 is considered good; substantially lower values indicate an unreliable instrument (Nunnally, 1978). However, lower thresholds may also be acceptable, considering the instrument's nature and diversity of constructs (Kline, 1994; Nunnally, 1978). The results of Cronbach's α for the overall PEGS tool and its sub-scales are presented in Table 4.8. An overall Cronbach's α = .958 represents the high internal consistency of the overall PEGS tool. The subscales also present good internal consistency as all the Cronbach's α values are above 0.7 (Table 4.8).

Table 4.8

Internal Consistency Coefficients (Cronbach's α) of the PEGS Tool

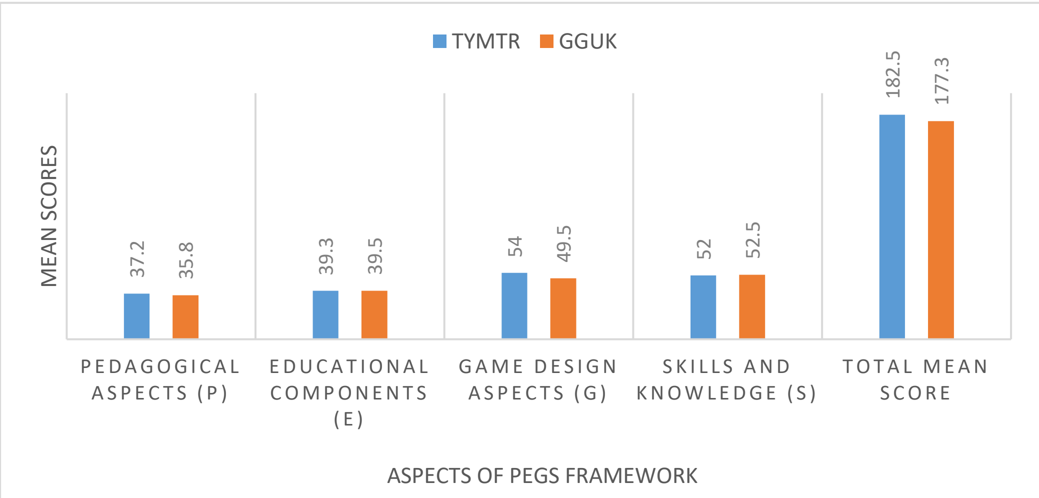
		Cronbach's alpha (α)	No. of Items
	PEGS tool Overall	0.958	63
Sub-scales	Pedagogical aspects	0.746	12
	English reading components	0.924	15
	Game design aspects	0.782	18
	Skills and knowledge	0.877	18

4.5 Game Selection - Comparison Between Games for Developing Reading Skills in English

This section compares the two reading development games selected by the researcher using the PEGS tool: Teach your monster learning to read (TYMTR) and Graphogame UK (GGUK). During Phase 1 of the study, these two games were evaluated using the PEGS tool by thirteen raters upon the aspects of the PEGS framework, i.e. pedagogical aspects, educational components (English reading components), game design aspects, and skills and knowledge. A mean score of the raters' agreed responses was calculated for each aspect, which was then analysed using descriptive statistics. Figure 4.4 presents a comparison of the two games on different aspects of the PEGS framework. It is apparent from Figure 4.4 that overall, TYMTR scored higher with a mean score of 182.5 compared to GGUK with a mean score of 177.3.

Figure 4.4

Comparison of TYMTR and GGUK on Different Aspects of the PEGS Framework



Comparing individual aspects of the PEGS framework depicts a slight difference between the games, with each game having strength in one aspect over the other (Figure R1 in Appendix R). For example, both the games scored equally well on pedagogical aspects; however, TYMTR game was rated slightly better on the game pedagogy. TYMTR received higher ratings on the learning content embedded in fantasy or a storyline, assessment of prior knowledge, and the instructional strategies that foster higher-order learning, such as learning by exploring, learning by being and learning by building. GGUK has strengths in the links to intended learning outcomes, assessment and feedback strategies, tracking individual performance, active reading strategies, and learning by expressing by presenting in-game activities to an out-of-game audience, such as sharing results with parents. Hence, the analysis of the two games' pedagogical aspects indicated that TYMTR is more focused on the learner with strategies, such as learning by exploring, learning by being and learning by building to generate higher-order thinking. At the same time, GGUK is teacher-focused with strategies to assess students' progress and sharing of results with parents

Similarly, a minimal difference was found in educational components as both the games have similar English reading components present in the game. The GGUK game was rated slightly better with a mean score of 39.5 on education components than TYMTR with a mean score of 39.3 (Figure R2 in Appendix R). This minimal difference did not make one game better than the other in educational components. A detailed analysis of educational components, as presented in Figure R2 in Appendix R indicated that both games had strengths and limitations in the components of reading skills. GGUK indicated slightly higher ratings on some aspects of phonological awareness, reading fluency, and comprehension compared to TYMTR. However, the minor differences in ratings made the TYMTR equally better on the educational components of reading skills.

Comparing two games on game design aspects revealed that TYMTR yielded a higher mean score (M= 54) than GGUK (*M*=49.5). A detailed analysis of game design aspects (Figure R3 in Appendix R) indicated that TYMTR had a better rewards mechanism, adaptability of starting the game from any topic, non-distracting graphics, elements of interactivity and fantasy, in-game instructions, the opportunity for self-paced learning, immersion, and engagement. The strengths of GGUK included more explicit rules to play the game, navigation and technical assistance provided to the game users. Based on this comparison, TYMTR was considered better in game design aspects compared to GGUK.

Comparing two games on skills and knowledge aspects revealed an intense competition where both the games had strengths and limitations. Overall, GGUK (*M*= 52.5) preceded TYMTR (*M*= 52.0) on various indicators of skills and knowledge aspects of the game. However, a detailed analysis of the two games (Figure R4 in Appendix R) indicated both the games included aspects of cognitive, affective and psychomotor skills equally well. GGUK was rated slightly higher on some psychomotor skills indicators, such as enabling players to copy or imitate the performance of a skill, allowing the players to perform certain skills confidently and recognising if these are not performed according to the game standards.

An overall score for each game was acquired by adding up ratings for all the aspects of the PEGS framework. The results showed that TYMTR scored slightly higher than GGUK; however, the difference between the overall scores of the two games was relatively low. Research on the educational value of games (e.g. Hanghøj et al., 2022) shows that games vary in the use of paradigms, underpinned models of learning, and assessment strategies, each providing distinct learning opportunities. However, the educational benefits of games lie in their integration of instructional strategies and game design elements closely aligned with learning objectives (Schrader & McCreery, 2012). The Phase 1 results of the present study show that TYMTR was a better pedagogically designed digital game as it scored higher on the pedagogical and game design aspects of the PEGS tool than GGUK. The GGUK was better from the management of teaching perspective as it focused more on tracking and sharing students' progress with parents and other stakeholders. Secondly, McTigue and Uppstad (2019) indicated that despite better game design elements, GGUK did not elicit a significant effect on students' reading skills. Therefore, in the present study, Teach Your Monster to Read (TYMTR) was selected to be used in the schools during Phase 2 of the research. The next subsection describes the main features of this game.

4.5.1 *The Selected Game for Phase 2: Teach Your Monster to Read*

Teach Your Monster to Read is a series of learning games designed for early reading development (Frail, 2018) available to download from https://www.teachyourmonstertoread.com/. The desktop version of this game is free to download, whereas the mobile version is available at a low cost of less than NZ$10. The game was a collaborative effort of graphic designers and developers of Popleaf Software Development Company and educational consultants from the UK specialising in early literacy development and digital games.

The game started with creating a customised avatar – a monster- linked to an interactive reward system offering a choice of accessories, outfits, or treats to select for the monster every time children complete a certain level in the game. The game has a storyline seamlessly woven throughout the game, changing slightly at each level. The game comprises a series of mini-games divided into three categories based on reading complexity: First steps for children, Fun with words, and Champion readers.

First Steps for Children

This category of games is aimed at children beginning to learn letters and sounds in the English language. The primary aim of this category is to develop children's speed and accuracy of letter recognition. Children work through each grapheme by practising letters and sounds across the series of games included in this category. The games in this category can be progressed over many days as the game world is set in eight islands, each presenting opportunities to practice graphemes with an intriguing storyline and settings. The overall playtime in this category spans over a week if played for 30 minutes for five days a week. Learning goals in this category of games include practising graphemes, blending sounds, decoding, and segmenting CVC (Consonant, Vowel, Consonant) words into their constituent sounds. The game is also complex adaptive as it responds to children's needs. Graphemes which children are struggling most with appear more often in the mini-games, thus providing ample practice opportunities to develop letter recognition skills.

Fun with Words

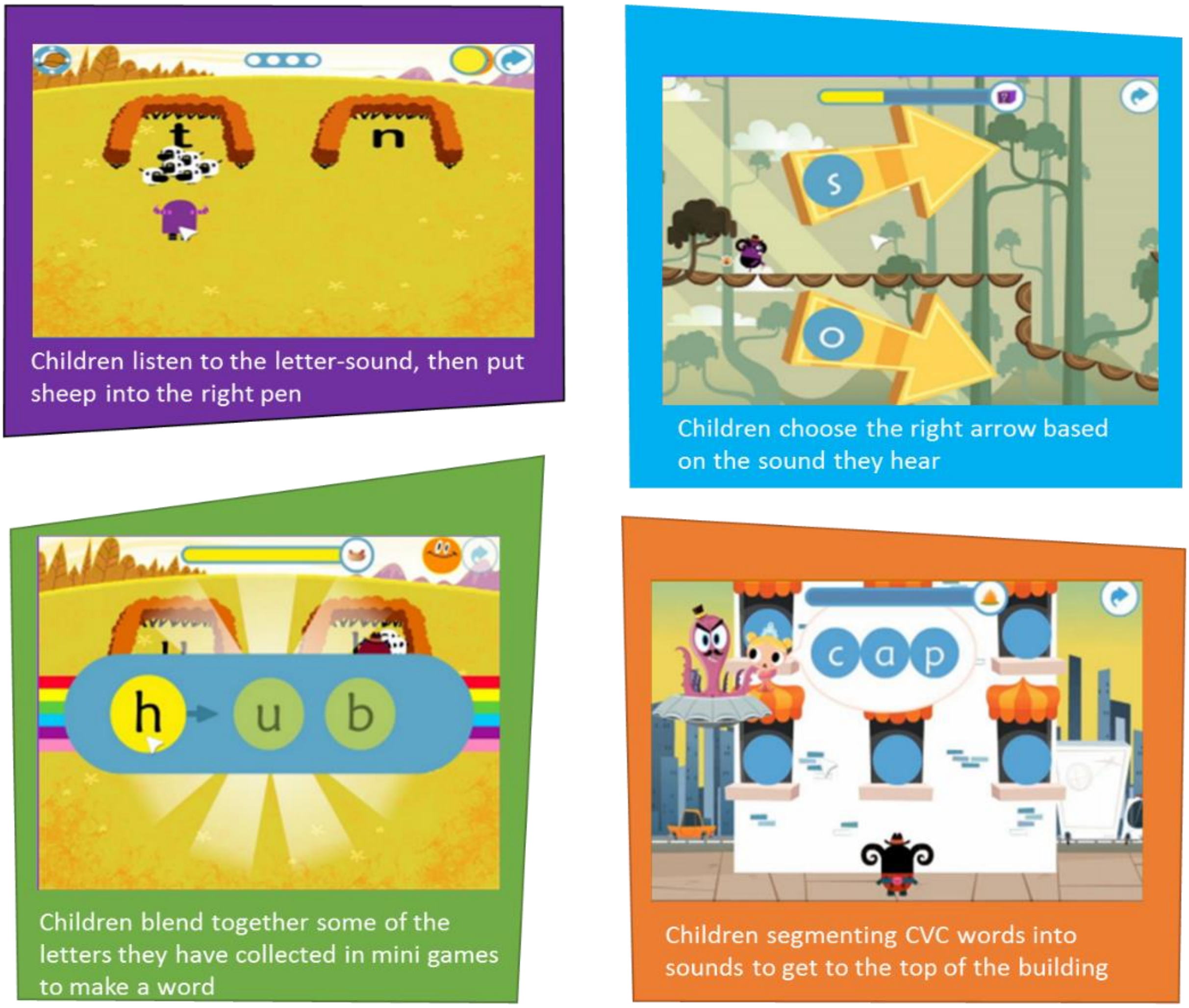
This category acts as a second game level designed for children who have completed Teach Your Monster to Read: First Steps. Series of games included in this category provides opportunities to practice new graphemes and phonemes such as ch, sh, th, ng, ai, ee. igh. oa, oo, ar, or, ur, ow, oi, ear, air, ure, er. It also introduces more blending and segmenting practice with consonants and vowel combinations: CVC, CVCC, CCV and CCVC words and some polysyllabic words. Moreover, reading and comprehension of simple sentences is also included in this category of games. Playtime of games in this category spans over two weeks if played for 30 minutes across five days a week.

Champion Readers

The third category of games is targeted for slightly advanced readers who have grasped good knowledge of graphemes-phonemes covered in previous game categories and who are able to read short sentences. The series of games included in this category provide children opportunities to practise alternative ways of pronouncing graphemes, such as i (pronounced as /*igh*), ch (pronounced as /*k*), y (pronounced as /*ee*), etc. It also provides practising sight words, reading and comprehension of sentences, rhymes, and short stories. Playtime of games in this category span over two weeks if played 30 minutes across five days a week. Figure 4.5 presents examples of game activities in Teach Your Monster to Read game.

Figure 4.5

Example of Game Activities from Teach Your Monster to Read Game



Note. Image taken from *Teach your monster to read: First steps.* By S. Kudev. https://prismic-io.s3.amazonaws.com/tymtr%2F1a1a39f2-2905-4661-b27b-224183007d1d_gameguide_final.pdf Copyright 2022 by the Usborne Foundation

4.6 Summary

This chapter presented data on the process of selecting the most suitable digital game to develop the reading skills of English language learners. Earlier frameworks or game design models (Becker, 2017; Clark et al., 2016; Gunter et al., 2008; Kiili, 2005) embed established and well-studied instructional design theories during the game designing process to foster learning through the engaging and immersive gaming experience. However, the PEGS framework took one step further in providing a tool to evaluate English reading games by linking key reading competencies in well-researched game design and instructional strategies. Most of the previously published game design frameworks do not report on educational content in the games. The PEGS framework was developed to incorporate reading competencies within game design. The PEGS framework aims to weave in essential components of good instructional design, engaging game features, and optimal challenge embedded in an intriguing storyline with achievable goals and outcomes based on the identified educational content. Since the present study aimed to evaluate games for reading development in English as a second language (L2), the framework presented here embeds core components of English reading skills.

The validity and reliability study reported in this chapter provides substantial support for the suitability of the PEGS tool in selecting effective games for reading development. Content validity with an I-CVI of more than 0.85 makes it a useful tool for measuring effective game variables. Three types of reliabilities were estimated. The high correlation coefficients for test-retest reliability suggest that the PEGS tool is stable in evaluating digital games for reading development over time. Inter-rater reliability analysis determined how much of the variance in observed scores of the data set was due to the variance in a true score after subtracting measurement error between multiple raters. IRR values of above 0.8 indicate that more than 80% of the observed variance is due to similarity in ratings between raters, and less than 20% is due to error or difference in ratings. Generally, values of ICC between 0.75 and 1 yield high inter-rater reliability and an excellent degree of agreement between raters (Cicchetti, 1994; Hallgren, 2012). Hence, the PEGS tool demonstrated a very high degree of agreement between multiple raters.

Internal consistency is also critical in establishing the reliability of the tool. The value of Cronbach's α above 0.7 indicates good internal consistency (Field, 2018), which implies that the items in the PEGS tool measure the same attribute they are supposed to measure. The outcome of Phase 1 of the study was selecting an effective reading development game that was distributed in participating campuses of OSCS during the next phase of the research. The next chapter presents the quantitative results gathered during Phase 2 and Phase 3 of the research related to the impact of digital games on developing and retaining reading skills.

CHAPTER 5: PHASE 2 AND PHASE 3 QUANTITATIVE FINDINGS

This chapter reports on the results of EGRA English and EGRA Urdu in relation to the research question: *how does digital game-based learning impact on reading skills development of primary school students of low socioeconomic status?* This chapter presents key findings of quantitative data collected during Phase 2 and Phase 3 of the study. Quantitative data were collected from 288 students belonging to randomly selected campuses of OSC schools using pre and post-tests in Phase 2 and delayed post-tests in Phase 3 of the study. The first three sections (Sections 5.1, 5.2, and 5.3) present the results of English (L2) reading skills. Section 5.1 presents a baseline study reporting on students' existing English (L2) reading skills, followed by section 5.2 analysing the impact of the digital game on developing English (L2) reading skills in Phase 2 of the study. Section 5.3 reports on the retention of English (L2) reading skills after the DGBL intervention in Phase 3 of the study. The next three sections (Sections 5.4, 5.5, and 5.6) report on Urdu (L1) reading skills, beginning with a baseline study of Urdu reading skills in section 5.4, followed by an analysis of the impact of the digital game in improving Urdu reading skills in section 5.5 and later reporting on retention of Urdu reading skills in section 5.6. The chapter concludes with a summary of inferences drawn from quantitative data analysis.

5.1 Baseline Study of Reading Skills in English (L2)

Phase 2 of the study commenced with an EGRA English pre-test to conduct a baseline study to assess students' existing reading skills in the English language (L2). This baseline study compared the means of pre-test scores using one-way analysis of variance (ANOVA) across CG, EG, and CMG students. The null hypothesis developed to compare baseline English reading skills of students belonging to three groups was:

H_{01}*: There is no difference between the English reading skills of students belonging to the control, experiment and comparison groups.*

Consequently, the alternative hypothesis was:

H_{a1}*: There is a statistically significant difference between the English reading skills of students belonging to the control, experiment, and comparison groups.*

The independent variables used in this study were the instructional strategies (e.g. traditional instruction in the CG, DGBL without teacher facilitation in the EG, and DGBL with teacher facilitation in the CMG). The dependent variable was the learning achievement measured through a total score of the EGRA pre-test. The data set was verified to comply with the assumptions for one-way ANOVA (Appendix T). The pre-test scores were normally distributed with no outliers detected through the box plots. However, Levene's test for homogeneity of variance was statistically significant, $F(2, 285) = 14.9$, $p < 0.001$, which violated the assumption of homogeneity of variance. Therefore, it was assumed that the variance of pre-test scores in the three groups was not equal (Appendix T). The violation of homogeneity of variance means that interpretation of standard one-way ANOVA may not be suitable to establish baseline results on English reading skills across the groups. Hence, a modified version of ANOVA, known as one-way Welch ANOVA, was conducted to provide valid results in case of unequal variances. The results of one-way Welch ANOVA are presented in the following subsection.

5.1.1 *One-Way Welch ANOVA*

The descriptive statistics presented in Table 5.1 show that the comparison group scored highest on pre-test EGRA English reading (M= 98.6, SD= 64.2). However, the differences between these results were not statistically significant, one-way Welch's F (2,184.45) = 0.760, $p = 0.469$ ($p > 0.05$) (Table 5.2). This finding indicates a failure to reject the null hypothesis. There was no statistically significant difference between the English reading skills of students belonging to the CG, EG and CMG.

Table 5.1

Descriptive Statistics of Pre-Test EGRA English

					95% CI for Mean	
	n	*M*	*SD*	*SE*	*Lower Bound*	*Upper Bound*
Control Group	96	89.2	54.8	5.6	79.2	100.2
Experiment Group	96	89.6	42.5	4.3	81.1	98.3
Comparison Group	96	98.6	64.2	6.6	85.9	111.9

Note: n = group sample size; M = mean; SD = Standard deviation; SE = Standard error, CI = Confidence interval

Table 5.2

One-Way Welch ANOVA for Pre-Test English Scores

	Statistic[a]	df1	df2	Sig.
Welch	.760	2	184.449	.469 ($p > 0.05$)

Note. [a]. Asymptotically F distributed

Hence, it was concluded that students belonging to the CG, EG, and CMG possessed similar English (L2) reading skills prior to the DGBL intervention. The next section presents the post-test results of English (L2) reading skills in Phase 2 of the research.

5.2 Impact of the Digital Game on Reading Skills in English (L2) in Phase 2

After the baseline study, students were exposed to interventions, as discussed in chapter 3 (Section 3.5.2). Phase 2 of the study utilised EGRA English post-tests to determine the impact of the intervention on reading skills in the English language (L2) of students belonging to the three groups. It was assumed that pre-tests might have a confounding impact on post-test scores. A one-way ANCOVA was conducted to determine the difference between mean scores across groups by keeping the pre-test as a covariate to address the impact of confounding variables.

It was predicted that the digital game would significantly improve students' reading skills compared to traditional methods of teaching reading. The null and alternate hypotheses developed to test this prediction were:

H_{02}: The digital game will have no impact on English reading skills compared to traditional methods of teaching reading when pre-tests are controlled as covariates.

Subsequently, the alternate hypothesis was:

Ha_2: The digital game will have a statistically significant impact on English reading skills compared to traditional methods of teaching reading when pre-tests are controlled as covariates.

5.2.1 *Assumptions for One-Way ANCOVA*

The post-test EGRA (English) data were verified against assumptions to conduct a one-way ANCOVA (Appendix U). The first four assumptions were related to the study design, with the continuous dependent variable (post-test scores) and covariate (pre-test scores); categorical independent variables (CG, EG and CMG); and independence of observations where no participants were common in groups. The remaining six assumptions: (a) linearity of the relationship between the covariate and output variables, (b) homogeneity of regression slopes, (c) normal distribution of dependent variable for each independent variable, (d) homoscedasticity, (e) homogeneity of variance, and (f) no significant outliers, refer to how the data set fits the one-way ANCOVA model and can be tested using SPSS. The data set fulfilled all the assumptions, hence deemed fit to run one-way ANCOVA. Section 5.2.2 presents results of one-way ANCOVA for determining the impact of the digital game on English reading skills by presenting an analysis of descriptive statistics, main results from one-way ANCOVA and related post hoc tests and effect sizes.

5.2.2 *One-Way ANCOVA for English Reading Skills*

The main objective of running one-way ANCOVA was to determine if pre-tests (covariate) predicted the post-test results (dependent variable) and whether there was a statistically significant difference between the mean scores of the CG, EG and CMG. The analysis constituted a comparison of descriptive statistics, the significance of the difference in mean scores using one-way ANCOVA, a post hoc analysis to determine precisely where the differences occurred in the group means, followed by calculating effect size to understand the magnitude of differences in means.

Descriptive Statistics

One-way ANCOVA procedures produce adjusted means representing mean scores for each group after the covariate is controlled. This procedure also impacts the number of cases used for calculating one-way ANCOVA. Descriptive statistics presented in Table 5.3 shows the number of cases included in one-way ANCOVA, original means, standard deviations, adjuted means, and standard errors after controlling for the covariate.

Table 5.3

Descriptive Statistics for Post-Test English (Phase 2) After Controlling for Covariates

		Unadjusted		Adjusted	
Groups	*N*	*M*	*SD*	*M*	*SE*
Control group	92	1.93	0.31	1.94	0.018
Experiment group	96	2.21	0.15	2.20	0.018
Comparison group	91	2.13	0.27	2.24	0.018

Note. The table presents Unadjusted and adjusted means and variability for post-test English scores results with pre-test English scores as covariates (Phase 2). N = number of participants, M = Mean, SD = Standard Deviation, SE = Standard Error, Control group = traditional reading instruction, Experiment group = using digital game without teacher facilitation, Comparison group = using digital game with teacher facilitation.

Originally there were an equal number of cases in each independent group (n=96); however, after controlling for the covariate, the model adjusted the cases for the suitability of data to run a valid analysis. The analysis considered 95.8% of observations from CG (n = 92), 100% observations from EG (n = 96), and 94.8% (n = 91) observations from CMG. Nevertheless, this reduction of cases did not compromise the power analysis of the study, as the sample size was still more than the ideal calculated sample size for this study (Section 3.8.2). After controlling for the covariate, it is evident from the adjusted means in Table 5.3 that the CMG outperformed the EG and the CG students in English reading skills after playing the digital game in Phase 2 of the research.

Next, statistical significance testing was conducted to compare the difference between the adjusted mean scores of the three groups using one-way ANCOVA. The rationale for calculating a statistically significant difference between the mean scores was to determine if the null hypothesis occurred by chance. If the null hypothesis occurred by chance, it would not be rejected, and it would be assumed that there was no difference in the mean scores of the groups. The next section presents the results of one-way ANCOVA.

One-Way ANCOVA Results for English Reading Phase 2

This section reports the main results of one-way ANCOVA, which shows an analysis of post-test results between the three groups (CG, Eg and CMG) whilst controlling for the covariate. Table 5.4 shows a statistically significant impact of covariate (pre-test scores) on dependent variable (post-test scores), $F(1, 275) = 227.7$, p <.001, Partial $\eta^2 = .453$. This means that 45.3 % of unexplained variance in post-test data may be attributed to the presence of the covariate. A statistically significant difference was also found between groups, $F(2, 275) = 80.81$, $p < 0.001$, partial $\eta^2 = 0.370$. According to Cohen's (2013) guidelines, values of Partial η^2 at .453 and .370 attribute to a large effect size.

Table 5.4

Analysis of Covariance for English Reading in Phase 2

		SS	*df*	*MS*	*F*	*p*	*Partial η^2*
Covariance	Pre-test English	6.69	1	6.69	227.7	.000	.453
Between-groups	Contrast	4.75	2	2.373	80.81	.000	.370
Within-groups	Error	8.08	275	.029			

Note. The F tests the effect of group. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.
SS = Sum of squares, df= degree of freedom, MS = Mean square, F= F-statistics, Sig = significance at p = 0.05, Partial η^2 = effect size

Since a statistically significant difference was identified between the groups, the next step was to investigate further to determine where the differences lie. The following section presents the result of a post hoc analysis to find exactly where the significant difference occurred.

Post Hoc Tests

Different post hoc tests may be applied to determine the difference in the groups, such as Bonferroni or Sidak; however, Sidak is less conservative to loss of power associated with Bonferroni corrections (Field, 2018). Hence, the current analysis used the Sidak post hoc test to find which groups differ significantly. Pairwise comparisons in Table 5.5 revealed that post-test English scores were statistically significantly greater in the experiment vs. control group (M_{diff} = 0.255, 95% CI [0.195, 0.316], p< 0.001) and the comparison vs. control group (M_{diff} = 0.296, 95% CI [0.235, 0.357], p < 0.001). There was no statistically significant difference found in post-test English scores of experiment vs. comparison group (M_{diff} = 0.41, 95% CI [-0.019, 0.101], p = 0.282).

Table 5.5

Pairwise Comparisons Between Groups on English Reading in Phase 2

Group (I)	Group (J)	Mean Difference (I-J)	Std. Error	p	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
Control Group	Experiment Group	-.255*	.025	.000*	-.316	-.195
	Comparison Group	-.296*	.025	.000*	-.357	-.235
Experiment Group	Control Group	.255*	.025	.000*	.195	.316
	Comparison Group	-.041	.025	.282	-.101	.019
Comparison Group	Control Group	.296*	.025	.000*	.235	.357
	Experiment Group	.041	.025	.282	-.019	.101

Note.This table compares pairwise differences between independent and dependent variables in English reading in Phase 2; MD = Mean difference; *SE* = Standard Error; *. The mean difference is significant at p = 0.001 using Sidak post hoc test

It is concluded that the EG and the CMG students performed statistically significantly better on EGRA English compared to the CG students. Nevertheless, the CMG outperformed the EG in English reading skills; however, the difference was statistically insignificant. The next step was to determine the magnitude of the significant difference between the groups, calculated using the effect size.

Effect Size

The present study utilised a large sample size; therefore, Pearson r as a measure of effect size to indicate the strength of the bivariate relationship between the groups was considered reasonable compared to Cohen's *d*. The following formula was used to calculate the effect sizes of comparison of English (L2) reading skills between different groups:

$$r = \sqrt{\frac{t^2}{t^2+df}}$$

where t = t-statistic, and *df* = degree of freedom.

According to Cohen (2013), a value of r that varies between 0.1 and 0.3 is considered as low, medium if r varies from around 0.3 to 0.5, and large if r ranges between 0.5 and 1.0. Table 5.6 compares the CG, EG and CMG on English (L2) reading skills in Phase 2.

Table 5.6

Effect Size of Pairwise Comparisons Between Groups on English (L2) Reading in Phase 2

Contrasts	*t*	*df*	*r*
Control vs. Experiment	-7.78	275	0.42
Control vs. Comparison	-11.692	275	0.57
Experiment vs. Comparison	-1.628	275	0.09

T = t-statistic; df == degrees of freedom; r = Pearson correlation coefficient

A comparison of effect sizes in Table 5.6 indicates a medium effect size between the CG and the EG (*r* = 0.42) and a large effect size between the CG and the CMG (*r* = 0.57), as they range between 0.4 and 0.6. However, the effect size between the CMG and EG is fairly small (*r* = 0.09).

The analysis from the overall section reveals that the pre-test scores as covariates were significantly related to the post-test scores. After controlling the covariates, the CMG and the EG students performed significantly better than the CG students, while the difference in reading skills between CMG and EG were insignificant. The next section compares the post-test results of English reading with the baseline results established earlier in Section 5.1.

5.2.3 *Pre- and Post-Test Comparison of English Reading Components*

This section compares the components of English reading skills: phonemic awareness, word decoding, word recognition, oral fluency, and comprehension reading between CG, EG, and CMG before and after the intervention. Pairwise statistical analysis was used to compare actual means of reading components on pre-and post-tests across groups and investigated the statistically significant difference between pre-and-post-test of reading components. Effect sizes were also calculated using Pearson *r* to assess the magnitude of the difference in reading skills across groups.

Phonemic Awareness

Phonemic awareness was measured through letter-sound reading using EGRA English. Table 5.7 shows that the three groups improved statistically significantly in phonemic awareness after being exposed to their planned reading instruction. However, the control group (M_{diff} = 9.4, SE = 1.7, t (95) = 5.4, p < .001, r = 0.48) showed minimal improvement in phonological awareness of reading skills as compared to the experiment group (M_{diff} = 36.2, SE = 2.0, t (95) = 7.8, p < .001, r = 0.62) and comparison group (M_{diff} = 33.7, SE = t (95) = 13.1, p < .001, r = 0.80).

Table 5.7

Pre and Post-Test Comparison of Phonemic Awareness in English Reading (Phase 2)

	Pre-LSS			Post-LSS		Mean Difference			t	Sig	Effect size
	n	*M*	*SD*	*M*	*SD*	M_{diff}	*SD*	*SE*	*t*	*p*	r
Control Group	96	15.2	17.3	24.6	18.3	9.4	17.1	1.7	5.4	.000*	0.48
Comparison Group	96	26.9	21.5	60.6	26.1	33.7	25.1	2.6	13.1	.000*	0.80
Experiment Group	96	24.2	14.1	60.4	22.0	36.2	19.9	2.0	7.8	.000*	0.62

Note. LSS= Letter Sound Skills*,* *n*= Group sample size, *M* = Mean; *SD* = Standard deviation; *Mdiff* = Mean difference; *SE* = Standard error; *t* = t-statistics; * *p* is significant at 0.05

Overall, the CMG appeared to outperform both the other groups on phonemic awareness. However, the difference between the EG and CMG is almost negligible and statistically insignificant, with the CMG showing a slight increase compared to the EG, M_{diff} = 0.260, SE = 3.25, t (95) = 0.080, p = 0.936. The EG depicted the greatest improvement (M_{diff} = 36.2, SE = 2.6, t (95) = 7.8, p < .001, r = 0.62) between pre and post-phonemic awareness of EGRA English compared to the other two groups.

Word Decoding

Word decoding was measured through the non-word reading component on EGRA English. Table 5.8 illustrates the comparison between pre-and post-test scores of word decoding skills using EGRA English. Initially, all three groups scored almost the same on pre-test word decoding. However, post-test word decoding results indicates a strong contrast between the statically insignificant improvement in the control group (M_{diff} = 0.2, *SE* = 0.9, t (95) = 0.183, p = 0.855, r = 0.06) with significant improvements made by both the experiment (M_{diff} = 12.9, SE = 1.2 , t (95) = 10.9, p < 0.001, r = 0.75) and comparison groups (M_{diff} = 16.0, SE = 1.1, t (95) = 14.7, p < 0.005, r = 0.83).

Table 5.8

Pre and Post-Test Comparison of Word Decoding in English (Phase2)

		Pre-NWR		Post-NWR		Mean Difference			t	Sig	Efect size
	n	*M*	*SD*	*M*	*SD*	M_{diff}	*SD*	*SE*	*t*	*p*	*r*
Control Group	96	14.7	10.8	15.2	10.7	.48	7.5	0.8	.62	.535	0.06
Comparison Group	96	14.9	12.1	30.9	14.7	16.0	10.7	1.1	14.7	.000*	0.83
Experiment Group	96	14.1	8.6	27.0	10.7	12.9	11.5	1.2	10.9	.000*	0.75

Note. NWR= Non-word reading, *n*= Group sample size, *M* = Mean; *SD* = Standard deviation; *Mdiff* = Mean difference; *SE* = Standard error; *t* = t-statistics; * *p* is significant at 0.05

Hence, it was concluded that the comparison group appeared to outperform both the other groups on word decoding skills. A statistically significant improvement was found in the CMG and the EG compared to the CG. However, the difference between the CMG and the EG was statistically insignificant. This implies that the EG students demonstrated word decoding skills at par with the CMG.

Word Recognition

Word recognition was assessed through familiar word reading using EGRA English. Table 5.9 compares pre-and post-test scores on word recognition skills using EGRA English.

Table 5.9

Pre and Post-Test Comparison Word Recognition Reading in English (Phase 2)

		Pre-FWR		Post-FWR		Mean Difference			t	Sig	Effect size
	n	*M*	*SD*	*M*	*SD*	M_{diff}	*SD*	*SE*	*t*	*p*	*r*
Control Group	96	23.2	16.5	23.4	17.1	0.2	8.37	0.9	.183	.855	0.02
Comparison Group	96	22.6	18.9	34.4	16.3	11.8	12.6	1.3	9.2	.000*	0.68
Experiment Group	96	19.8	14.1	32.6	13.7	12.8	15.4	1.6	8.1	.000*	0.64

Note. *FWR* = Familiar aord reading, *n*= Group sample size, *M* = Mean; *SD* = Standard deviation*;* M_{diff} = Mean difference; *SE* = Standard error; *t* = t-statistics; * *p* is significant at 0.05

Initially, the EG scored slightly lower on the pre-test as compared to the CMG and CG. After the intervention, the CG made a marginal improvement in word recognition skills, M_{diff} = 0.2, SE = 0.9, t (95) = 0.183, p = 0.855. Both the experiment (M_{diff} = 12.8, SE = 1.6, t (95) = 8.1, p < 0.001, r = 0.64) and comparison groups (M_{diff} = 11.8, SE = 1.3, t (95) = 9.2, p < 0.001, r = 0.68) made significant improvement, with the comparison group only slightly outperforming the experiment group. Nevertheless, the experiment group showed slightly greater improvement between pre-and-post word recognition skills compared to the other two groups.

Oral Fluency

Oral fluency was measured using the passage reading component of EGRA English. Table 5.10 and illustrates the comparison of groups between pre- and post-tests on passage reading.

Table 5.10

Pre-and Post-Test Comparison of Oral Fluency in English (Phase 2)

		Pre-PR		Post-PR		Mean Difference			t	Sig	Effect size
	n	*M*	*SD*	*M*	*SD*	M_{diff}	*SD*	*SE*	*t*	*p*	*r*
Control Group	96	34.9	21.8	35.9	22.1	1.03	10.9	1.1	.927	.356	0.09
Comparison Group	96	33.0	26.6	53.4	23.4	20.3	18.5	1.9	10.7	.000*	0.74
Experiment Group	96	30.2	18.0	48.1	19.1	17.9	21.1	2.1	8.3	.000*	0.65

Note. PR = Passage reading, *n*= Group sample size, *M* = Mean; *SD* = Standard deviation; M_{diff} = Mean difference; *SE* = Standard error; *t* = t-statistics; * *p* is significant at 0.05

The control group scored the best on the pre-tests, with the experiment group attaining the lowest score. However, the improvement made by the control group was statistically insignificant (M_{diff} = 1.03 SE = 1.1, t (95) = 0.927, p = 0.356, r = 0.09). The improvement made by the experiment (M_{diff} = 17.9, SE = 12.1, t (95) = 98.3, p < 0.001, r = 0.65) and comparison group on oral fluency (M_{diff} = 20.3 , SE = 1.9, t (95) = 10.7, p < 0.001, r = 0.74) after the intervention were statistically significant. However, the comparison group exceeded the experiment group with a statistically insignificant margin, M_{diff} = 5.2 , SE = 3.2, t (95) = 1.59, p = 0.115, which implies that the experiment group appeared to perform equally well compared to the comparison group on English oral fluency skills.

Comprehension Reading

Table 5.11 presents a comparison of pre-and post-tests on comprehension reading using EGRA English. The comparison group scored the least in the pre-test. The pre-test scores on comprehension reading of the control and experiment groups were greater than the comparison group. After the intervention, the control group (M_{diff} = 0.4, *SE* = 0.91, *t* (95) = 3.7, $p < 0.001$, r = 0.35) made a marginal but statistically significant increase on comprehension reading. On the other hand, both the experiment (M_{diff} = 1.0 , *SE* = 0.1, *t* (95) = 8.3, $p < 0.000$, r = 0.65) and comparison (M_{diff} = 1.9, *SE* = 0.1, *t* (95) = 16.1, $p < 0.001$, r = 0.86) groups made a statistically significant and substantial improvement on post-comprehension reading. The comparison group exceeded the experiment group with a statistically significant difference, M_{diff} = 0.66 , *SE* = 0.15 , *t* (95) = 4.33 , $p < 0.001$.

Table 5.11

Pre-and Post-Test Comparison of Comprehension Reading in English (Phase 2)

		Pre-CR		Post-CR		Mean Difference			t	Sig	Effect size
	n	*M*	*SD*	*M*	*SD*	M_{diff}	*SD*	*SE*	*t*	*p*	*r*
Control Group	96	1.3	.91	1.4	1.0	0.34	0.91	0.1	3.7	.000*	0.35
Comparison Group	96	1.1	1.1	2.8	1.1	1.9	1.1	0.1	16.1	.000*	0.86
Experiment Group	96	1.3	.96	2.3	.96	1.0	1.2	0.1	8.3	.000*	0.65

Note. *CR* = Comprehension reading, *n*= Group sample size, *M* = Mean; *SD* = Standard deviation; M_{diff} = Mean difference; *SE* = Standard error; *t* = t-statistics; * *p* is significant at 0.05

Hence, it can be concluded that overall all groups appeared to show a significant improvement in comprehension skills after the intervention. However, the magnitude of progress in the comparison and the experiment group was substantial compared to the control group.

Total EGRA English Scores

Table 5.12 illustrates the pre-and post-test comparison of total EGRA English scores between control, experiment and comparison groups. All three groups demonstrated a statistically significant improvement in all components of reading skills. However, the experiment (M_{diff} = 80.7, *SE* = 5.4, *t* (95) = 15.0, $p < 0.001$) and the comparison (M_{diff} = 83.6, *SE* = 5.2, *t* (95) = 15.9, $p < 0.001$) groups showed a phenomenal improvement on the total score of EGRA English.

Table 5.12

Pre-and-Post Test Comparison of Total EGRA English (Phase 2)

	Pre-Test EGRA-English			Post-Test EGRA-English		Mean Difference			t	Sig	Effect size
	n	*M*	*SD*	*M*	*SD*	M_{diff}	*SD*	*SE*	*t*	*p*	*r*
Control Group	96	89.2	54.7	100.6	59.7	11.4	29.2	2.9	3.83	.000*	0.37
Comparison Group	96	98.6	64.2	182.3	74.9	83.6	51.3	5.2	15.9	.000*	0.85
Experiment Group	96	89.6	42.5	170.4	53.8	80.7	52.7	5.4	15.0	.000*	0.80

Note: *n*= Group sample size, *M* = Mean; *SD* = Standard deviation; M_{diff} = Mean difference; *SE* = Standard error; *t* = t-statistics; * *p* is significant at 0.05

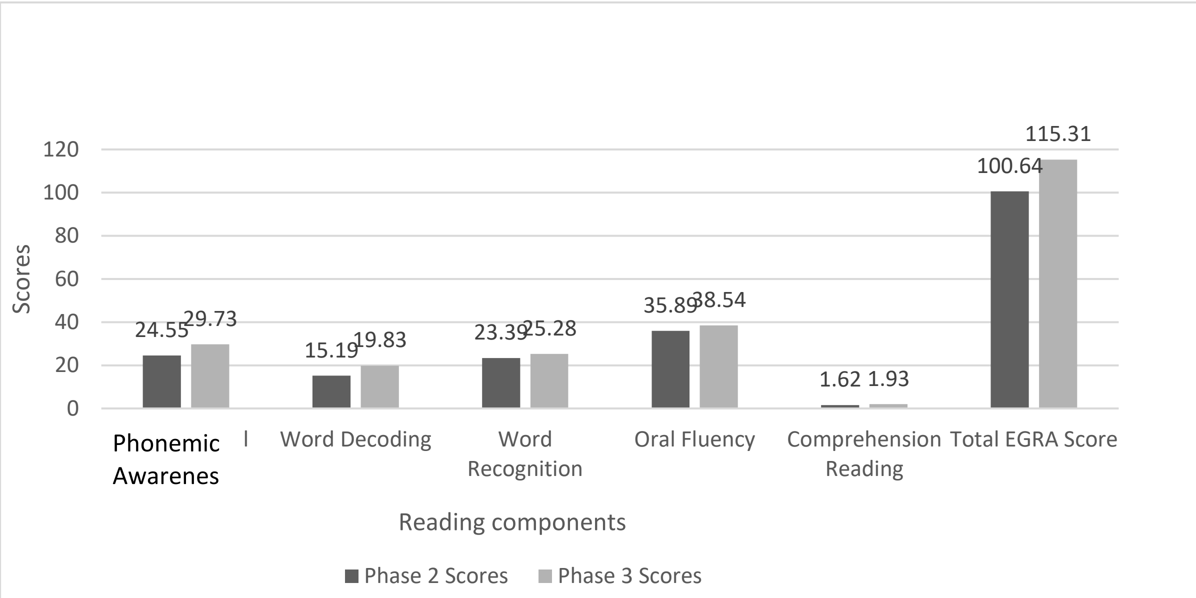
Overall, the comparison group appeared to outperform the other two groups in the post-tests, but the difference in post-tests between the experiment and the comparison group was statistically insignificant (M_{diff} = 11.9, *SE* = 9.3, *t* (95) = 1.28, *p* = 0.203). Hence, it can be concluded that the experiment group performed at par with the comparison group. The next section summarises the results and draws inferences from the statistical analysis for the impact of the digital game on English reading skills

5.2.4 *Inferences for the Impact of the Digital Game on English Reading Skills*

One-way ANCOVA was run to determine the effect of a controlled trial through traditional reading instruction and the use of the digital game with teacher facilitation and without teacher facilitation on post-test English reading skills after controlling for pre-test scores as covariates. There was a linear relationship between pre-and post-test English reading results for each intervention type, as assessed by correlations between pre-and post-test results. Assumptions for running one-way ANCOVA in Appendix U revealed that there was homogeneity of regression slopes as the interaction term was not statistically significant, $F(2, 276) = 1.92$, $p = 0.149$. The Shapiro-Wilk test (p >0.05) showed that standardised residuals for the interventions and overall model were normally distributed. The data demonstrated homoscedasticity and homogeneity of variances, as assessed by visual inspection of scatterplot and Levene's test of homogeneity of variance ($p = 0.085$). The few outliers identified with standardised residuals greater than $\pm$ 3 standard deviations were removed from the data set. After adjustment for pre-test English scores, there was a statistically significant difference in post-test English scores between the interventions, $F(2, 275) = 80.81$, $p < 0.001$, partial $\eta^2 = 0.370$. Post hoc analysis was performed with Sidak adjustment. Post-test English scores were statistically significantly greater in the experiment vs. control group ($M_{\text{diff}} = 0.255$, 95% CI [0.195, 0.316], $p < 0.001$) and the comparison vs. control group ($M_{\text{diff}} = 0.296$, 95% CI [0.235, 0.357], $p < 0.001$). Whereas, there was no statistically significant difference found in post-test English scores of experiment vs. comparison group ($M_{\text{diff}} = 0.41$, 95% CI [-0.019, 0.101], p = 0.282).

Figure 5.1

Distribution of CG Scores on English Reading Components in Phase 2 and Phase 3



Hence, the null hypothesis was rejected. It was inferred that the digital game had a statistically significant and medium to large impact (effect size) on developing English reading skills compared to traditional teaching methods. However, students in the comparison group who were exposed to the digital game with teacher support consistently performed slightly better on all components of English reading skills and on total EGRA English scores compared to the experiment group students who played the digital game without teacher support. However, the differences were not statistically significant. Therefore, it can be inferred that a balanced and pedagogically sound digital game can develop English reading skills without teacher facilitation. These results have implications for self-paced learning for students using balanced and pedagogically sound digital games for reading development. The next section presents an analysis of Phase 3 based on the retention of reading skills in English ten-week after the discontinuation of the intervention.

5.3 Retention of English Reading Skills in Phase 3

This section presents the results of retention of skills on English reading components by comparing Phase 3 delayed post-test EGRA English scores of the CG, EG and CMG with their respective post-test scores of Phase 2. A pairwise statistical analysis was conducted to investigate the difference between Phase 3 and Phase 2 results on reading components using EGRA English. This section begins with a pairwise comparison of within-group results (Sections 5.3.1, 5.3.2, and 5.3.3) followed by between groups analysis in Section 5.3.4.

5.3.1 *Retention of English Reading Skills in the Control Group*

Overall, the CG showed a stable increase in scores across all reading components as well as on total EGRA English results in Phase 3. Figure 5.1 shows a pairwise comparison of mean scores of post-tests and delayed post-tests from Phase 2 and Phase 3 on the components of English reading and the total EGRA Score.

As the control group was receiving additional reading instruction using traditional methods during Phase 2, discontinuation of that treatment did not affect their reading skills, which continued to improve over the period. A pairwise comparison of descriptive statistics of the control group from Phase 2 to Phase 3 is also presented in Table V1 of Appendix V.

A paired sample t-test was used to explore if there was a statistically significant difference between Phase 2 and Phase 3 EGRA scores (Table 5.13).

Table 5.13

Paired Samples t- Test of Control Group on English Reading Skills in Phase 3

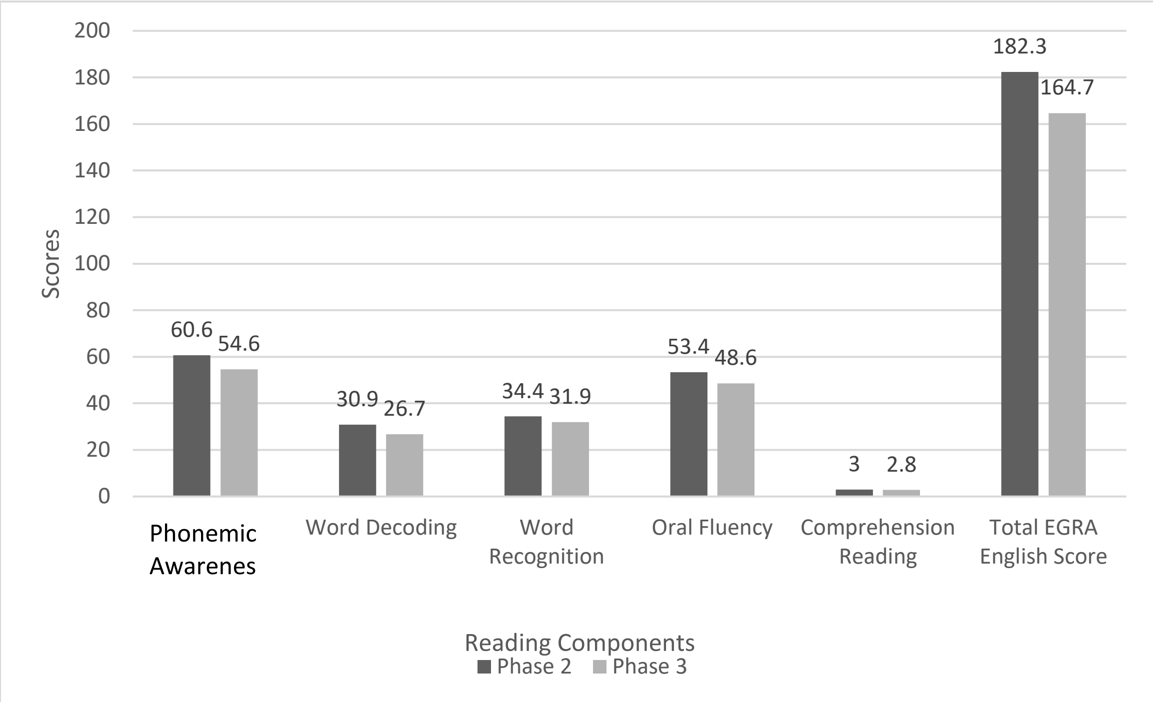
					95% CI of the Difference				
		M	*SD*	*SE*	*Lower*	*Upper*	*t*	*df*	*p*
Pair 1	Phase 3 Phonemic Awareness - Phase 2 Phonemic Awareness	5.2	27.5	2.8	-0.4	10.7	1.8	95	.068
Pair 2	Phase 3 Word Decoding - Phase 2 Word Decoding	4.6	15.3	1.6	1.5	7.7	2.9	95	.004*
Pair 3	Phase 3 Word Recognition - Phase 2 Word Recognition	1.9	21.6	2.2	-2.5	6.3	0.9	95	.391
Pair 4	Phase 3 Oral Fluency - Phase 2 Oral Fluency	2.7	29.9	3.0	-3.4	8.7	0.9	95	.386
Pair 5	Phase 3 Comprehension Reading - Phase 2 Comprehension Reading	0.3	1.5	0.2	.00	0.6	2.0	95	.047*
Pair 6	Phase 3 Total EGRA English Score - Phase 2 Total EGRA English Score	14.7	80.9	8.3	-1.7	31.1	1.8	95	.079

Note. M = Mean; *SD* = Standard deviation; *SE* = Standard error mean; *CI* = Confidence interval; *t* = t-statistics, *df*= degrees of freedom; **p* = Significance at 0.05 confidence level,

Before running the t-test, assumptions were verified to ascertain the suitability of the data set to apply the test. Boxplot investigation revealed only one outlier in the data, which upon further examination, was not of extreme value; hence it was not removed from the data set. The assumption of normality was not violated as the difference of means was normally distributed, as assessed by Normal Q-Q plots using SPSS. The results of the t-test (Table 5.13) showed that the control group scored higher in Phase 3, however, not statistically significantly on phonemic awareness compared to Phase 2 with M_{diff} = 5.2, 95% CI [-0.4, 10.7], $t(95) = 1.8$, $p = 0.068$. Interestingly, word decoding scores in Phase 3 increased statistically significantly from Phase 2 with M_{diff} = 4.6, 95% CI [1.5, 7.7], $t(95) = 2.9$, $p = 0.004$. Word recognition also improved, however, not statistically significantly in Phase 3 with M_{diff} =1.9, 95% CI [-2.5, 6.3], $t(95)$ = 0.9, p = 0.391. Following th

Figure 5.2

Ph*Distribution of CMG Scores on Reading Components in Phases 2 & 3*



ics depicting the mean scores, standard deviation from the mean and standard error for the comparison of means from Phase 3 to Phase 2 are presented in table V3 of Appendix V.

A Paired sample t-test was used to determine whether the decrease in scores was statistically significant. Table 5.15 presents paired sample t-test results calculated using SPSS. Few outliers were detected; however, upon inspection, they were not found to be of extreme threat to the data. Hence, they were kept in the analysis. Differences in means were approximately normally distributed, as assessed by Normal Q-Q plots using SPSS. Paired sample t-tests (Table 5.15) revealed a statistically significant decline in Phase 3 scores on phonemic awareness compared to Phase 2 scores with M_{diff} = -6.0, 95% CI [-11.6, -0.4], $t(95)$ = -2.1 , p = 0.037 ($p < 0.05$). Similarly, a statistically significant decrease in mean scores was observed on word decoding in Phase 3 when compared to Phase 2 with M_{diff} = -4.2, 95% CI [-7.1, -1.3], $t(95)$ = -2.9 , p = 0.005 ($p < 0.05$). A decline in word recognition was also noticed in Phase 3 compared to Phase 2, however it was not statistically significant with M_{diff} = -2.4, 95% CI [-5.7, 0.8], $t(95)$ = -1.5, p = 0.134. Similarly, statistically insignificant decrease in Phase 3 oral fluency scores was observed when compared to respective

Phase 2 scores with M_{diff} = -4.8, 95% CI [-9.7, 0.2], t (95) = -1.9, p = 0.058. On the same pattern, statistically insignificant decrease was noticed on Phase 3 comprehension reading scores when compared to respective Phase 2 scores with M_{diff} = -0.2, 95% CI [-0.4, 0.1], t (95) = -1.3, p = 0.199. The overall score on EGRA English in Phase 3 also dropped statistically significantly from in Phase 2 with M_{diff} = -17.6, 95% CI [-32.2, -2.9], t(95) = -2.4, p = 0.019 (p < 0.05).

Table 5.14

Paired Samples t- Test of CMG on English Reading Skills in Phase 3

					95% CI of the Difference				
		M	*SD*	*SE*	*Lower*	*Upper*	*t*	*df*	*p*
Pair 1	Phase 3 Phonemic Awareness - Phase 2 Phonemic Awareness	-17.6	72.2	7.4	-32.2	-2.9	-2.4	95	.019*
Pair 2	Phase 3 Word Decoding - Phase 2 Word Decoding	-6.0	27.8	2.8	-11.6	-.4	-2.1	95	.037*
Pair 3	Phase 3 Word Recognition - Phase 2 Word Recognition	-4.2	14.4	1.5	-7.1	-1.3	-2.9	95	.005*
Pair 4	Phase 3 Oral Fluency - Phase 2 Oral Fluency	-2.4	15.9	1.6	-5.7	0.8	-1.5	95	.134
Pair 5	Phase 3 Comprehension Reading - Phase 2 Comprehension Reading	-4.8	24.2	2.5	-9.7	0.2	-1.9	95	.058
Pair 6	Phase 3 Total EGRA English Score - Phase 2 Total EGRA English Score	-0.2	1.3	0.1	-0.4	0.1	-1.3	95	.199

Note: *M* = Mean; *SD* = Standard deviation; *SE* = Standard error mean; *CI* = Confidence interval; *t* = t-statistics, *df*= degrees of freedom; *p = Significance at 0.05 confidence level.

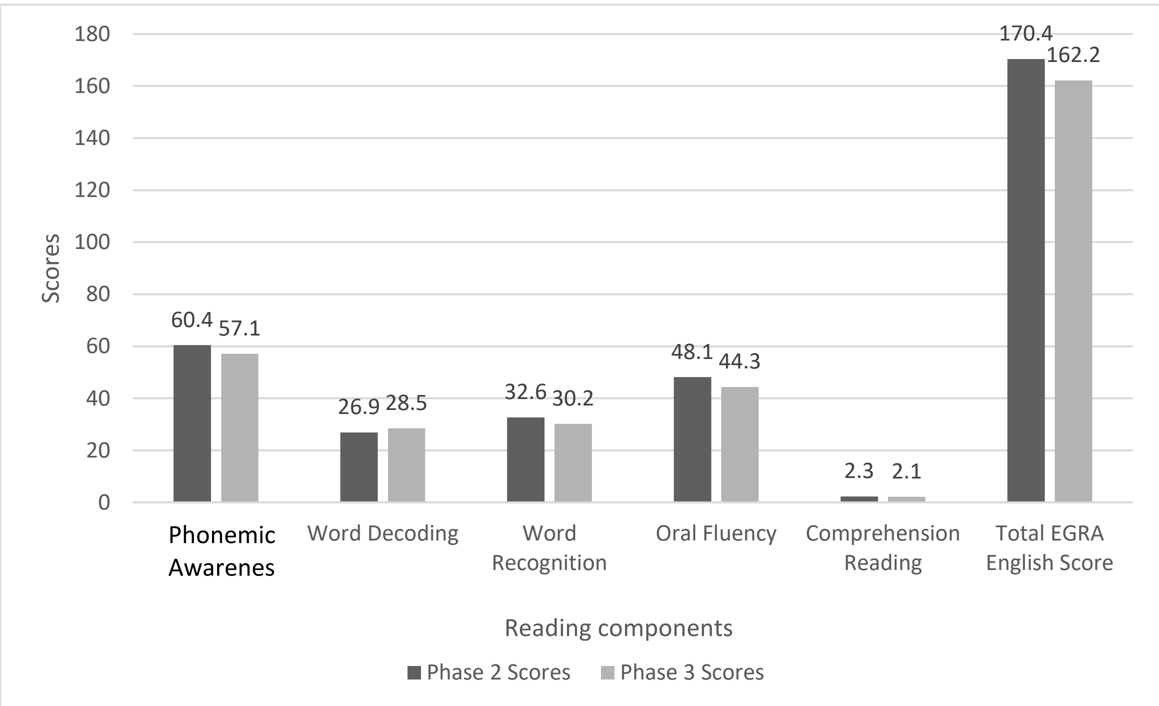
It was concluded that the comparison group suffered a consistent drop in scores on EGRA English results, including all components of reading. There was a statistically significant drop in overall EGRA English results in the comparison group after the use of the digital game was discontinued. A statistically significant decline was observed in phonemic awareness and word decoding skills, whereas the drop in scores in word recognition, oral fluency, and comprehension reading was statistically insignificant. The next section presents a comparison of English reading skills between three groups in Phase 3 of the study.

5.3.3 *Retention of English Reading Skills in Experiment Group*

Overall, the EG presented mixed results with some rises and falls on EGRA English reading components, as depicted by the bar chart in Figure 5.2. phonological awareness, word recognition, oral fluency, and comprehension reading saw a slight decline in scores in Phase 3 when the digital game was discontinued and students were receiving traditional instruction, whereas word decoding skills increased slightly from Phase 2 to Phase 3. Table V2 of Appendix V presents pairwise descriptive statistics of the experiment group on reading components as well as total EGRA English scores.

Figure 5.3

Distribution of EG Scores on Reading Components in Phase 2 and Phase 3



A paired sample t-test was used to determine whether there was a statistically significant difference between Phase 2 and Phase 3 scores on English reading components (Table 5.14). No outliers were detected, and the data were considered to be approximately normally distributed, as assessed by Normal Q-Q plots. Phase 3 scores on phonological awareness faced a slight statistically non-significant decline with M_{diff} = 3.3, 95% CI [-9.8, 3.3], t(95) = -0.099, p = 0.322 compared to Phase 2 scores. As opposed to this, word decoding scores improved statistically non-significantly from Phase

2 to Phase 3 in the experiment group with M_{diff} = 1.5, 95% CI [-1.7, 4.8], $t(95) = 0.948$, $p = 0.345$. Word recognition scores declined, however, statistically insignificantly from Phase 2 to phase 3 with M_{diff} = -2.4, 95% CI [-5.9, 1.2], $t(95) = -1.3$, $p = 0.183$. Oral fluency scores also saw a statistically non-significant drop from Phase 2 to Phase 3 with M_{diff} = -3.9, 95% CI [-9.4, 1.7], $t(95) = -1.3$, $p = 0.174$. Similar statistically insignificant decline in comprehension reading was noticed from Phase 2 to Phase 3 with M_{diff} = -0.3, 95% CI [-0.5, 0.04], $t(95) = -1.7$, $p = 0.095$. The overall reading score on EGRA English in experiment group declined from Phase 2 to Phase 3 with M_{diff} = -8.3, 95% CI [-23.4, 6.9], $t(95) = -1.1$, $p = 0.282$.

Table 5.15

Paired Samples t- Test of EG on English Reading Skills in Phase 3

					95% CI of the Difference				
		M_{diff}	*SD*	*SE*	*Lower*	*Upper*	*t*	*df*	*p*
Pair 1	Phase 3 Phonemic Awareness - Phase 2 Phonemic Awareness	-3.3	32.3	3.3	-9.8	3.3	-.99	95	.322
Pair 2	Phase 3 Word Decoding - Phase 2 Word Decoding	1.5	15.9	1.6	-1.7	4.8	.95	95	.345
Pair 3	Phase 3 Word Recognition - Phase 2 Word Recognition	-2.4	17.6	1.8	-5.9	1.2	-1.3	95	.183
Pair 4	Phase 3 Oral Fluency - Phase 2 Oral Fluency	-3.8	27.5	2.8	-9.4	1.7	-1.4	95	.174
Pair 5	Phase 3 Comprehension Reading - Phase 2 Comprehension Reading	-0.3	1.5	0.1	-0.5	.04	-1.7	95	.095
Pair 6	Phase 3 Total EGRA English Score - Phase 2 Total EGRA English Score	-8.3	74.7	7.6	-23.4	6.9	-1.1	95	0.282

Note: M_{diff} = Mean; *SD* = Standard deviation; *SE* = Standard error mean; *CI* = Confidence interval; *t* = t-statistics, *df*= degrees of freedom; **p* = Significance at 0.05 confidence level.

It was concluded that overall, the experiment group students experienced a slight decline in reading skills after the digital game-based intervention was discontinued. The decline in scores was statistically non-significant on all reading components and the total EGRA English results.

5.3.4 *Comparing Retention of English Reading Skills Across Groups*

This section presents the results of the retention of skills across the CG, EG and CMG in Phase 3 of the study. The percentages of Total EGRA-English scores were calculated for Phase 2 and Phase 3 for all groups to identify any differences between groups on retention of reading skills in Phase 3 of the study. The percentage difference was calculated between Phase 3 and Phase 2 scores to identify the percentage increase or decline in the reading skills (Table 5.16). Figure 5.4 presents the comparison of percentage scores between Phase 2 and phase 3 of the three groups. It also indicates the increase in reading scores in Phase 3 for the CG and the percentage decrease in scores for the EG and the CG in Phase 3 of the study.

Figure 5.4

Comparison of Phase 2 and Phase 3 English reading scores across groups

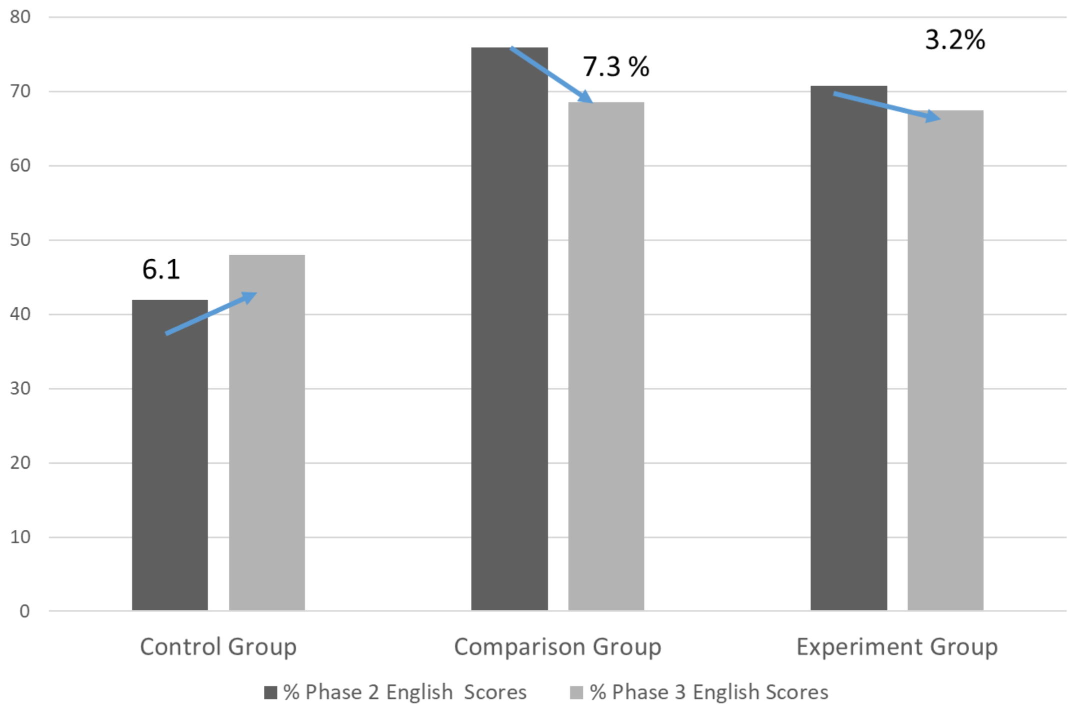


Table 5.16 shows that the CG that followed the traditional instruction continued to improve; however, the percentage of achievement of the control group in phase 2 and Phase 3 was far less

compared to the game groups (EG and CMG). The EG and CMG experienced a drop in reading skills ten weeks after the DGBL was discontinued. The EG students experienced a drop of 3.2 % compared to the CMG students, which experienced a decline of 7.3 % in English reading skills. This implies that the EG students were able to retain their English reading skills better than the CMG students.

Table 5.16

Percentage Comparison of Phases 2 and 3 English Reading Scores Across Groups

Groups	% age score Phase 2 EGRA _English	% age score Phase 3 EGRA _English	% difference in scores (Phase 3 and Phase 2)	Trend
Control group	41.9	48.0	6.1	Increase in reading skills
Comparison group	75.9	68.6	7.3	Decrease in reading skills (Summer slide effect)
Experiment group	70.8	67.5	3.2	Decrease in reading skills (summer slide effect)

It was concluded that although the CMG students performed slightly better on English reading in Phase 3, the drop in English reading skills from Phase 2 to Phase 3 was more than the EG. Therefore, it may be assumed that the EG was able to retain English reading skills better than the CMG after the discontinuation of the DGBL intervention. The next section presents the baseline skills in Urdu (L1) reading examined during Phase 1 of the study.

5.4 Baseline Study of Reading Skills in Urdu (L1)

Phase 2 of the study utilised pre-test EGRA Urdu to establish a baseline for Urdu reading skills (L1) of students belonging to CG. EG and CMG before the digital game-based intervention. The purpose was to compare mean scores of Urdu reading skills across three groups. Therefore, the following null and alternative hypotheses were created to compare means:

H_{03}: There is no difference between the Urdu reading skills of students belonging to control, experiment, and comparison groups.

The subsequent alternative hypothesis was:

H_{a3}: There is a statistically significant difference between the Urdu reading skills of students belonging to control, experiment, and comparison groups.

The independent variable was the instruction method across CG, EG and CMG, whereas the dependent variable was the total score of the EGRA Urdu pre-test. One-way Welch ANOVA was conducted to determine the difference between the Urdu reading skills of students prior to intervention in CG (n=96), EG (n=96), and CMG (n=96). The data set was verified to comply with the assumptions for one-way ANOVA (Appendix X). The pre-test scores were normally distributed, with no outliers detected through the boxplots. However, Levene's test for homogeneity of variance was statistically significant, $F(2,285) = 5.082$, $p = 0.007$ ($p < 0.05$), which implies no homogeneity is variances across groups. Hence, one-way ANOVA was not a suitable test to compare the means. A modified version of ANOVA, known as one-way Welch ANOVA was performed to compare means of populations with unequal variances.

5.4.1 *One-Way Welch ANOVA*

One-way Welch ANOVA was performed to examine the difference between Pre-test EGRA Urdu scores between the CG, CMG and EG students. The descriptive statistics in Table 5.17 presents the mean, standard deviation, standard errors, and confidence intervals of pre-test EGRA Urdu scores achieved by students from the three groups.

Table 5.17

Descriptive Statistics for Pre-Test EGRA Urdu in Phase 2

					95% CI for Mean	
	n	*M*	*SD*	*SE*	*Lower Bound*	*Upper Bound*
Control Group	96	84.7	64.4	6.6	71.7	97.8
Experiment Group	96	83.4	49.2	5.0	73.4	93.4
Comparison Group	96	77.9	62.9	6.4	65.2	90.7

Note. *n* = group sample size; *M* = mean; *SD* = Standard deviation; *SE* = Standard error, *CI* = Confidence interval

The CG took the lead in Urdu reading skills, followed by the EG and then the CMG. Table 5.17 presents pre-test EGRA Urdu scores in order of achievement from the control group to the experiment group to the comparison group. However, the differences between the pre-test Urdu scores was not statistically significant (Table 5.18), one-way Welch's $F(2, 186.9) = 0.320$, $p = 0.727$ ($p > 0.05$). Therefore, there was a failure to reject the null hypothesis, i.e., no significant difference exists between the Urdu reading skills of students belonging to the CG, EG and CMG.

Table 5.18

One-way Welch ANOVA Test for Pre-Test EGRA Urdu in Phase 2

	Statistic[a]	df1	df2	Sig.
Welch	.320	2	186.872	.727 ($p > 0.05$)

Note. [a]. Asymptotically F distributed.

It was concluded that overall, students belonging to the CG, EG and CMG possessed similar Urdu reading skills prior to the intervention. The next section presents the results and analysis of post-test Urdu reading skills in Phase 2 of the study.

5.5 Impact of the Digital Games on Urdu (L1) Reading Skills in Phase 2

After the baseline study, students were exposed to the planned intervention focused on developing English reading as described earlier (Section 3.5). It was assumed that students might be able to transfer reading skills from English (L2) to Urdu (L1) as both are phonetical languages. Therefore, it was predicted that the digital game, although developed for English (L2) reading skills, will significantly impact Urdu (L1) reading skills. After controlling the pre-test scores as covariates, the following null and alternate hypotheses were developed to test the prediction:

H_{04}: The digital game will have no impact on Urdu reading skills compared to traditional methods of teaching reading when pre-tests are controlled as covariates.

Subsequently, the alternate hypothesis was:

H_{a4} : The digital game will have a statistically significant impact on Urdu reading skills compared to traditional methods of teaching reading when pre-tests are controlled as covariates.

5.5.1 *Assumptions for One-Way ANCOVA*

Data were assessed to verify assumptions to apply one-way ANCOVA. The first four assumptions: continuous dependent variable, categorical independent variable, continuous covariate, and independence of observations, were part of the research design and hence were fulfilled. The remaining six assumptions: (a) linearity of the relationship between covariate and output variables, (b) homogeneity of regression slopes, (c) normal distribution of dependent variable for each independent variable, (d) homoscedasticity, (e) homogeneity of variance, and (f) no significant outliers, referred to how the data fitted the one-way ANCOVA model and was tested using SPSS. These assumptions are reported in Appendix Y.

The data set complied with the assumptions and was considered robust to some violations of one-way ANCOVA. Overall, the data set was deemed appropriate to conduct one-way ANCOVA. The next section presents results of one-way ANCOVA for determining the impact of the digital game on Urdu reading skills by analysing descriptive statistics, main results from one-way ANCOVA, post hoc tests and effect sizes.

5.5.2 *One-way ANCOVA for Urdu Reading Skills*

One-way ANCOVA was used to investigate if pre-tests (covariate) had influenced post-test results using EGRA Urdu and whether there was any statistically significant difference between mean scores of the CG, EG and CMG on Urdu reading skills. Descriptive statistics presented an overview of the data set. Table 5.19 shows independent groups, the number of cases included in one-way ANCOVA, unadjusted means and standard deviation before the covariate manipulation, and adjusted means and standard deviation after controlling for the covariate.

Table 5.19

Descriptive Statistics for Post-Test Urdu in Phase 2 After Controlling for Covariates

		Unadjusted		Adjusted	
Groups	*N*	*M*	*SD*	*M*	*SE*
Control group	91	92.9	66.0	85.9	4.4
Comparison group	90	161.4	69.8	158.0	4.4
Experiment group	96	161.2	57.2	160.4	4.4

Note. Unadjusted and adjusted means and variability for post-test Urdu scores results with pre-test Urdu scores as covariates (Phase 2). *N* = number of participants, *M* = Mean, *SD* = Standard Deviation, *SE* = Standard Error, Control group = traditional reading instruction, Experiment group = using digital game without teacher facilitation, Comparison group = using digital game with teacher facilitation.

Originally there was an equal number of cases in each independent group (n=96); however, the covariate model adjusted the cases for suitability of data to run a valid analysis. The analysis considered 94.8% of observations from CG (*n* = 91), 100% observations from EG (*n* = 96), and 93.8% (*n* = 90) observations from CMG. The reduction in sample size was assumed not to compromise the study's power analysis since the selected sample cases were still more than the ideal calculated sample size for this study (Section 3.8.2). After controlling for the covariate, it is evident from Table

5.19 that the EG outperformed the CMG and the CG. The results indicate a difference in Urdu reading skills between the groups. The next step was to identify if the difference is statistically significant.

Table 5.20 presents the main results of one-way ANCOVA, which shows an analysis of post-test results between different groups (CG, EG and CMG) whilst controlling for the covariate. There is a statistically significant impact of covariate (pre-test scores) on dependent variable (post-test scores), $F(1, 273) = 236.3$, $p <.001$, Partial $\eta^2 = 0.464$. This means that 46.4 % of unexplained variance in post-test data may be attributed to the covariate. A statistically significant difference was also found between groups, $F(2, 273) = 63.0$, $p < 0.001$, partial $\eta^2 = 0.316$. According to Cohen's (1988) guidelines, values of Partial η^2 at .446 and .316 attribute to a large effect size.

Table 5.20

Analysis of Covariance for Urdu Reading in Phase 2

		SS	*df*	*MS*	*F*	*p*	*Partial η^2*
Covariance	Pre-test Urdu	527484.7	1	527484.7	236.3	.000	.464
Between-groups	Contrast	281278.5	2	140639.2	63.0	.000	.316
Within-groups	Error	609343.7	273	2232.0			

Note. The F tests the effect of group. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.
SS = Sum of squares, df= degree of freedom, MS = Mean square, F= F-statistics, Sig = significance at p = 0.05, Partial η^2 = effect size

One-way ANCOVA of Urdu reading skills demonstrated a statistically significant difference between the groups. Therefore, the next step was to apply a post hoc test to find which groups differed significantly. Pairwise comparison between groups using Sidak post hoc test (Table 5.21) revealed that post-test Urdu scores were statistically significantly greater in experiment vs. control group ($M_{diff} = 73.8$, 95% CI [58.5, 89.2], $p < 0.001$) and the comparison vs. control group ($M_{diff} = 71.5$, 95% CI [56.1, 86.8], $p < 0.001$). No statistically significant difference was found in post-test Urdu scores of the experiment vs. comparison group ($M_{diff} = 2.4$, 95% CI [-12.9, 17.7], $p = 0.976$).

Table 5.21

Pairwise Comparisons of Variables on Urdu Reading in Phase 2 using Sidak Post Hoc Test

(I) Group	(J) Group	MD (I-J)	SE	Sig.*	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
Control Group	Experiment Group	-73.8*	6.4	.000	-89.2	-58.5
	Comparison Group	-71.5*	6.4	.000	-86.8	-56.1
Experiment Group	Control Group	73.8*	6.4	.000	58.5	89.2
	Comparison Group	2.4	6.4	.976	-12.9	17.7
Comparison Group	Control Group	71.5*	6.4	.000	56.1	86.8
	Experiment Group	-2.4	6.4	.976	-17.7	12.9

Note. Pairwise comparisons of independent variables to test the significance of differences in the dependent variable on Urdu reading in Phase 2
Dependent Variable: Post-Test Urdu Score
MD = Mean difference; *SE* = Standard Error
[b]. Based on estimated marginal means
*. The mean difference is significant at $p = 0.001$; b. Adjustment for multiple comparisons: Sidak.

It is concluded that the experiment and the comparison group students performed statistically significantly better on reading skills using EGRA Urdu compared to the control group students. Overall, the experiment group outperformed both the other groups on Urdu reading skills; however, the difference between the experiment and comparison group was not statistically significant.

Effect Size

Pearson r was used to calculate the effect size of the intervention for each group. According to Cohen's (2013) considerations, medium effect sizes were observed between the experiment and control group ($r = 0.51$), and comparison vs. control group ($r = 0.43$). However, the effect size of the intervention between the comparison vs. experiment group was very small ($r = 0.05$). The next section compares the pre-and post-test components of Urdu reading skills across groups.

5.5.3 *Pre- and Post-Test Comparison of Urdu Reading Components*

This section presents a comparison of Urdu reading components: phonological awareness, word decoding, word recognition, oral fluency, and comprehension reading skills between the CG, EG and CMG students before and after the intervention. Pairwise statistical analysis was used to compare the actual means of reading components on pre-and post-tests using EGRA Urdu across groups and investigate the statistically significant difference between the pre-and-post comparison of reading components.

Phonemic Awareness

Phonoemic awareness on Urdu reading skills was measured through the letter-sound reading component of EGRA Urdu. Table 5.22 depicts that all three groups improved phonemic awareness after the intervention.

Table 5.22

Pre-and Post-Test Comparison of Phonemic awareness in Urdu (Phase 2)

		Pre-LSS		Post-LSS		Mean Difference			t	Sig	Effect size
	n	*M*	*SD*	*M*	*SD*	M_{diff}	*SD*	*SE*	*t*	*p*	*r*
Control Group	96	32.0	21.9	34.5	22.6	2.4	19.6	2.0	1.2	0.224	0.06
Comparison Group	96	28.6	23.7	61.7	25.6	33.1	25.0	2.6	12.9	0.000*	0.56
Experiment Group	96	37.9	16.2	69.2	20.5	31.3	21.8	2.2	14.1	0.000*	0.65

Note. LSS = Letter sound score*; n*= Group sample size, *M* = Mean; *SD* = Standard deviation; M_{diff} = Mean difference; *SE* = Standard error; *t* = t-statistics; * *p* is significant at 0.05

The experiment group (M_{diff} = 31.3, *SE* = 2.2, *t* (95) = 14.1, $p < .001$, r = 0.65) and the comparison group (M_{diff} = 33.1, *SE* = 2.6, *t* (95) = 12.9, $p < .001$, r = 0.56) showed statistically significant improvement compared to the control group (M_{diff} = 2.4, *SE* = 2.0, *t* (95) = 1.2, $p = 0.224$, r = 0.06). However, the experiment group outperformed both the other groups on phonemic awareness in Urdu reading.

Word Decoding

Word decoding was measured through the non-word reading component of EGRA Urdu. Table 5.23 shows that the experiment and the comparison group improved nearly two-fold compared to the control group. The control group slightly regressed on word decoding skills in Urdu reading (M_{diff} = -0.3, *SE* = 0.76, *t* (95) = -0.4, $p < .0.673$, r = 0.01), whereas, the experiment group (M_{diff} = 14.6, *SE* = 1.3, *t* (95) = 11.4, $p < .001$, r = 0.45) and the comparison group (M_{diff} = 13.5, *SE* = 1.0, *t* (95) = 11.4, $p < .001$, r = 0.41) showed a statistically significant improvement.

Table 5.23

Pre-and Post Test Comparison of Word Decoding in Urdu (Phase 2)

		Pre-NWR		Post-NWR		Mean Difference			t	Sig	Effect size
	n	*M*	*SD*	*M*	*SD*	M_{diff}	*SD*	*SE*	*t*	*p*	*r*
Control Group	96	16.8	14.4	16.5	13.6	-0.3	7.4	0.76	-0.4	0.673	0.01
Comparison Group	96	15.3	14.3	28.8	15.4	13.5	11.6	1.0	11.4	0.000*	0.41
Experiment Group	96	16.1	10.8	30.7	12.3	14.6	12.6	1.3	11.4	0.000*	0.45

Note. NWR =Non word reading*; n*= Group sample size, *M* = Mean; *SD* = Standard deviation; M_{diff} = Mean difference; *SE* = Standard error; *t* = t-statistics; * *p* is significant at 0.05

The pre-and post-test analysis on Urdu word decoding skills indicates that the experiment group outperformed both the other groups.

Word Recognition

Word recognition was measured through the familiar word reading component of EGRA Urdu. Table 5.24 reveals that all three groups improved word recognition in Urdu reading.

Table 5.24

Pre-and Post-Test Comparison of Word Recognition in Urdu (Phase 2)

		Pre-FWR		Post-FWR		Mean Difference			t	Sig	Effect Size
	n	*M*	*SD*	*M*	*SD*	M_{diff}	*SD*	*SE*	*t*	*p*	*r*
Control Group	96	8.9	10.7	9.1	11.2	0.3	5.8	0.6	0.43	0.662	0.01
Comparison Group	96	8.1	10.4	20.2	14.5	12.1	9.8	1.0	12.1	0.000*	0.43
Experiment Group	96	6.4	8.3	18.0	13.0	11.6	11.3	1.1	10.1	0.000*	0.58

Note. FWR= Familiar word reading, *n*= Group sample size, *M* = Mean; *SD* = Standard deviation; M_{diff} = Mean difference; *SE* = Standard error; *t* = t-statistics; * *p* is significant at 0.05

The control group showed the slightest and statistically insignificant improvement on familiar word reading in Urdu, M_{diff} = 0.3, *SE* = 0.6, *t* (95) = 0.43, *p* = 0.662. The experiment group (M_{diff} = 31.3, *SE* = 2.2, *t* (95) = 14.1, *p* < .001) and the comparison group (M_{diff} = 31.3, *SE* = 2.2, *t* (95) = 14.1, *p* < .001) depicted a statistically significant improvement on Urdu word recognition skills. The pre-post analysis of Urdu word recognition skills shows that the CMG students appeared to outperform the other groups; however, there was not a substantial difference between Urdu word recognition skills of the comparison and the experiment group.

Oral Fluency (Passage reading)

Oral fluency in Urdu reading was assessed using the passage reading component of EGRA Urdu. Table 5.25 shows that all three groups improved in oral fluency after the intervention.

Table 5.25

Pre-and Post-Test Comparison of Oral Fluency in Urdu (Phase 2)

		Pre-PR		Post-PR		Mean Difference			t	Sig	Effect size
	n	M	SD	M	SD	M_{diff}	SD	SE	t	p	r
Control Group	96	26.0	26.6	27.2	27.3	1.1	14.5	1.5	0.77	0.442	0.02
Comparison Group	96	25.1	26.6	40.6	23.9	15.5	18.2	1.9	8.4	0.000*	0.29
Experiment Group	96	22.1	22.8	40.8	21.3	18.7	22.7	2.3	8.1	0.000*	0.39

Note. n= Group sample size, *M* = Mean; *SD* = Standard deviation; M_{diff} = Mean difference; *SE* = Standard error; *t* = t-statistics; * *p* is significant at 0.05

The control group demonstrated a statistically insignificant gain between pre-and-post test scores of passage reading (M_{diff} = 1.1, *SE* =1.5, *t* (95) = 0.77, *p* = 0.442, r = 0.02). The experiment (M_{diff} = 18.7, *SE* = 2.3, *t* (95) = 8.1, *p* < .001, r = 0.39) and comparison group (M_{diff} = 15.5, *SE* = 1.9, *t* (95) = 8.4, *p* < .001, r = -0.29) improved nearly twice and statistically significantly compared to their respective pre-test scores on passage reading in Urdu. Overall, the experiment group outperformed both the other groups; however, the difference between the experiment and comparison group on passage reading was almost negligible.

Comprehension Reading

Table 5.26 presents pre and post-comprehension reading skills using EGRA Urdu of students belonging to all three groups. After the intervention, all three groups improved their comprehension skills in Urdu.

Table 5.26

Pre-and Post-Test Comparison of Comprehension Reading in Urdu (Phase 2)

		Pre-CR		Post-CR		Mean Difference			t	Sig	Effect Size
	n	*M*	*SD*	*M*	*SD*	M_{diff}	*SD*	*SE*	*t*	*p*	*r*
Control Group	96	0.9	1.3	1.1	1.4	0.2	1.1	0.1	1.6	0.107	0.07
Comparison Group	96	0.9	1.2	2.9	1.4	2.1	1.3	.13	14.9	0.000*	0.61
Experiment Group	96	1.0	1.3	2.5	1.5	1.5	1.4	0.1	10.9	0.000*	0.47

Note. n= Group sample size, *M* = Mean; *SD* = Standard deviation; M_{diff} = Mean difference; *SE* = Standard error; *t* = t-statistics; * *p* is significant at 0.05

The comparison group outperformed the other groups with twice the statistical significant improvement compared to initial testing, (M_{diff} = 2.1, *SE* = 0.13, *t* (95) = 14.9, $p < .001$). The experiment group showed a statistical significant improvement of one and half times more (M_{diff} = 1.5, *SE* = 0.1, *t* (95) = 10.9, $p < .001$) compared to the pre-tests. Whereas the control group showed a slight but statistically non-significant improvement compared to initial testing, (M_{diff} = 0.2, *SE* = 0.1, *t* (95) = 1.6, *p* = 0.107).

Total EGRA Urdu Scores

A comparison of total EGRA Urdu scores between the control, experiment and comparison groups is presented in Table 5.27. All three groups have made improvement, however, experiment (M_{diff} = 77.0, *SE* = 4.4, *t* (95) = 13.9, $p < 0.001$, r = 0.56) and comparison group (M_{diff} = 80.1, *SE* = 4.4, *t* (95) = 16.5, $p < 0.001$, r = 0.47) have improved statistically significantly.

Table 5.27

Comparison of Pre-and-Post Total EGRA Urdu Scores in Phase 2

		Pre-Test EGRA Urdu		Post-Test EGRA Urdu		Mean Difference			t	Sig	Effect size
	n	M	SD	M	SD	M_{diff}	SD	SE	t	p	r
Control Group	96	84.7	64.4	85.9	67.2	1.2	32.9	4.4	1.1	0.273	0.01
Comparison Group	96	77.9	62.9	158.0	73.3	80.1	45.4	4.4	16.5	0.000*	0.47
Experiment Group	96	83.4	49.2	160.4	57.1	77.0	54.6	4.4	13.9	0.000*	0.56

Note. n= Group sample size, *M* = Mean; *SD* = Standard deviation; M_{diff} = Mean difference; *SE* = Standard error; *t* = t-statistics; * *p* is significant at 0.05

The EG outperformed all other groups with a large effect size (r = 0.56) on Urdu reading skills. However, there was not a substantial difference between the EG and the CMG's total EGRA Urdu scores. Hence, it can be concluded that the CMG performed at par with the EG. The next section presents a summary of inferences drawn from statistical analysis for developing Urdu reading skills after playing the digital game.

5.5.4 *Inferences for the Impact of the Digital Game on Urdu Reading Skills*

One-way ANCOVA was conducted to determine the impact of the digital game on the Urdu reading skills of students in the comparison and experiment group compared to the students belonging to the control group. After adjustment of pre-tests for EGRA Urdu, there was a statistically significant difference in post-test Urdu reading between the interventions, $F(2, 273) = 63.0$, $p < 0.001$, partial $\eta^2 = 0.316$. Post hoc analysis was performed using Sidak adjustment, which revealed that post-test Urdu reading skills were statistically significantly greater in the experiment vs. control group (M_{diff} = 73.8, 95% CI [58.5, 89.2], $p < 0.001$) and comparison vs. control group (M_{diff} = 71.5, 95% CI [56.1, 86.8], $p < 0.001$). The difference between the experiment and comparison group was the lowest; however, not statistically significant (M_{diff} = 2.4, 95% CI [-12.9, 17.7], $p = 0.976$).

Hence, the null hypothesis (H_{04}) was rejected, and it was concluded that the digital game in English (L2) had a statistically significant and medium impact on developing Urdu (L1) reading skills compared to traditional teaching methods for reading. Experiment group students performed better on phonemic awareness, word decoding and passage reading in Urdu, whereas comparison group students performed better on word recognition and comprehension reading in Urdu. The next section, Section 5.6, presents an analysis of Phase 3 based on the retention of reading skills in Urdu ten-week after the discontinuation of the intervention.

5.6 Retention of Urdu Reading Skills in Phase 3

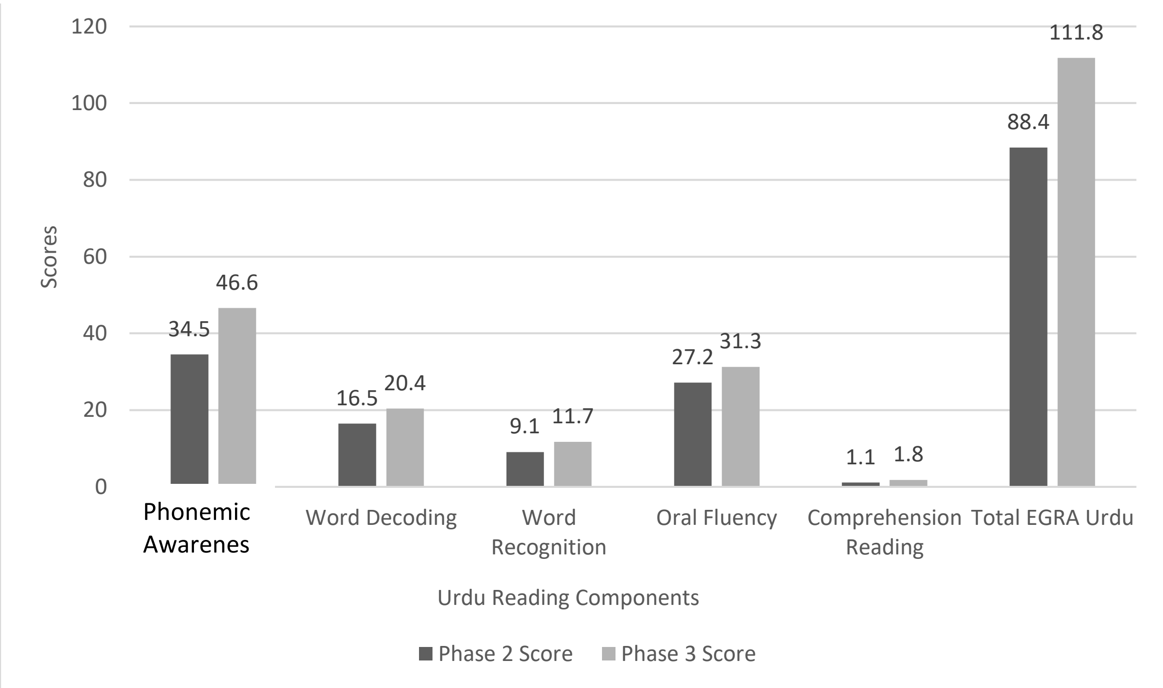
Retention of Urdu reading skills was calculated by comparing components of reading in Phase 3 delayed post-test using EGRA Urdu scores of the CG, EG and CMG students with their respective post-test scores of Phase 2. Pairwise statistical analysis was conducted to investigate the difference between Phase 2 and Phase 3 results on reading components using EGRA Urdu. This section begins with a pairwise comparison of within-group results followed by between groups analysis.

5.6.1 *Retention of Urdu Reading Skills in the Control Group*

Overall, the CG students retained the skills and showed a steady increase in all Urdu reading components in Phase 3 of the research after the intervention of providing additional traditional instruction in English was discontinued. Figure 5.5 shows a pairwise comparison of scores on Urdu reading components and the total score of EGRA-Urdu from Phase 2 to Phase 3. Pairwise comparisons of descriptive statistics are also presented in Table Z1 of Appendix Z.

Figure 5.5

Distribution of CG Scores on Urdu Reading Components in Phases 2 & 3



A paired sample t-test was used to examine if there was a statistically significant difference between Phase 2 and Phase 3 EGRA Urdu scores (Table 5.28). The data were verified against assumptions to apply t-test. No outliers were detected, and the data were assumed to be normally distributed as per the central tendency theorem. Phonological awareness in Urdu was statistically significant improved from Phase 2 to Phase 3 with M_{diff} = 12.1, 95% CI [6.4, 17.7], $t(95)$ = 4.2, p <0.001. Similarly, word decoding skills in Urdu were statistically significantly improved from Phase 2 to Phase 3 with M_{diff} = 3.9, 95% CI [1.6, 6.1], $t(95)$ = 3.4, p = 0.001. Word recognition in Urdu was also improved statistically significantly from Phase 2 to Phase 3 with M_{diff} = 2.6, 95% CI [0.1, 5.1], $t(95)$ = 2.1, p = 0.039. Following the same pattern, oral fluency in Urdu was also increased statistically significantly from Phase 2 to Phase 3 with M_{diff} = 4.1, 95% CI [0.1, 8.1], $t(95)$ = 2.1, p = 0.043.

Comprehension reading in Urdu also saw a statistically significant increase from Phase 2 to Phase 3 with M_{diff} = 0.7, 95% CI [0.4, 1.0], $t(95) = 4.7$, p <0.001. The overall EGRA Urdu score was increased from Phase 2 to Phase 3 with M_{diff} = 23.4, 95% CI [11.9, 34.8], $t(95) = 4.1$, p <0.001.

Table 5.28

Paired samples t- test of CG on Urdu reading skills in Phase 3

					95% CI of the difference				
		M	SD	SE	Lower	Upper	t	df	p
Pair 1	Phase 3 Phonemic Awareness - Phase 2 Phonemic Awareness	12.1	27.9	2.8	6.4	17.7	4.2	95	.000*
Pair 2	Phase 3 Word Decoding - Phase 2 Word Decoding	3.9	11.2	1.1	1.6	6.1	3.4	95	.001*
Pair 3	Phase 3 Word Recognition - Phase 2 Word Recognition	2.6	12.	1.2	0.1	5.1	2.1	95	.039*
Pair 4	Phase 3 Oral Fluency - Phase 2 Oral Fluency	4.1	19.7	2.0	0.1	8.1	2.1	95	.043*
Pair 5	Phase 3 Comprehension Reading - Phase 2 Comprehension Reading	0.7	1.5	0.2	0.4	1.0	4.7	95	.000*
Pair 6	Phase 3 Total EGRA English Score - Phase 2 Total EGRA English Score	23.4	56.5	5.8	11.9	34.8	4.1	95	.000*

Note. M = Mean; *SD* = Standard deviation; *SE* = Standard error mean; *CI* = Confidence interval; *t* = t-statistics, *df*= degrees of freedom; **p* = Significance at 0.05 confidence level.

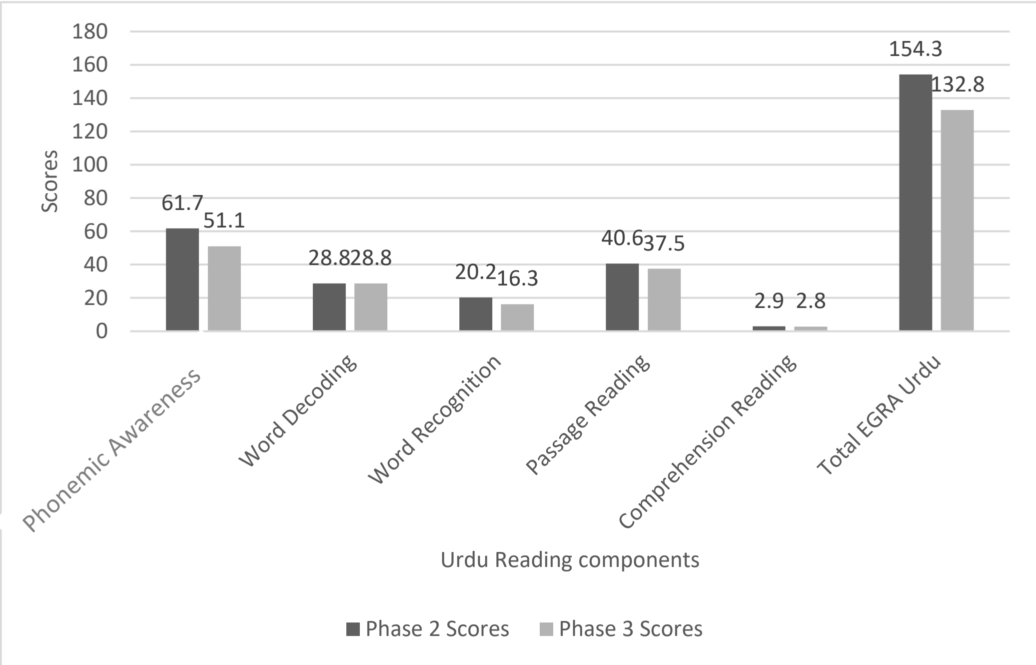
In conclusion, overall, the CG students were able to retain skills and made a statistically significant and steady improvement on all components of Urdu reading skills when measured against EGRA Urdu in Phase 3 of the study. Also, the total EGRA Urdu score was improved statistically significantly in Phase 3.

5.6.2 *Retention of Urdu Reading Skills in Comparison group*

In Phase 3, the CMG students saw a decline in Urdu reading skills across all components of reading as well as in total EGRA Urdu scores, as shown by the bar chart in Figure 5.7. Descriptive statistics comparing the means and standard deviations of Phase 2 and Phase 3 Urdu reading scores of the comparison group are presented in Table Z3 of Appendix Z.

Figure 5.6

Distribution of CMG Scores on Urdu Reading Components in Phases 2 & 3



A paired sample t-test was used to determine if the decrease in scores was statistically significant. Table 5.30 presents paired sample t-test results calculated for Urdu reading skills using SPSS. Only two outliers were detected; however, they were found not to be of extreme threat to the data analysis, hence, were not removed from the data set. Differences in means were approximately normally distributed as inspected using Normal Q-Q plots using SPSS.

Table 5.29

Paired Samples t- Test of CMG on Urdu Reading Skills in Phase 3

		M	SD	SE	95% CI of the Difference Lower	Upper	t	df	p	Cohen's d
Pair 1	Phase 3 Phonemic Awareness - Phase 2 Phonemic Awareness	10.6	18.9	1.9	6.7	14.4	5.5	95	.000*	0.4
Pair 2	Phase 3 Word Decoding - Phase 2 Word Decoding	3.6	10.1	1.0	1.6	5.7	3.5	95	.001*	0.2
Pair 3	Phase 3 Word Recognition - Phase 2 Word Recognition	3.9	10.5	1.1	1.7	5.9	3.6	95	.000*	0.3
Pair 4	Phase 3 Oral Fluency - Phase 2 Oral Fluency	3.2	14.1	1.4	0.3	6.0	2.2	95	.031*	0.07
Pair 5	Phase 3 Comprehension Reading - Phase 2 Comprehension Reading	0.2	1.1	0.1	0.0	0.4	1.9	95	.063	0.1
Pair 6	Phase 3 Total EGRA English Score - Phase 2 Total EGRA English Score	21.4	43.3	4.4	12.7	30.2	4.8	95	.000*	0.3

Note: *M* = Mean; *SD* = Standard deviation; *SE* = Standard error mean; *CI* = Confidence interval; *t* = t-statistics, *df*= degrees of freedom; **p* = Significance at 0.05 confidence level.

Paired sample t-test of the comparison group revealed a statistically significant decline on phonological awareness in Phase 3 compared to Phase 2 with M_{diff} = 10.6, 95% CI [6.7, 14.4], $t(95)$ = 5.5 , $p < 0.001$. Similarly, word decoding saw a statistically significant decline from Phase 2 to Phase 3 with M_{diff} = 3.6, 95% CI [1.6, 5.7], $t(95)$ = 3.5 , p = 0.001. Word recognition skills in Urdu declined statistically significantly from Phase 2 to Phase 3, M_{diff} = 3.9, 95% CI [1.7, 5.9], $t(95)$ = 3.6 , $p < 0.001$. Oral fluency in Urdu reading also saw statistically significantly drop in scores from Phase 2 to Phase 3 , with M_{diff} = 3.2, 95% CI [0.3, 6.0], $t(95)$ = 2.2 , p = 0.031. Comprehension reading skills declined slightly with a statistically non-significant difference from Phase 2 to Phase 3 with M_{diff} = 0.2, 95% CI

[0.0, 0.4], $t(95) = 1.9$, $p = 0.063$. The total EGRA Urdu score also dropped statistically significantly from Phase 2 to Phase 3 with $M_{diff} = 21.4$, 95% CI [12.7, 30.2], $t(95) = 4.8$, $p < 0.001$.

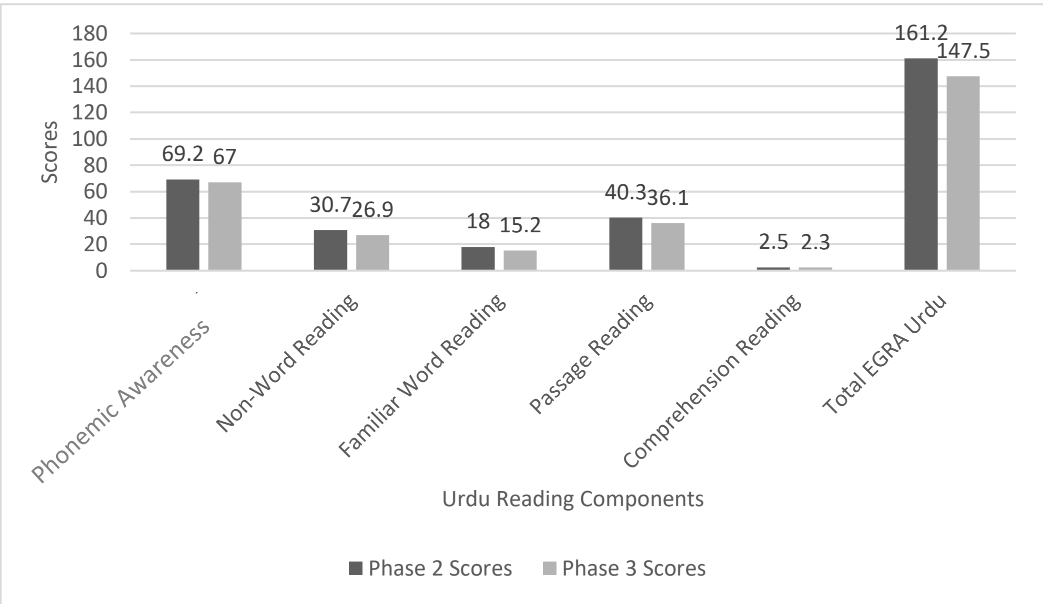
It was concluded that the comparison group consistently experienced a decline in all components of Urdu reading. There was a statistically significant drop in overall EGRA Urdu results ten weeks after the intervention of digital game-based learning with teacher facilitation was discontinued.

5.6.3 *Retention of Urdu Reading Skills in the Experiment Group*

Figure 5.6 presents a comparison of individual components of Urdu reading skills from Phase 2 to Phase 3 for the EG. A slight decrease in all components of Urdu reading skills of the EG in Phase 3 is evident in Figure 5.6. The decline in Urdu reading skills may be attributed to the removal of the digital game-based intervention without teacher facilitation. Table Z2 of Appendix Z presents pairwise descriptive statistics of the experiment group on all components of Urdu reading skills as well as the total score of EGRA Urdu.

Figure 5.7

Distribution of EG Scores on Urdu Reading Components in Phases 2 & 3



A paired sample t-test was conducted to determine whether the decrease in scores was statistically significant between Phase 2 and Phase 3 on Urdu reading components (Table 5.29). Data were verified against assumptions to apply the t-test. Few outliers were detected using boxplots, which did not reveal to be of extreme value upon investigation. Hence, these were kept in the analysis. The assumption of normality was not violated as the difference of means were normally distributed, as assessed by Normal Q-Q plots using SPSS.

Table 5.30

Paired Samples t- Test of EG on Urdu Reading Skills in Phase 3

		M	SD	SE	95% CI of the Difference Lower	Upper	t	df	p
Pair 1	Phase 3 Phonemic Awareness - Phase 2 Phonemic Awareness	2.2	29.4	3.0	-3.7	8.2	0.7	95	.462
Pair 2	Phase 3 Word Decoding - Phase 2 Word Decoding	3.8	14.4	1.5	0.8	6.7	2.6	95	.012*
Pair 3	Phase 3 Word Recognition - Phase 2 Word Recognition	2.8	17.3	1.8	-0.7	6.3	1.6	95	.112
Pair 4	Phase 3 Oral Fluency - Phase 2 Oral Fluency	4.7	27.3	2.8	-0.8	10.3	1.7	95	.092
Pair 5	Phase 3 Comprehension Reading - Phase 2 Comprehension Reading	0.2	1.8	0.2	-0.2	0.6	1.1	95	.272
Pair 6	Phase 3 Total EGRA English Score - Phase 2 Total EGRA English Score	13.7	67.9	6.9	-0.1	27.4	1.9	95	.051

Note: *M* = Mean; *SD* = Standard deviation; *SE* = Standard error mean; *CI* = Confidence interval; *t* = t-statistics, *df*= degrees of freedom; **p* = Significance at 0.05 confidence level.

Phase 3 EGRA Urdu scores on phonemic awareness saw a statistically non-significant decrease with compared to Phase 2 scores. However, word decoding in Urdu saw a statistically significant decline in Phase 3 compared to Phase 2 with M_{diff} = 3.8, 95% CI [0.8, 6.7], $t(95) = 2.6$, $p = 0.012$ ($p < 0.05$). Word recognition skills in Urdu suffered a statistically insignificant decline from Phase 2 to Phase 3 with M_{diff} = 2.8, 95% CI [-0.7, 6.3], $t(95) = 1.6$, $p = 0.112$. Similarly, oral fluency in Urdu reading also decreased statistically insignificantly from Phase 2 to Phase 3 with M_{diff} = 4.7, 95% CI[-0.8, 10.3], $t(95) = 1.7$, $p = 0.092$. Following the same pattern, comprehension reading declined statistically non-significantly from Phase 2 to Phase 3 with M_{diff} = 0.2, 95% CI[-0.2, 0.6], $t(95) = 1.1$, $p = 0.272$. Overall, the total EGRA Urdu score of the experiment group in Phase 3 dropped statistically non-significantly from Phase 2 with M_{diff} = 13.7, 95% CI[-0.1, 27.4], $t(95) = 1.9$, $p = 0.051$.

It was concluded that overall, the experiment group students suffered a statistically insignificant loss in Urdu reading skills ten weeks after the intervention was removed and students were subjected to traditional instruction.

5.6.4 *Comparing Retention of Urdu Reading Skills Across Groups*

This section compares the retention of Urdu reading skills across groups (CG, EG and CMG) in Phase 3 of the study. The percentages of total EGRA-Urdu scores were calculated for Phase 2 and Phase 3 to identify the difference in reading scores across groups in Phase 3. The percentage difference was calculated between Phase 3 and Phase 2 scores to identify the increase or decrease in Urdu reading skills (Table 5.31). Figure 5.8 comparing the percentage difference of Urdu reading scores across three groups reveals a consistent improvement in Urdu reading in the control group and a drop in Urdu reading skills for the experiment and the control group after the DGBL intervention was removed. These results follow similar trends as in English reading after the discontinuation of the digital game (Section 5.3.4).

Figure 5.8

Percentage Difference in Urdu Reading Across CG, EG, and CMG in Phases 2 and 3

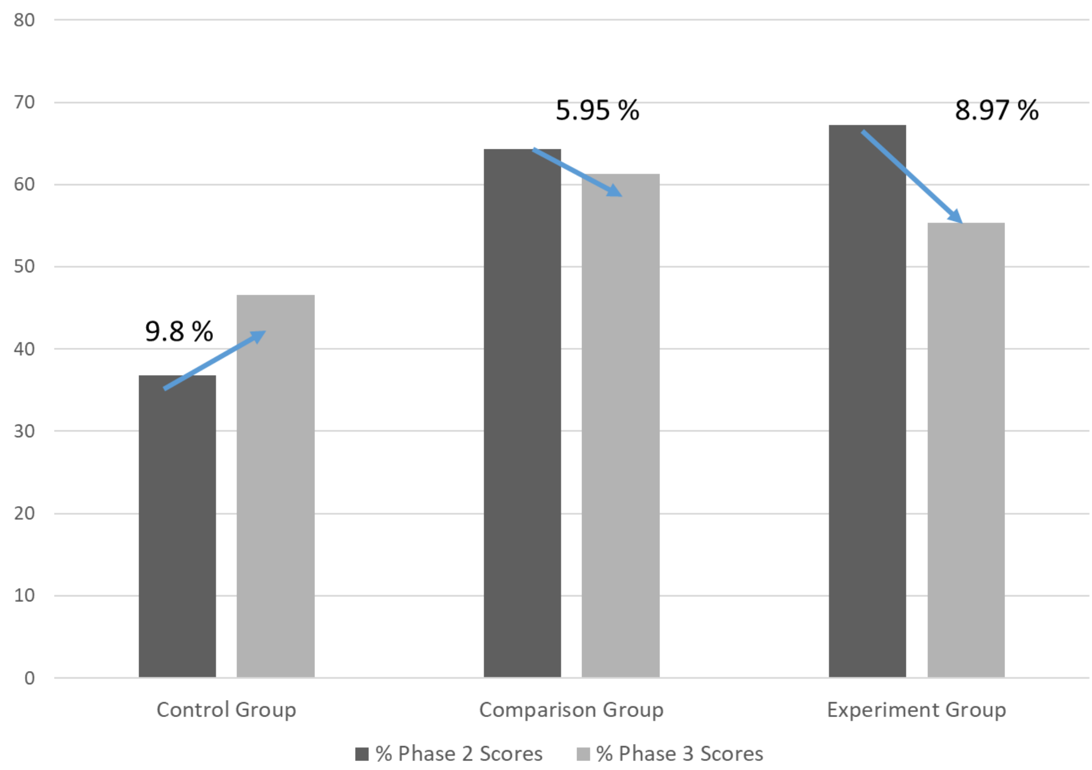


Table 5.31 shows that the control group experienced a natural improvement due to traditional style instruction; however, the percentage of achievement in Phase 2 and Phase 3 was far less compared to the game groups (EG and CMG). The experiment and the comparison group experienced a decline in Urdu reading skills ten weeks after the DGBL intervention was discontinued. The experiment group experienced a decline of 5.95%, while the comparison group experienced a decline of 8.97%. This implies that the experiment group retained Urdu reading skills better than the comparison group.

Table 5.31

Percentage Comparison of Urdu Reading Across CG, EG, and CMG in Phase 2 & 3.

Groups	% age score Phase 2 EGRA _Urdu	% age score Phase 3 EGRA _Urdu	% difference in scores (Phase 3 and Phase 2)	Trend
Control group	36.8	46.6	9.8	Increase in reading skills
Comparison group	64.3	55.33	8.97	Decrease in reading skills (Summer slide effect)
Experiment group	67.2	61.25	5.95	Decrease in reading skills (summer slide effect)

Overall, the results of Phase 3 revealed that the control group continued to improve Urdu reading skills, whereas the experiment and comparison group saw a slight decline in Urdu reading skills. However, despite the decline in scores, the experiment and comparison groups outperformed the control group on Urdu reading in Phase 3 of the research. The experiment group maintained the highest scores, implying that they retained Urdu reading skills better than the comparison and control groups ten weeks after the intervention was discontinued.

5.7 Summary

This chapter presented quantitative data findings obtained through multiple data sources, including pre-, post- and delayed post-tests using EGRA English and Urdu during Phase 2 and Phase 3 of the research. The chapter commenced by presenting results of the impact of the digital game on developing reading skills in English (L2) and Urdu (L1). It then reported the retention of reading skills in students during Phase 3 of the research once the intervention was discontinued.

The quantitative findings in Phase 2 of the research suggested that students from the CG, EG and CMG initially possessed similar reading skills in English and Urdu. These initial findings established a baseline of reading skills in English (L2) and Urdu (L1). After the intervention, it was concluded that the digital game had a statistically significant impact with a medium effect size on developing reading skills in English (L2) and Urdu (L1). Comparison and the experiment group scored considerably higher on all components of reading using EGRA English and Urdu than the control group. The CG students who played the digital game with teacher facilitation outperformed the other groups in English reading; however, the EG students who played the digital game without teacher facilitation performed equally well, with no statistically significant difference compared to the comparison group. Similarly, in Urdu reading, the CMG outperformed both the other groups on word recognition and comprehension reading, whereas the EG outperformed both the other groups on phonological awareness, word decoding and passage reading

The findings in Phase 3 of the research established that the EG and CMG experienced a consistent decline in English and Urdu reading skills compared to the CG, which continued to improve skills in Phase 3 following the traditional instruction. Nevertheless, the CMG and EG performed much better on all components of reading skills (English and Urdu) than the CG. Comparing English reading skills between groups in Phase 3 showed that the CMG students retained skills more than the other two groups. The EG students that played the games without teacher facilitation outperformed both the other groups on Urdu reading during Phase 3. This implies that the EG was able to retain Urdu reading skills better than the CMG and CG ten weeks after the intervention was discontinued.

The quantitative findings of Phase 2 and Phase 3 indicate that pedagogically balanced digital games could have the potential to develop reading skills in English (L2) and encourage students to transfer skills to read in Urdu (L1), even without teacher facilitation. These results have implications for self-paced learning for students using balanced and pedagogically sound digital games for reading development and transfer of skills from second to the first language. The next chapter presents qualitative data findings gathered through multiple sources, including classroom observations, students' group interviews and teachers' interviews during Phase 2 and Phase 3 of the research.

CHAPTER 6: PHASE 2 AND PHASE 3 QUALITATIVE FINDINGS

This chapter aims to present findings to gain insights into the use of digital games in developing reading skills and the impact of digital games on students' behaviours and skills towards reading in English (L2) and in Urdu (L1). The data sets consisted of unstructured classroom observations during digital game-based sessions in Phase 2, followed by students' group interviews and teachers' individual interviews in Phase 2 and Phase 3 of the research.

The selected game, Teach Your Monster To Read (TYMTR) from Phase 1, was installed on 30 Android tablets and was distributed to the comparison and experiment groups. Classrooms assigned for digital game playing consisted of a floor mat, a blackboard, and a table to place the tablets. The researcher briefed the comparison group teachers on how students will access tablets with their name tags. The CMG teachers were given the authority to design and facilitate DGBL sessions. On the very first day of DGBL intervention, the researcher briefed EG students about the expected routines of game playing, where students will pick a tablet with their name tag name-tag, sit wherever they like, play the given game until the bell rings, and then place the tablets back on the desk after the period was over. The EG students were given control over their own learning environment to suit their needs during DGBL sessions.

Using video-conferencing technology, the researcher conducted non-participatory sub-covert observations of DGBL sessions in both groups. The researcher's camera was placed at a distance for minimum distractions for students, enabling the researcher to observe students while playing the game but not to intimidate students with her presence. The qualitative data findings were categorised under two key themes: behaviours, and skills and competencies in reading. Emerging sub-themes were subsequently grouped under the key themes. A coding scheme was used to refer to the quotes included in this chapter. A code number of the transcript type, group, and page number are indicated after each quote (Appendix M). For example, O7.CP1.1 refers to a quotation cited from the seventh observation transcript from the first comparison group, appearing on page 1 of the transcript. The researcher read the transcripts multiple times to identify themes emerging from the interview data. Sub-themes from classroom observations and interviews were triangulated and grouped under the key themes.

Section 6.1 presents the first key theme of behaviours, followed by section 6.2, describing students' skills and competencies in a DGBL environment. The chapter concludes with a summary presented in section 6.4. A coding scheme was used to refer to the quotes included in this chapter

Table 6.1 presents the organisation of sub-themes from most prominent or recurring to least prominent or recurring, nested under the key theme as emerged in the comparison and the experiment group.

Table 6.1

The Organisation of Themes and Sub-Themes

Theme 1: Students' and teachers' behaviours	
Comparison group	**Experiment group**
Teacher-led classroom design • Maintaining discipline • Following the teacher's instructions • Teacher facilitation • isolated knowledge development **Students' and teachers' behaviours** • Passive participation • Lack of motivation and excitement • Secretive behaviours to avoid teacher's confrontation • Change in teachers' beliefs • Confidence in reading using digital games	**Students-initiated classroom design** • Peer support network • Collaborative learning • Opportunity to solve problems **Student behaviours** • Active participation • Excitement • Self-awareness • commitment

Theme 2: Skills and competencies	
Comparison group	**Experiment group**
• Attentive listening and reciprocal interaction with the tablet • Reading skills • Transfer of reading skills from English (L2) to Urdu (L1) • Self-regulated learning	• Reading skills • Transfer of skills from English (L2) to Urdu (L1) • Digital Literacy • Self-regulated and self-managed learning • Recognising patterns and establishing connections

6.1 Students' and Teachers' Behaviours

This section refers to behaviour as an inference of interactions or actions that occurred in DGBL sessions across the comparison and experiment groups. The findings in this section helped to examine the behaviours of students playing the same game but in different classroom environments. These findings also unveiled teachers' readiness to adopt digital games as a learning medium. The following subsections present central tenets of teachers' and students' behaviours firstly in the comparison and then in the experient group during DGBL sessions

6.1.1 *Comparison Group*

The sub-themes related to the comparison group behaviours are grouped in two subsections: classroom design and student behaviours.

Teacher-Led Classroom Design

The first and the most prominent behavioural characteristic observed was the classroom design. For the comparison group, the classroom design and layout were influenced by the teacher's beliefs exercised through instructions and directions to her students. The teacher instructed students to sit in a semi-circle on the mat facing the teacher (O7.CP1.1). She then explained the procedure of accessing tablets and provided instructions on maintaining good behaviour and discipline during the sessions. An example of such observation is:

> The teacher asks students to sit in a semi-circle on the mat at a small distance from each other. She hands over tablets to each student. Students are not allowed to talk to each other. The teacher instructs students to sit quietly in the class and display their best behaviour. She then explains the purpose of DGBL sessions and briefly introduces the game students are going to play (O7. CP1. 1).

This was further evidenced by teacher interviews where their beliefs of providing individual support to each student compelled them to adopt this design. For example, one of the teachers shared during the interview that

> …during the games, I didn't allow the children to talk amongst themselves. If they didn't understand anything, they could come and ask me rather than disturbing the other children…and I sat the children at a distance from one another… when children are sitting in circles [groups] it becomes more difficult to figure out to tell who is playing well and who isn't… This way [sitting in a semi-circle as opposed to groups] the teacher can keep an eye on everyone [TI.CP2:20].

The prominent characteristics observed in a teacher-led classroom design within the CMG were, maintaining discipline, following teacher's instructions, teacher-support, and individual learning and isolated knowledge development. The following subsections describe the characteristics of teacher-led classroom design.

Maintaining Discipline

In the comparison group, maintaining discipline in the classroom where students sit quietly and focus on their work without distracting others appears to be very important to the teachers. The teachers shared their beliefs about an effective classroom environment where students concentrate on their work and do not disturb others by asking questions. For example, one teacher shared

> …these students come from illiterate backgrounds and are very ill-mannered. Parents send these children to school to acquire good manners. So, we have to discipline them and teach them how to sit properly and behave well in the classroom. If we don't punish them, they will start being naughty and disrupt the learning process (TI.CP1.32).
>
> and another teacher shared
>
> …these lessons involve the handling of equipment; therefore, it is extremely important that we keep an eye [on students] to avoid any accidents. Students must also listen to us and sit quietly while concentrating on their game playing (TI. CP2. 22).

It appeared from the observations that teachers used disciplining techniques, such as verbal warnings, whenever student-to-student interaction happened during the session. For instance, students got a verbal warning when students wanted to ask something from a peer sitting next to them or when they wanted to express joy verbally or non-verbally. The teacher had full control, and she consistently discouraged any exchanges of joy or information between students. Examples of such verbal warnings were, "sit straight in your places… I don't want to see you leaning towards each other…"(O8.CP2:3); "…if I see you one more time making silly noises or talking to someone else, I will ask you to leave the class" (O7.CP1.3). The researcher's observation notes reveal that in one instance, the teacher got so angry at a student that she was about to hit him,

> It is the third time in ten minutes that the teacher discourages a student who is talking to a peer. She is really upset with that student, nearly about to hit him. She warns him to take the tablet away if he continues to talk to others during the session (O8.CP2 4).

The teachers were of the view that discipline is obtained if students follow the teacher's instructions in the classroom. For example, one teacher shared, "…discipline means that students should do what they are told to do…." (TI.CP1.33). The next section describes following the teacher's instructions as the second major characteristic of teacher-led classroom design.

Following the Teacher's Instructions

Following the teacher's instructions appeared to be another prominent characteristic of the teacher-led classroom design. During the interview, a teacher shared, "I'm in the habit of keep reminding students of sitting quietly and listening very carefully to me when I am teaching… and also give a response to me when I ask questions" [TI.CP2:5]. The observation data showed that teachers explained classroom dynamics at the beginning of sessions, which every student had to follow. Instructions on classroom dynamics consisted of taking and handing over tablets, completing game targets as identified by the teacher and seeking support from the teacher. Such as:

> The teacher explains the daily routine of taking and handing over the tablets in the beginning and at the end of the session. She asks students to play independently on their own tablets without disturbing others. If they [students] need help, they can ask the teacher for help (O7.CP1.2)
>
> The teacher reiterates the importance of following the teacher's instructions all the time, which otherwise will have serious implications on their game playing (O8.CP2.3).

This teacher set the targets as to what game levels the students should have aimed to be achieved by the end of the session. The CMG teachers conveyed the sanctions if students did not follow instructions and tried to disrupt the session, as illustrated from the following observation:

> The teacher explains the consequences of not listening to the teacher…students will not be allowed to play games if they are found talking to each other or disturbing others. Students will have to return the tablet and leave the class if they do not listen to the teacher (O8.CP2.2).

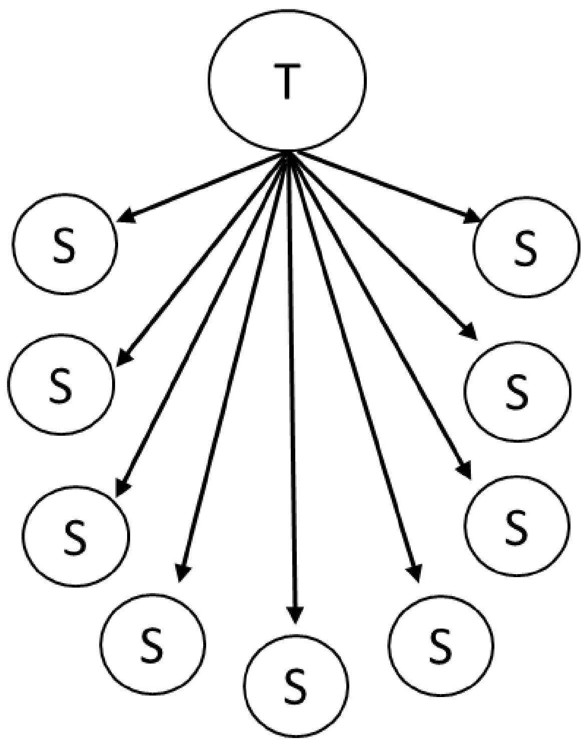
The majority of students listened to the teacher and followed her instructions. Only a handful of students ignored the instructions, talked to other students, or showed their games to others. These students were constantly disciplined and warned by the teacher; however, they did not face the sanction of taking away the tablets. The teacher facilitation during DGBL sessions, as described in the following subsection was the next observed characteristic of a tutor-led classroom design.

Teacher Facilitation

The availability of teacher facilitation for each student during DGBL sessions differentiates it from the EG. Although the CMG students played games individually on tablets, the management of learning was teacher-directed. It appeared that the teacher was the source of support and information throughout the DGBL sessions in the CMG. Figure 6.1 presents a visual representation of the learning management style in the CMG, where the students (S) are sitting in a semi-circle arrangement facing the teacher (T). The support (arrows) flows directly from the teacher (T) to each student (S).

Figure 6.1

Teacher-directed support Network



No collaboration between the students was evident during DGBL sessions in the CMG. At times, students were observed seeking support from the person sitting next to them; however, they were strictly discouraged by the teacher from consulting each other.

> Students are not allowed to talk to each other or even lean towards each other as if they are sitting in exam conditions (O8.CP2:1)
>
> Students are not seeking peer support if they experience a problem or do not understand game instructions. Instead, they wait for their teacher to provide support (O7.CP1. 3).

Students needed support on the technical aspects of the game playing, such as moving back and forward in the game or understanding the game instructions. The game instructions were in English (L2), which appeared difficult to be understood by English language learners. However, visual cues and demonstration of solved examples in the game helped in comprehending the game instructions. Students sought help from the teacher if they were still unable to comprehend the instructions. The teacher was trying to provide support to each student while maintaining discipline in the classroom. Consequently, students were seen waiting for their turns to get help, which inevitably wasted time and disrupted the flow of game playing, as evident from the following observation:

> Peer support network is missing in the comparison group. If students need help, they raise their hands and wait for the teacher to provide support. Few students are waiting for their turns to get support from the teacher…. They look bored and disinterested after a while of wait in getting support from the teacher (O9. CP1:1)

Comparison group teachers considered the teacher a source of authentic information. The teachers shared in interview data that students may learn from each other but strongly believed that students might not be a good source of information as there is a risk of providing misleading information to other students. For example, one teacher said, “students do not have the expertise to help each other. They may give misleading information to the other student, so it is best that they should seek help only from the teacher, as a teacher is the authentic source of information” (TI.CP1. 34). Teacher-student interaction promoted individual learning and the development of isolated knowledge, which was the next observed trait of teacher-led classroom design.

Isolated Knowledge Development

Learning appeared to be taking place using a pedagogically sound digital game for developing reading skills. Teacher-led classroom design resulted in fostering individual learning within CMG students, as described by a student in the interview, “we focused on our own games. It helped us in developing our knowledge of alphabet sounds [and] of the games’ (SGI.CP2.27). Another student commented, “…if children keep asking other people for help, they will not be able to focus on their own games. They will not understand the game instructions… game instructions were hard to understand [because] they were in the English language" (SGI.CP1:30).

The teachers in the comparison group wanted students to follow an equal pace in game-playing. Based on the learning content, the teachers used to plan which levels of the game their students would play in the session. An example of such an observation is as follows:

> The teacher is providing instructions on what to do during the session. She is sharing objectives for the session and which games students will be playing during the session (O10.CP2:1).

The concept of maintaining an equal pace of learning was also evidenced by teacher interviews when a teacher commented that,

> I used to play the game a day before my session. This helped me in identifying the games [game levels] for the session that match our curriculum. For example, if I planned to work on sight words, I asked students to play games related to the sight words. However, it was not applicable to all students as there were students who had not completed the earlier game levels, so they could not play the games that I identified for the session. So, I had to ask them to play the games quickly so they can catch up with the rest of the class (TI.CP2:19).

Some students completed the game levels earlier than the others did, whilst some lagged behind. Students who completed the game earlier were involved in question-answer sessions about the game as what they had learned from the game, what they liked best about the game and how they could apply these skills in their routine learning (O9. CP1:3), whilst the other students were given the time to complete the game levels planned for that day. Hence, the CMG students demonstrated partial self-paced learning as their teacher was managing their environment, teaching and learning approach.

Students' and Teachers' Behaviours

The CMG students' behaviour appeared to be a reflection of their teacher's expectations within a teacher-directed DGBL environment. The data indicate that the teacher was the source of power and control. She wanted students to behave according to her expectations oriented towards maintaining discipline, listening to the teacher's instructions and avoiding classroom disruptions. Students' behaviours appeared to meet their teacher's expectations; they sometimes deviated from expected behaviour. The following subsections present characteristics of the CMG students' behaviours.

Passive Participation

In the CMG, students' passive participation is defined as sitting quietly, listening to the teachers or fellow students, listening to the game instructions, and observing other students playing the game. Nevertheless, the students were seen actively engaged in playing games on their individual tablets. The following quotes from the researcher's observation notes indicate that all of them demonstrated passive participation within a DGBL environment. The fact that students were not allowed to talk to each other appeared to contribute to passive participation where they were listening to the game instructions, e.g. "some students are sitting quietly, listening to the game instructions and watching game demos (O7.CP1:1), listening to the teacher's instructions, e.g. "the students are listening to the teacher who is setting whole-class targets to achieve during the session (O10.CP2:1) or quietly awaiting the teacher's support, "few students are waiting quietly for teacher's assistance, who was assisting another student. They raised their hands to gain teacher's attention"(O8.CP2:3). Passive student participation within the game environment was also evidenced in group interviews where the students shared,

> We used to play games that the teacher told us to play. Sometimes we were not able to play those games since we hadn't completed the earlier game levels. She would then ask us to quickly play the earlier game levels and move on to play the games she had planned for the day (SGI:CP1:30).

Some students, when stuck on a game level, started observing other students as to how they were playing the games; however, soon, they got told off by their teachers and reminded to concentrate on their own games. At one instance, the teacher asked a student to sit at a distance from the other student to avoid looking at other student's screens, "…how many times have I asked you not to talk to others? Now immediately move away from these students… sit in that corner… next time I should not see you disturbing other people in class" (O8.CP2:3). The teacher's intention appeared to be the avoidance of any disruptions by students to the game playing of other students. This was further evidenced in one of the teacher interviews,

> I never allowed students to talk to each other when they were playing games. I always encouraged them to ask me if they didn't understand anything rather than disturbing other students. I also made sure to sit them at a distance from each other to avoid any disruptions (TI. CP1:33).

and further evidenced in student group interviews with comments such as, “we concentrated only on our own games”, “Ma’am instructed us to only look at our own tablets (SGI.CP1:34).

The teacher’s beliefs of discipline and classroom dynamics promoted passive learning, where students were actively engaged with their own games but remained passive in relation to their peers.

Lack of Motivation and Excitement

Data collected from multiple sources suggests that the excitement of game playing in the comparison group appeared to wear off after some time of game activities. The observation data suggests that the students appeared to be more excited at the beginning of each session but soon appeared to lose excitement and motivation to play games as the session progressed. For example, "students are exhibiting positive body language at the beginning of the session… they are smiling, sitting up straight and fully engaged in playing games (O7.CP1:1)”; “… their eyes are fixed on the tablets, and they are concentrating on the game” (O8.CP2:3). But as soon as they started interacting with each other, the teacher interrupted; discouraged peer interactions, for example, “…stop talking to each other and concentrate on your own work” (O8.CP2:1) or “how many times have I asked you not to speak to others?” (O7.CP1:2). These teacher comments appeared to result in a lack of motivation and excitement. In a few instances, the teacher used a stern tone and harsh words to discourage peers from talking to each other. For example, once the teacher twisted a student’s ear and said,

> How many times have I asked you to do your own work! Can you not understand that? If I see you talking to someone again, I will take this tablet away and ask you to leave the class” (O9.CP1.12:35).

She then moved the student further away from other students. After this incident, the student appeared to lose motivation in playing games, as evident from the researcher’s observation notes:

> … the student who got told off by the teacher is constantly looking outside the window. He is tapping aimlessly on the tablet. The other students near him are sitting cautiously and playing quietly on their tablets (O9.CP1:4).

Similar incidents of over disciplining occurred. The data suggests that this resulted in losing interest and excitement in many other students. The observation data used body language and gestures as indicators of interest or lack of interest. Some examples from the researcher’s observation notes are:

> Two students who were told off by the teacher have lost interest in playing games. One is yawning and the other is stretching his arms and looking vacantly outside the window. They both have stopped playing on the tablets. After a few minutes of staring outside the window, one student has picked up the tablet and started tapping aimlessly on the screen whilst still looking outside the window (O9.CP1:4).

> Students are fully engrossed in playing games; however, they are not exhibiting any sign of joy, excitement, or happiness from their body language. They are sitting like zombies playing individual games (O12.CP2: 2).

Lack of motivation and excitement appeared to be linked to the prevalent learning environment during game-based sessions. The interview data also suggests that the CMG students found the game-based learning environment similar to a traditional one, with the only difference in replacing books with games on tablets. One student shared during the interview:

> …the only difference in our traditional classroom and game-based learning classroom was the use of tablets instead of books and sitting in a semi-circle instead of sitting in rows. We were not allowed to talk to each other as in our traditional classroom. We were not allowed to even laugh or express joy upon getting rewards in the game. Our teacher really got angry with us if we talked to each other or if we slightly giggle while playing games" (SGI.CP2:23).

Upon asking about how they would like to play games, one student shared,

> I liked to sit relaxed and just wanted to have fun while playing games. I would like to talk to my friends and want to show them the rewards I received… things I could collect in the game to dress up my monster. I liked the scarf and the hat that I got for my monster in the game… and the goggles… (SGI.CP2:21).

Another student shared

> I like playing games but I did not enjoy it in the class as the teacher got very upset if I talked to other students … I wanted to show my friends what rewards I got and how I dressed up my monster… but the teacher would get angry if I talked to someone in class (SGI.CP1:28).

The teacher interviews suggest that the teachers' point-of-view on maintaining discipline was linked to their teaching philosophy. They thought of the teacher as a source of control and power over students. They thought a well-disciplined cohort would have a good impression on other teachers or the school head. This is evidenced in the following interview response:

> When children are in their normal traditional classes, they tend to mess around with each other. In game-based sessions, I feared that they would display the same behaviour. So I told them to sit at a distance from each other and avoid talking to others during the class. I told them that it would give a bad impression on other teachers or the head-teacher if they happened to see them messing up with each other. The children understood and tried to maintain good discipline in the class (TI.C2:22).

The responses obtained from students and teachers provide a contradicting view of an ideal game-based learning environment. The students wanted more freedom in playing games by expressing joys and interacting with peers, whereas the teachers wanted a disciplined environment where students are focused on their individual game playing. The contradiction in teaching philosophy and students' ideology in the CMG appeared to result in a lack of motivation and excitement while playing games.

Secretive Behaviour to Avoid Teacher's Confrontation

The game-based sessions in the CMG appeared to display two levels of behaviours. The first was the expected behaviour as idealised by the teacher, and the other was the secretive behaviour that students displayed in the absence of the teacher or when the teacher was turned away. Expected behaviour reflected the teacher's idea about 'ideal classroom behaviour', a disciplined classroom where students sat quietly concentrating on their own work without disturbing others. Contrarily, secretive behaviour refers to the students' opportunities for displaying behavioural traits that appear to contradict the teacher's idea of good classroom behaviour. Examples of this behaviour included secretively peeping on other student's screens and giving them affirmative nods as praise and talking to other students secretively when the teacher is busy supporting other students (O11.CP1:2). It was interesting to note that students appeared to switch behaviours as soon as the teacher left the class. An example of switching behaviours is evident from the researcher's observation notes:

> The teacher has left the room for a little while. Instantly, students feel at-ease. Their excitement of playing games is obvious from their facial expressions and joyous squeals. They are talking to each other, showing their games and rewards to each other. But this joyful ambience could not last long as the teacher returned. The students immediately revert back to their teacher-expected behaviour… but the teacher has caught them talking and giggling. She is very angry with the students. She says: "unbelievable! You guys can't even sit quiet for two minutes. The moment I was gone and you people started talking to each other and made this place look like a fish market… shame on you all! You people do not deserve to play games… if I see someone talking again, I will take the tablets away and send you back to your normal classes. Now sit back and play your own games… Don't force me to take strict action against you" (O7.CP1:3)

Switching between expected and secretive behaviours was also discussed during group interviews. A student shared:

> The game was funny… the monster was ticklish, it used to giggle when we fed him the 'right' sounds… and it will spit the 'wrong' sounds…. it made me laugh when it made funny noises….but the teacher used to get angry when I laughed…. I always wanted to show my friend what funny things my monster was doing… I showed it to my friends [sneakily] when the teacher was busy helping some else in the class… (SGI.CP1:38).

The teachers were aware of students' switching of behaviours, which they considered an element of breaking classroom rules or norms of good behaviour. For teachers, "…good classroom conduct means listening to teachers and always behaving the way teacher expects students to behave" (TI.CP2:20). The data obtained from multiple sources suggests that the CMG students were pretending to behave in teacher-expected ways whereas, in reality, they displayed traits of secretive behaviour (e.g. interacting with other students, expressing joy, sharing game achievements, etc.) as the predominant behaviour during the game-based sessions.

Change in Teachers' Beliefs.

The interview data revealed that after the DGBL intervention, the CMG teachers appeared to have a change in opinion on restricting peer collaboration in class. Teacher interviews conducted during Phase 3 of the research (after the discontinuation of DGBL sessions) revealed a possible shift in teachers' beliefs about teaching where the teachers appeared to be flexible about peer interaction. One teacher reported:

> …after DGBL sessions, we have noticed a change in students' attitudes towards each other…They are more willing to help each other if someone is stuck on a learning task…. Perhaps we should also encourage more peer support in class… (TI.CP3.22)

Another teacher shared:

> I think game-based sessions have improved student relationships with each other. They are now willing to help each other in class. I have now changed my classroom layout…students sit in small groups so they can discuss classroom activities with each other. I'm not sure if our headteacher will approve it, but students like it, and they are becoming more confident…. and it is certainly having a positive impact on student learning (TI.CP3.24)

Teachers' shift in beliefs about teaching shows their acceptance of integrating technology, such as digital games, and their readiness to transform their teaching practice to include peer learning in their regular sessions.

Confidence in Reading Using the game

During the study, the CMG students gained confidence in reading. They reported improvements in phonological awareness, decoding and blending of sounds, and improved oral fluency not only in English but also in Urdu. During the group interview, a student shared:

> "I have learned phonics through the games… I can now read big words in English which I couldn't read before… I can apply the same techniques in reading Urdu… I enjoy reading Urdu more than English…[because] we speak Urdu and I understand big Urdu words better than English (SGI.CP1:13).

Another student shared during the group interview:

> Our knowledge of alphabet sounds has improved a lot after playing games. The monster in the game taught us well…. It would say Abracadabra… and a door opens… then it would guide us to play the game… when we made mistakes such as fed him the wrong alphabet 'sounds', it used to throw up… and when we fed him the correct sound, it would giggle and give us stars [rewards]… it would get fat when we feed lots of correct alphabets sounds…it would make funny noises and give us rewards…. I like collecting stars [rewards] because I can then buy things [within the game] to dress up my monster (SGI.CP2. 27).

Confidence in reading appeared to be the outcome of regular interaction with the game and getting timely feedback. "We liked to play games, and we tried not to skip any sessions so we could play more games… (SGI.CP1:29)", said a student during the interview. Another student mentioned that the feedback system in the game was very useful and helped them in reading. She said:

> "…teachers used to be busy in helping other students so I listened carefully to what the monster was saying… for example in the flower game, we had to make the flower bloom by clicking on the correct sounds… if I clicked on the wrong sound, the monster would say 'no, no, no", then I would listen to the sound again… if I would make a mistake again, the monster will give me a hint for the correct sound… [so] I learned a lot from the feedback monster was giving us in the game (SGI.CP2. 32).

Teachers reported that students interested in playing games and who displayed best behaviours in class gained more confidence in reading than students who were disruptive and were less interested in game playing. For example, a teacher shared during the interview:

> "there were students who were a bit shy in the beginning, but with consistent game playing and staying focused on playing their own games, they acquired better confidence in reading and handling technology…these students rarely needed a teacher's support… they preferred to resolve issues on their own and made the best use of in-game feedback mechanism (TI.CP3:15)

Overall, it appeared from the data that students who played the games regularly and with a consistent focus gained more confidence in reading in English and Urdu language.

6.1.2 *Experiment Group*

This section presents the behaviours of the EG students categorised in two subsections: classroom design and student behaviours. The characteristics of classroom design appear to influence student behaviours, instigating categorisation in the following subsections.

Students Initiated Classroom Design

The EG was given the freedom to sit anywhere in the classroom and play the digital game (TYMTR). There was no teacher present in the classroom. The students appeared to sit in small groups. Initially, there were few students sitting alone, at a distance from small groups, but they joined groups as soon as they wanted to share their joy of achievement with others or if they needed to ask for help. The overall classroom configuration consisted of small groups consisting of four to five students in each group (O1.EX1:1). The outstanding characteristics observed in the student-initiated classroom design within the EG were the formation of a peer support network, collaborative learning, and the opportunity to solve problems, as described in the following subsections.

Peer Support Network

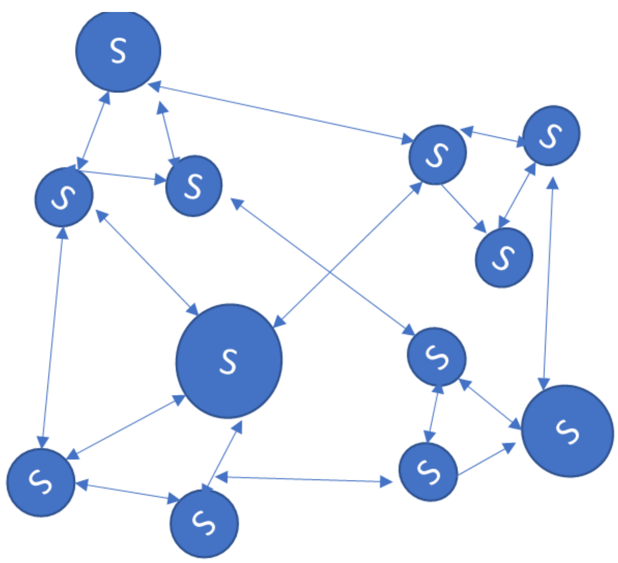
The EG was observed to manage their own learning process using the digital game on tablets. These students developed their own peer support networks where students sought help from each other. Students with more experience and knowledge of playing games helped struggling students voluntarily and were seen as 'gurus' to help others, as evident in the following researcher's observations:

> A student struggles in understanding the instructions. She is seeking support from the person sitting next to her, who is guiding her in interpreting the instructions (O1.EX1:3).
>
> After a while, the same student is stuck again. Another person sitting next to her offered support. Together, they unpack the issue and continue with their own games (O1.EX1:4)

The concept of peer support was also prominently discussed in student group interviews. For example, a student described, "…when I was stuck on something in the game, I asked my friends for help. If they also didn't know what to do, we used the hit and trial method to solve the problem" (SGI.EX1.13). Similarly, another student shared that, "…there was no teacher in the room to help us if we get stuck on something. The best thing was to ask another student for help who has already completed that game" (SGI. EX3.14). Seeking help defined a new role for more experienced and knowledgeable students where peer support was seen to be flowing freely from high knowledgeable to low knowledgeable students. Figure 6.2 presents a visual model of a peer support network as observed in the EG.

Figure 6.2

Peer support network mesh in the experiment group



All students were collaborating and learning from each other, and it appeared as if they were on the lookout for each other to help. Although everyone was helping or sharing, the 'gurus', represented by larger circles in Figure 6.2, reached out to those who desperately needed help (O4.EX2:2). Peer support was needed more in the initial sessions, which tapered down with time towards the later sessions, where only occasional incidents of support were evidenced (O6.EX2:1).

Collaborative Learning

Another prominent characteristic of student-initiated classroom design was collaborative learning. Students appeared to collaborate with each other in comprehending game instructions or sharing game techniques with other students. Some examples of such observations are:

> One student shows another student in the group how to click and drag all the ducks to the pond at once (O1.EX1:3).
>
> A student informs the other student that she cannot skip game levels; she has to complete the game level before continuing to the next level (O1.EX1:3).
>
> Another student who has completed the game supports other students who are still learning to play the games (O1.EX2:1)

The EG students set an example of constructing collective knowledge with peer collaboration where all students were contributing in their own capacity to construct knowledge, be it about the use of the tablets, completing a particular game level or dressing up their monsters. The students' group interviews also evidenced seeking help from peers or learning collaboratively. For example, one student shared that,

> In the beginning, I was unable to understand the game instructions as these were in the English language. I tried to listen to the instructions again and again but still couldn’t understand. Then I asked my friend sitting next to me. She guessed by looking at the visual cues, and together we figured out the game was instructing us to find the words beginning with ‘f’ sound (SGI.EX1: 33).

In another example, a student shared, “in the [duck] game, I wanted to take all the ducks together to the pond but didn’t know how to do it. I was dragging each duck to the pond, which was taking too much time. I asked my friend. She showed me the trick to gather all the ducks and drag them to the pond together” (SGI.EX2.14).

Students also appeared to share their achievements and excitement with each other or discuss what game rewards they could get. Examples of such observations are:

> The students talk to each other only when they want to share something from the game (O6.EX2:2)

> Students show their in-game rewards or achievements to each other before handing over tablets (O4.EX2: 3)

> Sharing of achievements mostly happens towards the end of the session (O6.EX2:3)

The above observations coincide with students' comments in the group interviews. For example, one student shared, " before returning tablets, we used to discuss what we would like to have for our monster the next day… so we kind of planned beforehand as how many points we would need to buy new stuff for the monster" (SGI.EX1: 47)

A critical review of observation revealed that initially, sharing occurred mostly throughout the session in the early days, but as the days went past and students became experienced in playing games, sharing appeared to occur towards the end of the sessions, while the students were focusing more on individual learning through games.

Opportunity to Solve Problems

One of the noticeable characteristics of student-led classroom design was the opportunity for the students to solve their own problems. With no teacher support available during the DGBL sessions, the students were provided with the opportunity to identify problems, find solutions, and subsequently avoid future problems. The EG students appeared to avail this opportunity to develop problem-solving skills. The problems observed during the sessions were related to the use of technology or understanding the game instructions. For example, during a group interview, a student shared her experience of problem-solving as:

> By accident, I clicked on a tablet button, and the game was switched off. I did not know how to start the game again. The tablet screen became locked. I was clicking on the screen, but nothing was happening. I carefully looked at the screen. There was an image of a padlock. I found out that if I drag the padlock to a side, the tablet screen gets unlocked. Once unlocked, I clicked on the game icon and started the game. So that's how I solved this problem and remembered not to click the back button of the tablet (SGI. EX1: 33).

In another example, a student shared her experience of collective efforts of problem-solving in comprehending game instructions as:

> In one of the game levels, the instructions were to read the sentence aloud, so the monster knew what to do. I guess I did not understand the instructions properly. I was saying the

> sentence out loud, but nothing was happening in the game. I asked another student in the group, but she also didn't know what to do. Using the hit-and-trial method, we figured out that we had to click on the correct option after saying the sentence aloud. So, we found the solution and then shared it with other students who were also struggling to get it right (SGI. EX1: 43)

The data obtained from observations and student group interviews confirm that the small group layout of the classroom and interactions between the EG students provided opportunities for sustainable learning by sufficiently dealing with the problems.

Student Behaviours

The behaviour of EG students appeared to be the outcome of the freedom in arranging their learning environment. The data indicate that students used their agency to create a DGBL environment that promoted naturalistic participation and interaction to construct sustainable learning. As a result, learning emerged as an active process of meaning-making when students interacted with the games and with each other in a social classroom context. The following subsections present behavioural characteristics of the EG students' in a DGBL environment. These include active participation, excitement, self-awareness, and commitment.

Active Participation

In this study, active participation is considered as student-student interaction and student-tablet interaction while playing games. Across six weeks, all EG students appeared to be actively interacting with the game and actively participating with their peers by asking questions and helping each other. This active participation is evident in the following researcher's notes:

> Today is the first day of game-based learning. Students are cheerfully talking to each other, showing the games they are playing. Some students are struggling to understand the instructions. The other students in groups volunteer to help. Whenever someone gets stuck in the game, other students offer help (O1.EX1:2)
>
> We are in the fifth week of game playing. Most of the students are playing games independently without seeking help from others. However, they are actively showing their game achievements to other students in the group (O5.EX1: 1)

Students appeared to be actively seeking help or providing support to struggling students. For example, some students were struggling to find the options to create the monster, "how do you get there to dress up your monster? I want to change my monster's gloves and hat…" (O2.EX1.P1.0:39). Another student in the group showed the process of accessing options to dress up the monster. The following extract from the recorded observation evidences this:

> Student A: How do I get there to dress up my monster?… I want different gloves, just like yours.
>
> Student B: You need to complete this game level first….
>
> Student A then went on to complete the game level. After completing the game level, Student A again asked Student B to help to find the options to dress up the monster.
>
> Student A: Ok, I have completed this level. How do I dress up my monster?
>
> Student B: Let me see…., here on the left top corner is the icon… it looks like a monster… Click on this… you will see this screen with your monster on and the stuff you can have for your monster. You'll have more of it [accessories] when you complete more game levels. You can choose from here… and dress-up your monster as you like… Tada

This conversation illustrates active participation in solving a problem through peer learning. One student approached the other student without hesitation. The other student responded immediately and provided support.

There was no expectation for students to display their best behaviours as they were in charge of their actions. Students were cheerfully talking to each other and discussing the options available to create their monsters, for example. "I like to have a fiery looking monster with massive teeth and horns" (O2.EX1.P1.1:28), "… I like a modern fashionable monster with nice outfits, colourful scarfs, hats, and goggles…" (O1.EX2.P1.2:59). It seemed that small group-sitting arrangement allowed them to look at each other's screens and pass encouraging comments such as "Wow! Look at that…" (O1.EX1.P1.10:56). Looking at each other's games also appeared to promote peer learning. For example, comments like: "how did you get there? I couldn't find this in my game…" (O2.EX2.P2.1:40) enabled students to explore different options which they may not have experimented before.

The students were listening to the game instructions and carrying out the instructions in playing games. At one stage, it appeared that some students were struggling to hear or understand game instructions. This was evidenced in the researcher's observation notes "students bring the tablets closer to their ear to listen to the instructions … some students are listening to the instructions twice before carrying out the task” (O3.EX1:3). Those who understood the instructions actively helped others to comprehend instructions and play the games. Again evidence in the researcher's observation. “one student is struggling to understand game instructions. She is bringing the tablet closer to her ears but is still unable to understand the instructions. The student sitting next to her offers help and demonstrates how to play the game” (O1.EX1:3). The issue of listening and understanding game instructions was also highlighted during students’ group interviews. A student shared, “the background music was a bit loud due to which I had trouble understanding the accent… I always got muddled up between ‘m’ and ‘n’ sounds… I used to ask my friend… she is good in English; she used to understand the game instructions better…” (SGI.EX2:8). The opportunity to play the digital game with the freedom to seek help from peers presented a lively classroom with active student participation that fostered positive and friendly relationships between students. This was also evidenced in student group interviews,

> Our game-based sessions were very different from regular school lessons. In games session, we were freely talking to each other without the fear of being told off by the teacher. Most of the time we would ask other students or our friends about things we don’t understand in the game… We never do this [peer learning] in our regular classes…we fear that other students will copy our work and will get more praise from the teacher…. But in games session, it felt alright to share with other students and help each other. There was no competition… and no feelings as a teacher would praise one student more than the others…. We all were playing equally good…(SGI.EX1.26).

Although the EG teachers did not facilitate game-based sessions, during interviews, these teachers commented on a change in student behaviours. They witnessed active participation and a supportive learning environment in their routine sessions where students were willing to help each other and actively facilitate struggling students in completing classwork,

> I think these game-based sessions have brought a considerable change in students’ behaviours. Earlier they would sit quietly in class and hesitate to participate in class discussions… I would hardly get a response from them…. [but] now they are actively participating in discussions… (TI.EX1:42).

At another instance, the teacher commented on students’ behaviours they acquired during game-based sessions,

> Earlier, they [students] did not like to help each other… they would hide their work from the student sitting next to them…but now they are actively supporting each other… they volunteer help if someone is unable to understand, for example, math questions or science tasks…. I would say they are sharing my burden by extending support to others…and I guess I also like the way they are interacting with each other… Now, I don’t mind them talking to each other as long as they are not misbehaving or fighting (TI.EX1:53).

The data obtained from multiple sources indicates that student agency to design a game-based learning environment promoted active participation. Students actively participated in making-sense of game activities by helping each other. This behavioural trait was not limited to the game-based sessions but also transferred to regular school sessions afterwards.

Excitement

Data from observations and student group interviews suggest that the EG students not only appeared to be excited during game-based sessions but consistently maintained this excitement until the last session. Cheerful expressions, loud discussions and joyous squeals were some of the indicators of excitement observed during game-based sessions, as evident from the following researcher's observation notes,

> Throughout the session, students' faces are beaming with joy upon receiving tablets. They are settling in small groups, excited and happy…eager to explore games… they are excitedly creating monsters in the game… they are cheerfully talking with peers showing their game achievements…. (O1.EX1:1)

Interest and excitement in playing the digital game were also evident from their curiosity about what other students were playing. Students checked on each other's screens to see what game levels their peers are at, "after every few minutes, students excitedly look at each other's screens" (O1.EX2:4). The excitement was evident from their beaming faces and animated chatter while sharing game achievements with others during the sessions, "…students are showing their games to each other and excitedly talking… looking at the game…using hand gestures to facial expressions for providing feedback (O3.EX1:3). This was also evidenced in the students' group interview; for example, a student shared, "… the best thing in game-based sessions was the opportunity to talk to each other, showing our games and commenting on each other's games, especially the monsters…. (SGI.EX1:25).

The excitement grew as they completed game levels and received more rewards in the game. Examples of such observations are evident from the researcher's notes:

> This is the first week of game playing. One student is struggling on a game level. She is seeking help from a fellow student…The struggling student squeals with joy upon completing the game level (O2. EX2:2).
>
> A group of students is playing together by helping each other to get more rewards. They are excitedly discussing how to use rewards to dress up their monsters (O2. EX2:2).

All EG students displayed positive body language evident from their postures when they were engrossed in playing games. Examples of such observations from the researcher's observation notes are:

> All students are fully engrossed in playing games. Today they seem to understand the game better than before, which is evident from reasonably long periods of individual concentration on games. They are not even distracted by people talking around them (O2.EX2:2).

> We are in week six of game playing. Today it seems as if students are taking games seriously as a learning material rather than an entertainment item. They are fully engaged in following game instructions and concentrating on individual work (O6.EX2:2).

The element of excitement was also evident from students' attendance. The teachers reported improved attendance during game-based sessions, "… [students'] attendance improved…earlier they would miss at least a day or two during the week, but I have noticed they are attending school regularly ever since the game-based learning started" (TI.EX1: 42). This was further evidenced in the student group interview, "I never wanted to miss a [game-based] session… sometimes my mother wanted me to go to work with her… but I wouldn't listen to her…. because I didn't want to miss game-based sessions at school" (SGI.EX2:14).

Students' excitement was also evident from their eagerness to attend game-based sessions. A teacher shared during the interview,

> My sessions were timetabled before game-based sessions. I noticed that students were always very excited to attend game sessions... they wanted to be the first to attend the game-based session. They would hurriedly complete their work and be ready to go [to the game-based session] five minutes early … sometimes, they compromised on their work quality just to be able to play games on tablets in the next session... (TI.EX1:64).

Another indicator of excitement was prolonged game playing. Students appeared to continue playing games even after the session was over. They had to be asked several times to return the tablets and go to their regular timetabled sessions. This is supported by the following researcher's notes:

> After 40 minutes of game playing, students are asked by a data collector to stop playing and return the tablets. Students have ignored the call of returning the tablets. They are pretending as if they haven't heard the call…. [students] are not ready to return the tablets… (O2.EX2:4)

> this is the third call to return the tablets, and so far only a few students have reluctantly returned the tablets…the data collector is now literally snatching the tablets from their [students] hands (O2.EX2:5)

This was further evidenced in students' group interviews as "we wanted to play games for longer… we hated to return the tablets" (SGI.EX2:29). Another student shared, "… usually, I was the last one to return the tablets during game-based sessions… I used to pretend as if I haven't heard the call to return the tablets and I kept playing until ma'am snatched it from my hand…(SGI.EX1:30). The teachers also reported this during interviews, "one thing I always complained about the games session was the time it took for students to settle back in regular sessions. First, they always returned late from those sessions; second, they never wanted to learn traditionally… they always wanted to have fun" (TI.EX1.67).

The data obtained from multiple sources indicate that the EG students demonstrated excitement and interest in playing games through various indicators, such as positive body language, facial expression, engagement, eagerness, etc. This excitement did not wear off as the sessions progressed.

Self-Awareness

This research considers self-awareness as an ability to reflect and respond to uncertainty and pressure, showing resilience in facing challenges and being aware of and planning to overcome personal limitations (Silvia & Duval, 2001). The researcher observed several instances where the students struggled to understand game instructions or apply strategies to complete the game levels. Still, despite such challenges, they never gave up playing the game. The following are some examples from the researcher's observation notes:

> Some students seem to be struggling to understand or hear the instructions. They are bringing the tablets closer to their ears. They seem determined to follow the instructions without asking for help. Sometimes they are listening to the instructions twice before carrying out the task (O3.EX1:3).
>
> One student looks frustrated upon not understanding the game instructions. She has stopped playing and put the tablet on the floor. She is observing other students in her group as to how they are playing. She is enjoying watching other students playing games. It has been a few minutes that she is observing others… now she seems to learn a few game strategies, gathers enough confidence and motivation to start playing on her tablet again. She has picked up her tablet and started playing. This time she is confidently playing (O4.EX2:2).

The above examples demonstrate that the EG students were aware of their challenges. They devised solutions, such as bringing tablets closer to their ears or taking a break, observing others how they were playing, and then using the same strategies for playing their games.

Showing resilience in facing challenges and empathy with other students in the same situation was also evident from students' group interviews. A student shared:

> I was trying to complete a game-level. It was a space mission where we had to match the sounds to build a space ship. I knew the sounds very well, but I was still unable to complete the level. Despite many attempts, I was unsuccessful. I stopped playing for a while and thought that I must be doing something wrong, which is why I couldn't complete the game-level. I sat there thinking about what I was doing wrong. I used error-and-trial method; I found that the bottom part of the spaceship was to built before moving on to the top…later, whoever got stuck in that game, I went to help them…" (SGI.EX1:60).

From the above account, it appeared that the student was aware of her lack of understanding in using the correct strategy to complete the game level. Instead of asking for help from others, she reflected on her current practice and used alternate strategies to arrive at the solution. The student also appeared to exhibit empathy with other students. She was aware that others might also come across the same challenge, and thus went out of her way to help others overcome that difficulty, "…later, whoever got stuck in the game, I went to help them…" (SGI.EX1:60). This behavioural trait was also evident during observations when students appeared to extend support to other students, "…some students in the groups are watching over the other students. They are providing instant support to others if someone is stuck in the game" (O2.EX2:1).

Interestingly, teachers of the EG also reported on students empathising with other students during regular sessions,

> I have noticed a significant improvement in their behaviours. Earlier they never wanted to share their work or even help out each other, but now they are willing to extend support to other students. If a student finds a solution to a problem, she would instantly share it with other students… (TI.EX1:43)

The data also suggests that the students appeared to be willing to take challenges. A teacher shared during the interview:

> before the game-based sessions, students wanted me to solve all math exercises for them so they could copy of the board… but now they are willing to take the challenge. They want me to show the work out to solve math problems, but they are motivated to solve math exercises on their own… (TI.EX1:39).

The above accounts demonstrate self-awareness, where the students realised that they needed to change their approach to tackle the tasks. The students were also showing resilience in facing challenges. They did not give up on repeated failures. The data suggested that the students were aware of their skills and willing to take calculated risks to provide them with enough challenges that they could handle. They seemed to be cautious in their approach to taking on challenges, where they asked teachers during regular sessions to facilitate them in problem-solving. Whereas, during game-based sessions, they were using error and trial methods to solve problems or seek peer support.

Commitment

This research considers commitment as a consistent behaviour and student willingness to achieve desired academic, social and personal skills (Hanson, 1955) through playing games. Indicators of commitment are derived from Hanson (1955) to suit the context of this research which include consistent focus, motivation to complete game levels, integrity, self-paced learning and time management, and demonstrating ownership of decisions and actions while playing games. Some of the indicators demonstrated by students are exemplified below:

Consistent focus

During observations, the students exhibited a consistent focus on playing games, which is evident from the following researcher's notes:

> It is the fifth day of classroom observation. The students are fully engrossed in playing games. Their gaze is fixed on tablets, yet they are aware of their surroundings. They know if a student sitting next to them needs help. They quickly facilitate the student in need and get back to their game-playing (O5.EX1:2).
>
> …they [students] are committed to playing the game right. They are listening to the instructions, again and again, sometimes by bringing the tablets closer to ears… their focus is to complete the game levels by getting maximum rewards. (O4.EX2:1)

Motivation to complete game levels

Multiple data sources indicate that the primary focus for some students was to achieve maximum game rewards. A student shared during the interview, “ I wanted to get maximum points so I can buy more stuff for my monster” (SGI.EX1.25). Another student mentioned, “… I liked playing the duck game most… I played it twice or thrice just to have fun before moving on to the next game” (SGI.EX1:26). Another student shared,

> Some of the game levels were challenging… at first, I struggled to play games to achieve targets, but I didn't give up. With a little help from my friends, I got them right, but I practised playing those games until I mastered the skills in those levels. (SGI.EX2:14)
>
> This shows that game design elements such as rewards, fun, and challenge helped improving students' commitment towards playing games.

Integrity

Students also appeared to demonstrate integrity and ethical use of technology by picking tablets with their name tags on and using tablets responsibly to avoid any accidents in class. This is illustrated by the researcher's observation notes:

> Today is the fifth day of the game-based session with EG 1. As demonstrated in earlier observations, students enter the room in a line. They pick a tablet with their name tag on and sit on the floor in small groups. (O5.EX1.1)

Students' responses in group interviews also supported this observation:

> ... there was no teacher in our game-based sessions. We used to pick the tablets with our name tags on and started playing from where we left the day before…if we needed more practice to improve our skills; we used to repeat the games played previously. (SGI.EX1:21)

Students also shared that they liked to take good care of their tablets as they never wanted to cause damage due to mishandling the tablet.

> We tried to handle tablets carefully…it was something that we have never used before, and maybe we will never own it in future; therefore, we wanted to look after the tablets… we used to wipe the screens before we started playing… we tried to hold the tablets firmly or put on our laps or floor to avoid any damage due to accidental falls. (SGI.EX2:11)

It appears that the opportunity to play games on tablets developed a sense of responsibility in students, which was evident from their cautious behaviour in handling tablets to avoid any damage. Also, the discipline to pick up tablets with their name tags and planning to repeat playing games to gain mastery of skills could be attributed to integrity as students were not expected to repeat playing games to gain mastery. It was something they initiated on their own, probably due to developing a sense of responsibility or self-commitment.

Self-paced learning and taking ownership of decisions

Self-paced learning was another indicator of commitment that students exhibited during the game-based sessions. The students appeared to manage their learning through the games, "… a student is repeating the game that she played yesterday. She is having a quick review before she decides to play a new game" (O3.EX1:3). Some students appeared to repeat the games until they become proficient at a game level. A student mentioned in the interview, "I used to repeat game activities to strengthen my reading skills…if I got even one sound incorrect, I would keep playing the same game level until I get all of them right" (SGI.EX2:19). In another instance, a student shared, "I tried to listen to the instructions carefully, so I don't make mistakes" (SGI.EX2. 12).

It also appeared from the data set that the students were committed to providing support to each other. They were volunteering support to peers who were struggling to play the games. It was evident in the researcher's observation notes that the students were showing a positive attitude and determination while providing volunteer support to struggling students: "students who are providing support to others are exhibiting a positive body language. Not a single student shrugged shoulders, discouraged or refused if someone asks for help" (O2.EX2:1). Teachers also commented on this behavioural trait during the interview, "students have now started to own their decisions. They help each other in class. Earlier, they would not like to help each other, but now they volunteer for help if anyone struggles in class"(TI. EX2:23).

The evidence obtained from multiple sources confirms that the EG students demonstrated a commitment to playing games which helps them develop academic, personal and social skills in a fun and exciting digital game-based environment.

6.2 Skills and Competencies

This section refers to the skills and competencies students demonstrated during DGBL sessions. The present study considered skills as specific abilities acquired by students in DGBL sessions, whereas competencies were regarded as inherent qualities students demonstrated in complex situations based on their knowledge, skills, attitudes and values (Calhoun et al, 2002). The findings from this section helped explore the impact of two different DGBL environments in developing skills and competencies in students. The results also helped to examine teachers' role in assisting students in developing desired skills and competencies. The following subsections present skills and competencies demonstrated by the comparison in Section 6.4.1 and EG in Section 6.4.2 during DGBL sessions.

6.2.1 *The Comparison Group*

Skills and competencies demonstrated by the comparison group appeared to be the outcome of a teacher-directed DGBL environment. The data indicate that the teacher's control and power in establishing a classroom culture had an impact on skills and competencies development by students. Table 6.2 shows the competencies demonstrated by the CMG students.

Table 6.2

Skills and Competencies Demonstrated by the Comparison Group

Comparison Group Competencies
Reading skills
Transfer of skills from English (L2) to Urdu (L1)
Attentive listening and reciprocal interaction with the tablet
Self-regulated learning

The following subsections present skills and competencies demonstrated by the CMG students in a teacher-directed DGBL environment.

Attentive Listening and Reciprocal Interaction with the Tablet

Students appeared to be attentively listening to game instructions on the tablets. They demonstrated the ability to comprehend the information and carry out the necessary action on the tablet. The following quote from the researcher's observation notes indicates that the majority of students were paying attention to the game instructions to perform the required action on the tablet:

> … [students] body language shows they are paying attention to the game instructions. Sometimes they listen to the instructions twice, and sometimes they bring tablets closer to their ears if they can't hear clearly. (O11.CP1:1).

Students appeared to be aware of the importance of attentive listening in playing games. A student shared during the group interview, "…we can only succeed in games if we listen to the instructions carefully…." (SGI.CP1:31). The game instructions were in English, which students were not well-versant as it was not students' first language. Despite the language limitations, the students appeared to apply the game actions to achieve the required outcome. Students stated that the design and layout of the game, including visuals such as arrows, hints or example demonstrations, helped to understand the instructions,

> In the beginning, I couldn't understand the instructions in English. So I randomly started to click on the screen. After a while, I noticed that the game demonstrated what to do. That's how I understood what I needed to do to play the game. (SGI.CP2:25)

Another student shared,

> I had a tough time understanding the instructions in English. Initially, I had to listen to it [instructions] twice or sometimes three times. I would say that most of the time, I didn't know what the monster in the game was asking. I watched the demonstrations and looked for the visuals to help me understand what to do" (SGI.CP1:31)

Once the students understood the instructions, they appeared to maintain a sustained interaction with the tablets following the instructions. The following researcher's observation notes suggest that students were adopting different strategies to understand the game instructions:

> Students are applying different methods to understand game instructions. Some are listening carefully; some are asking for the teacher's help, and some are randomly clicking on the screen as if using error and trial method… those randomly clicking on the screen appear to have lost motivation to play… (O7.CP1:2)

The data also suggested that motivation to play the game was linked to being attentive in the game and being able to understand instructions. One student shared in the group interview:

> the instructions were in English, and I don't know English… I didn't like playing the game as I didn't know what to do. I was just randomly clicking on the screen to let something happen in the game….if I tried to ask my friend to help me; the teacher would get cross and threaten me with punishment… the teacher was busy helping other students, but she told me to listen to the sounds and click on the right sound. (SGI.CP2:13).

The evidence suggests that the digital game provides students with an opportunity to develop active listening skills, comprehend the information and take prompt action to play the game. It was also evidenced that students who struggled to be attentive in listening or who were unable to understand the instructions tended to lose motivation in playing games.

Reading Skills

Indicators of reading skills include phonological awareness, word decoding, word recognition, oral fluency, and comprehension reading. Improvement in reading skills was evident from students' responses in group interviews, where they shared that playing through the digital game has improved their reading skills, “ We learned alphabet sounds from the games… our reading skills have improved a lot... the words that we could not read without help before, we can read them now using phonics” (SGI.CP1:17). Another student shared,

> Our reading skills have improved. The monster in the game helped us in finding the word sounds… for example, in the beginning, I did not know how to read the word ‘forest’… but after playing the game, I know how to blend sounds to say the word ‘forest’. (SGI.CP1:21)

Another interesting finding was the students’ ability and motivation to read outside textbooks. Initially, their reading was restricted to textbooks only, but after acquiring some reading skills, students mentioned reading texts other than textbooks, which is evident from the following quotes from students’ group interviews:

> We used to read from our school books only as we do not have access to any other reading material. Also, before playing games, we did not like reading in English as it was difficult... we usually used to rote-memorise the words…but games have helped us in using phonics and blending sounds to make words… (SGI.CP1:11)

> …. we can now read signboards in English, read advertisements and newspaper headlines… although sometimes we don’t understand the meaning, but at least now we can read…(SGI.CP1:13)

> I like reading billboards whenever I am travelling on a bus… My sister and I play a reading game… whoever reads the most signboards will win. (SGI.CP2:15)

Teachers also endorsed improvement in reading skills as an outcome of playing the digital game; however, in their view, only the students who were able to understand game instructions were benefitted from games. Following is an example of a teacher’s response in the interview:

> Students were interested in learning through games… some were listening to the sound attentively, then clicked on the correct alphabet in the game… but some were randomly clicking on alphabets; if it happens to be incorrect, they will click on another alphabet until they got it right. These students were merely playing games for fun sake rather than for learning… only a few students learned from the games effectively. (TI.CP1:30).

On another instance, the teacher reported that students who were unable to understand the game instructions also showed some improvement, “there were a few students who were using hit and trial methods to play the game also showed improvement…, especially in phonological awareness” (TI.CP1:30).

In summary, the evidence in the preceding paragraphs suggests that the digital game helped most CMG students improve their reading skills; however, the extent of improvement varied across students depending upon their attitudes towards game playing.

Transfer of Reading Skills from English (L2) to Urdu (L1)

This section reports on the transfer of reading skills from English (L2) to Urdu (L1) immediately after playing the game using tablets. The ability to transfer reading skills from English (L2) to Urdu (L1) was evident from student group interviews and teachers' interviews in the comparison group. Following are examples of students' responses,

> Urdu can also be read like English using phonics techniques. Our teacher told us how to read Urdu using phonics and blending of sounds in Urdu… for example, the sound of letter 'b' is similar to the sound of letter 'ب' in Urdu (SGI.CP1:35).

> We enjoy reading in Urdu because Urdu is easy to read and understand… English is difficult….even if we can read English words; we do not always know the meaning (SGI.CP1:21)

During DGBL sessions, teachers appeared to establish a deliberate relationship between English and Urdu reading by drawing similarities in alphabet sounds (phonological awareness) in both languages. Some of the teachers asked questions to let students reflect on the use of phonics in Urdu or the Arabic language when they read the Quran, "Think how you can use the same phonics techniques as in the games in learning Urdu… which sounds are similar in English and Urdu and which letters do they represent in English and Urdu?" (O9.CP1:4). In response, students appeared to establish a connection between similar sounds in both languages. Examples of students' responses were, " the sound of the letter 'L' is identical to 'ل' in Urdu…. The sound of the letter 'M' is same as 'م' in Urdu…(O9.CP1:5). Another example of a student response noted during classroom observation showing student's understanding of transferring skills from one language to the other was, "…we read the Quran using phonics method… so we can also read Urdu using the same method… for example, if we blend the sounds 'ك' (ki) 'تا' (ta) 'ب' (b), it becomes 'كتاب'(kitab) [book]…" (O10.CP2:4).

The data suggest that teachers' deliberate interaction with students in establishing a link between English and Urdu reading encouraged students to experiment with phonics techniques, such as blending sounds to read the Urdu language.

Self-Regulated Learning

Self-regulated learning (SRL) refers to the process of developing and implementing strategies to accomplish the task. This section is organised into Zimmerman's (2000) three phases of self-regulated learning (SRL): forethought, performance, and self-reflection. The following paragraphs report on the evidence of the three phases of SRL demonstrated by the CMG students.

Forethought Phase

The forethought phase of SRL refers to the analysis of the task, goal setting, and planning to complete the task. The CMG students appeared to follow the forethought process before playing the game. At the beginning of the session, the teacher set the same goals for all students to achieve; the students were engaged in analysing the skills required to complete the task. The researcher's observations provide evidence of goal-setting for students by the teacher:

> The teacher is setting the classroom discourse. She is providing instructions on what to do in the session and which games to be played, " …children, today you will be playing two games of matching letters to sounds. The first is the duck game, where you will listen to the letter-sound carefully, then put the ducks in the right pond. Next is the underwater build where you will again listen to the sound, then pick the right blocks to build the spaceship, so it can go to space [the spaceship was built underwater; then launched to go into space]" (O8.CP2:1).

From the researcher's observation notes, some students appeared to analyse the pre-requisites required to play the games, "... some students cannot unlock the teacher-selected game levels as they have not completed the previous game levels…they are asking for help" (O8.CP2:2). Other students who had completed the pre-requisite game levels were preparing to play the targeted games, "…some students are watching demos to plan how to play the game" (O8.CP2:2). Planning during the forethought phase of SRL was also evident from students group interviews. One student shared how they planned to achieve the goals and what were the motivating factors to play the game,

> … when the teacher used to tell us which games to play in the session, I would quickly see how many points I would need to score in the game to buy stuff for my monster… I liked dressing up my monster with different accessories. (SGI.CP2:24)

Teachers also reported on students' forethought phase in game playing, "…a few students used to listen to the game instructions, plan how to play the game… set themselves a target as how many points they needed to achieve in the game…" (TI.CP2:46).

Performance Phase

The performance phase refers to task execution, where students apply strategies to monitor their progress and use several self-control measures to remain cognitively engaged and motivated to complete the task. For the CMG students, the self-control measure to stay engaged in playing games appeared to be the collection of items to dress-up their monsters. They also appeared to monitor their progress so that they knew how much more they needed to score to buy an item for their monster. For example, one student shared during the interview, " … I wanted to get the maximum points so I can buy lots of things for my monster… I used to keep on playing the game until I get all the answers correct…" (SGI.CP2:45). Teachers were also of the same opinion that interested students were mindful of their progress while playing the games, "students who were taking interest were focused on their progress… they were trying to get the maximum score… they were playing the same game a couple of times until they achieve the maximum score in the game…" (TI.CP1: 29). The motivation to score maximum points and be able to dress-up a monster using a variety of items was the driving force to monitor performance. Hence, the evidence suggests that a motivational cause facilitated performance monitoring in students.

Self-reflection phase

The self-reflection phase refers to the self-assessment of performance and making attributions about success or failure in completing the task. In the present research, it appeared that teacher's question-answer-evaluation sequences facilitated the reflection process in students to assess the strategies they used to accomplish the task and understand the role of game-based learning in a broader context. In the first few sessions, the researcher observed teachers asking closed questions, such as, "are you enjoying the game?" (O7.CP1:4), "do you understand what you are playing?" (O8.CP2:4). Such questions may not engage students in a reflection process. However, during later sessions, a few teachers were observed to ask open-ended questions that enabled students to reflect on their learning through games. Examples of such questions, as noted in the researcher's notes, were, " if you know the alphabet sounds and know the blending and segmenting techniques, think how you can apply the same on reading in Urdu? (O10.CP2:5), "…what benefits do you think you are getting from the game?" (O11.CP1:4). These open-ended questions appeared to incite a reflection process in students, which was evident from students' responses such as, "…I can use phonics in reading Urdu… I can also read science books using phonics… (O10.CP2:6).

It was interesting to observe that some students also reflected upon their lack of interest in the game. An example of such an instance was when a student told the teacher that he did not like playing the game, " … I don't like playing this game… I don't understand what the game is asking me to do…" (O12.CP2:5). Attributing self-reflection to the success or failure in game-playing was also evident from the student group interview where a student shared,

> … I didn't see any value in game-playing unless we understand what are we doing… it was a waste of time…the instructions were in English… so I couldn't understand… I was just tapping on the screen… sometimes I hit the correct answer and got points… but I didn't know what I was doing. (SGI.CP2: 45)

It can be suggested from the evidence reported in the preceding paragraphs that learning through a pedagogically sound digital game encouraged self-regulated learning. Nevertheless, the skill of self-regulated learning varied across students depending on their attitudes and their ability to be reflective towards learning using the digital game. The next section presents skills and competencies demonstrated by the EG students as a result of learning through digital games.

6.2.2 *The Experiment Group*

The skills and competencies demonstrated by the EG students were somewhat different from the CMG. The data suggests that freedom of collaboration, opportunities for problem-solving, peer learning and a fun and relaxed learning environment contributed to developing skills and competencies in the EG students that were somewhat different from the CMG. Table 6.3 shows the competencies demonstrated by the EG students.

Table 6.3

Skills and Competencies Demonstrated by the Experiment group

Experiment group Competencies
Reading skills
Transfer of skills from English (L2) to Urdu (L1)
Digital Literacy
Self-regulated and self-managed learning
Design thinking – finding creative solutions to the problems
Recognising patterns and establishing connections

The following subsections present skills demonstrated by the experiment group, such as reading skills (phonological awareness, word decoding, word recognition, oral fluency, and comprehension), transfer of reading skills from L2 to L1, digital literacy; and competencies of the experiment group, such as self-regulated and self-managed learning, design thinking, recognising patterns and establishing connections, active listening and reciprocal communication skills, building a relationship of care in a social context, and demonstrating flexibility and responsiveness.

Reading Skills

In this section, reading skills mainly relate to students' ability to use phonological awareness, word decoding, word recognition, oral fluency, and comprehension reading immediately after game playing. It appeared from students' group interviews that DGBL helped considerably develop overall reading skills in the EG students. One student stated, "… if we rate learning of reading skills from games on the scale of 1 to 5 where "1" being lowest and "5" being highest, we would say that we have developed the skills to the scale of "5", at the highest level… (SGI.EX1:48). On meta-cognitive levels, the students appeared to be able to think about their learning and compared traditional learning to learning through games and thought digital games were effective compared to traditional teaching and learning,

> Our teacher taught us phonics way before playing games… we learned the sounds, but we were not fully confident to blend the sounds to make a word… we did not know the purpose of phonics until we played the game and learned how to blend the sounds to make a word… (SGI.EX1:7)

Another student shared:

> During classroom reading, the teacher asks us to read the full words without using phonics. Sometimes, when I am stuck on a word, I quickly blend the sounds in my head and say the word… Now I enjoy reading almost anything… (SGI.EX2: 12)

The students also reported improving word recognition and their spelling skills after playing games. Use of phonics and sound-blending techniques appeared to help students in remembering familiar words (also known as sight words) and spelling, "…I have learned spellings from the game… there was a bird game in which we had to locate words, like 'fish', 'frog', etc…it helped me remembering spellings…" (SGI.EX1:33).

Improvement in reading skills was also evidenced in the teacher's interview. The experiment group teacher did not participate in DGBL sessions. However, she reported a great deal of improvement in reading skills immediately after game playing,

> Students enjoyed playing games…they learned better from games… they saw visuals in games, listened to the sounds, managed to understand the game instructions and applied the skills required to play the game, which certainly improved their reading skills, especially the blending of sounds… (TI.EX1:17)

Although the teacher reported improvement in reading, it appeared that the teacher's idea of teaching reading differed from the games. The teacher wanted students to learn sight words and follow the whole-word reading approach rather than using phonics. The teacher also shared her thoughts on using phonics. In her opinion, phonics should be used by young children just learning to read, but for mature students, she recommended whole-word reading,

> I would say that students improved their reading skills after playing games, but this is not how we wanted them to learn. The game taught them to use phonics, but I want them to use whole word reading and remember the words and spellings as a whole… phonics are introduced in early reading… these students should learn to read the whole word…(TI.EX1: 38).

Like CMG students, the students in the EG also appeared to be motivated to read beyond their textbooks. Initially, their reading was restricted to textbooks only, but after gaining reading skills, they appeared to extend learning outside textbooks. Examples of such comments are evident from students' group interviews, "I am now able to read short stories in the newspaper's children section my mother brings me from her workplace" (SGI.EX1:??). Another student shared,

> We wish we had tablets to play games at home… we create our own vocabulary games using storybooks or newspapers… we play a reading game where we have to read words from a passage in a book or newspaper in one minute. Whoever reads more words correctly will get stars and win… this game has helped us remember familiar words and spellings of such words. (SGI:EX2:10)

In sum, the evidence presented from multiple sources shows that EG students have acquired better reading skills after playing the digital game (TYMTR). They appeared to be applying these skills to read in the broader context outside their curriculum or textbooks.

Transfer of Reading Skills from English (L2) to Urdu (L1)

The game used in the intervention was an English reading game that focused on developing reading skills in the English language. However, it appeared that students were able to transfer skills from English (L2) to Urdu (L1) immediately after playing the digital game. The ability to transfer skills across languages was evident from the student group interviews, where the students discussed transferring of skills from English (L2) to reading Urdu (L1). The following response from the students' group interview shows how students are able to apply phonics and blending techniques to Urdu reading:

> It is fun reading Urdu now… earlier, we used to get stuck on tricky words…because we tried to read the whole word, but now we apply the same phonics and blending techniques we learned in the game to Urdu readings, for example, the word 'پنکھا' (Pankha) [fan] can be read by blending the sounds of letters, پ ن ک ھ ا (SGI.EX1:37)

In another example, one student shared that she is able to read outside textbooks by applying the phonics techniques to read in the Urdu language,

> I like reading Urdu stories in the book… because we understand the meaning better in Urdu compared to English… I have now started reading Taleem o Tarbiyat [an Urdu magazine for children] or other storybooks…my mother brings those from the discarded books at her workplace (SGI.EX2:13)

The EG students appeared to understand languages' complexity, which enabled them to think meta-cognitively about learning languages. They compared some differences between English and Urdu reading and shared their thoughts as follows,

> Blending of sounds is easy in Urdu as compared to English. In English, the sounds of some letters are not always the same; for example, the sound of 'u' is different in 'cut' and 'put'… similarly, the sound of 'ough' is different in 'cough' and 'dough'… but this is not the case in Urdu reading. In Urdu, each alphabet has a unique sound, or they have directives [diacritical marks] to pronounce the correct sound, like آ or ا for long or short sounds of Alif [the first Urdu alphabet] which guides us as to how to read a word. (SGI.EX2:16)
>
> In another example, students shared,
>
> We also read the Quran [in Arabic] using the same phonics techniques… the difference between reading in Urdu and Arabic is that we understand the meanings in Urdu, but we don't understand the meanings of words in Arabic. (SGI.EX1: 38)

The ability to transfer reading skills was also endorsed by the EG teacher, who shared the successful outcome of learning through the digital game as students' confidence and motivation to read outside the textbooks,

> I think digital games have a positive impact on students… they are now more confident and motivated to read other than textbooks… they are more willing to read the unfamiliar text in newspapers or storybooks, which sometimes I bring in the class… it is incredible to see how students are experimenting skills they acquired from the game in reading the Urdu language. (TI.EX1:20)

Overall, the evidence obtained from multiple data sets implies that the experiment group students were able to transfer reading skills from English as a second language (L2) to Urdu as their first language (L1). They also have appeared to acquire meta-cognitive skills in comparing the two languages. Being able to read in both languages also appeared to improve students' confidence and motivation towards learning.

Digital Literacy

This research considers digital literacy as the ability to use digital devices, such as computers, tablets, smartphones and internet at basic levels; understand and evaluate digital media, and create and communicate content using digital media (Standing Council on Tertiary Education, Skills and Employment 2012). Student group interviews revealed that reading using the digital game (TYMTR) on tablets enabled students to acquire some digital literacy skills. It appeared that students were able to use digital devices and the internet to locate and communicate information to facilitate everyday tasks. They were able to apply literacy as well as digital literacy skills beyond the confines of their classroom to participate in real-world activities. For example, one student shared during the group interview that she was able to book a cab using Careem app on her father's smartphone,

> Ever since Careem taxis came on smartphones, it becomes easy and accessible to book a taxi and travel on a cheaper fare compared to ordinary taxis. The digital game that we played at school improved my confidence and helped me… to read instructions on the app and book a taxi… the kids at my mother's workplace told me how to download the ap …I used my knowledge of phonics to read on internet…. I can now book a Careem taxi. (SGI. EX1:47)

In another example, one student shared that she is helping her mother in paying electricity bills using ATMs (Automated Teller Machines) at the banks,

> My mother had to stand in long queues at the bank to pay the bills due to which she used to lose quite a bit of her work time and wages. After playing on tablets, I feel confident in handling technology… One day, I asked my mother to use ATM to pay the bill… She was bit reluctant, but I forced her to let me experiment once… I put the ATM card in the machine and followed the instructions… I was able to read instructions in English… there were instructions in Urdu as well!… I was able to read in both the languages… I was very excited…I followed the instructions and successfully paid the electricity bill… Now we always use ATMs to pay bills… this saves us time and wages…(SGI.EX2: 36)

It appeared that improved reading skills using the digital game on tablets motivated students in exploring social media using digital technology. It was interesting to note that rather than using social media for fun and entertainment, some of the students wanted to use it to improve their living conditions. A student shared,

> "… I want to use Facebook to start a business… like selling something… maybe homemade food items like samosas, rolls, etc… I have seen people getting orders from Facebook…they use 'easy paisa' [a money transaction using to pay for the stuff they bought… so one day I want to start my own business using Facebook… (SGI.EX3:33)

Another example of digital literacy was about using social media to find jobs. One mature student studying in class 4 shared that she downloaded an app to help her father looking for a job,

> My father is a daily wage labourer. He goes to find work every day. There are days when he couldn't find work… sometimes, we don't have enough money to buy groceries and cook food… Some research assistants from NUST who came to our school some time ago told us about an app, 'Fori Mazdoori'… to connect to the potential employer and access work. After playing games on tablets, I feel confident enough to download the app on my father's phone and register him on the app... He could have registered himself through the phone shops... but I guess he was not convinced that this app would be any good … He has got two endorsements [on the app] from someone he worked for in the past. Employers are now contacting him sometimes… I feel he is more known for his work now…I hope he will get more job requests from the app…(SGI.EX3:36)

The above examples of students' stories imply that learning to read using the digital game on tablets fostered digital literacy skills in students. It appeared to open up new avenues in applying the skills to improve their living conditions.

Self-Regulated and Self-Managed Learning

The digital game that students were playing in a self-managed learning environment appeared to equip them with self-regulated and self-managed learning skills. The DGBL sessions in the EG were not facilitated by teachers; therefore, students appeared to self-manage their learning process and instinctively followed phases of Zimmerman's (2000) self-regulation model: forethought, performance, and self-reflection. The following paragraphs reveal how students were engaged in phases of self-regulated learning.

Forethought phase

Before planning which games to play during the session, students were engaged in the forethought phase, where they were self-evaluating previously acquired skills. They appeared to decide if they possessed sufficient skills to play the advanced game levels. Some students preferred to repeat previously played games as if they wanted to strengthen already acquired skills before moving on to the next skills set in advanced game levels. The researcher's observation notes revealed that many students were repeating playing the game levels before advancing to the next levels,

> Today is the third day of observation. Some students are playing the games they played yesterday… they look thrilled and excited when they achieve the highest score in the games they were repeat playing. (O3.EX1: 1)
> Today is the second last session of game-playing. Some students still repeat playing games from the previous weeks. Some students are playing the games again in which they did not score the highest. (O6.EX2:3)

When students were asked during the group interviews about the rationale of repeat playing the games, all of them thought it as a strategy to reinforcing the skills gained through the games, "we liked to play the games again so we can remember all the sounds thoroughly… remembering the sounds helped us in advanced game levels, especially it helped us in reading sentences" (SG.EX1:34). Another student shared, "it was important to me to gain maximum score in all the game levels… I wanted to gain maximum points so I could buy new stuff for my monster… and also be able to proceed to the next game level (SGI.EX2:19). Once the students were confident in their abilities, they appeared to set goals and decided which games they would play during the session.

Performance Phase

During the performance phase of Zimmerman's SRL model, the EG students appeared to apply strategies to monitor their progress and manage their learning through games. Following is an example from the researcher's observation note showing strategies students were using to remain cognitively engaged and managing their learning:

> …after playing previously played games, students are now moving on to the next game levels… not all students are playing the same games… some have decided to play the easiest levels of a new reading skill before moving on to the advanced levels… some have randomly selected the game levels, which later they found difficult. So they revert to the easiest levels before playing the advanced levels. (O4.EX1:1)

The student group interviews also revealed the process of managing learning during DGBL sessions. One student shared,

> "…I liked to play the easy level first, then moved on to the hard level… if I could not score the best in the game, I would play the game again… it helped me in remembering the sounds well. (SGI. EX1:50)

Another student shared,

> I liked to play the rocket game… so I always started with that game and then moved on to playing the other game levels… the best thing about these games were the opportunities to

> practice the same sound many times in different games… due to which we did not get bored of practising the same sounds over and over again. (SGI.EX2:35)

Self-reflection Phase

Throughout the intervention period, the EG students appeared to reflect on their gained skills and areas of improvement. If they needed to strengthen their skills, they appeared to play the same game until they felt confident in applying the skills for reading,

> I know I am not doing well in a game if I struggle to listen to the instructions or if I get many wrong answers… I would have to repeat the game so I know all my sounds and have the reading skills required for the next game level… (SGI.EX1:51)

The data obtained from multiple sources revealed that the EG students exhibited implicit self-regulated learning skills that enabled them to manage their learning process during DGBL sessions. They were displaying the phases of Zimmerman's (2000) self-regulated learning, beginning with self-assessment of skills and goal setting in the forethought phase, followed by the performance of skills phase, then leading on to the self-reflection phase.

Recognising Patterns and Establishing Connections

The data also revealed that the EG students appeared to recognise patterns and applied already established solutions to solve problems. A student shared during the interview that she remembered how she resolved tablet-related issues earlier in DGBL sessions; hence, she would apply the same solutions whenever encounter the similar problems, "… in the beginning, I did not know how to 'go back' in the game… whenever I tried to go back, I would exit from the game instead of going back one level… so I remembered to use the back button instead of using the exit button" (SGI. EX3: 33). The student also shared her understanding of the difference between exiting the game and going back on the previous game level,

> I know the difference now… which button to use for exiting the game and which button is used to go back to the previous game level… I can recognise the difference in other games which I sometimes watch children playing at my mother's workplace. (SGI.EX3:34)

The above example suggests that the opportunity of playing games without teacher facilitation compelled students to develop skills and abilities to evaluate problems, establish links with previously encountered problems and apply already developed solutions to resolve problems. If the solutions did not work, the students appeared to seek peer help and collaborate again to co-create a solution.

Similarly, the students appeared to recognise patterns and establish connections between different phonetical languages such as English, Urdu and Arabic where they were able to recognise similar sounds associated to alphabets in different languages,

> …I know… there are similar sounds in English, Urdu and Arabic which are represented by different alphabets… for example, letter b makes a sound of /b/ in English. The letter 'ب' makes the same sound in Urdu and Arabic. (SGI.EX1:38)

Another student contributed,

> … but not all the times alphabets have the same sounds in different languages… letter c in English makes two sounds, one /s/ and other /k/…Similarly, in Urdu the same sound /s/ is represented by two letters, 'س' and 'ص'… its interesting as how languages work… I have never thought of this before…(SGI.EX1:39)

The skill of recognising patterns and establishing connections between multiple languages suggests students' receptivity and readiness to learn languages.

6.3 Summary

The results presented in this chapter indicate that student behaviours were influenced by the teacher-led or student-directed facilitation of learning. The facilitation guided the interactions and ultimately improved students' motivation and participation in learning to read using the digital game. The highly controlled teacher-led learning environment in the CMG led to passive participation in learning activities, lack of motivation and excitement in learning through the digital game. The students appeared to maintain a disciplined classroom culture as expected by their teachers. However, at times, the CMG students were found to secretively break classroom discipline by interacting with peers to either share game achievements or to seek help. Nevertheless, the CMG students demonstrated the development of isolated knowledge by individual learning and showed some confidence in reading, which appeared to be the outcome of regular feedback obtained by playing a pedagogically balanced digital game. On the contrary, the flexible student-directed learning environment of the EG led to developing behaviours that aligned with the behaviours of 21st-century learners. They appeared to be more excited about learning through digital games than the CMG students and actively participated in creating collaborative knowledge and problem solving through peer support. These students also demonstrated self-awareness and resilience in facing challenges and showed commitment to staying focused on learning despite facing challenges.

In terms of skills and competencies, both the groups developed some skills and competencies, such as reading skills, transfer of reading skills from English (L2) to Urdu (L1) and self-regulated learning. However, the experiment group appeared to develop more higher-order skills and competencies compared to the comparison group, such as digital literacy, self-managed learning, design thinking to find creative solutions to solve problems, and recognising patterns to establish connections, which were evident from their narratives of applying skills to solve real-life problems. The results indicate that the freedom of collaboration and interaction to solve problems resulted in developing higher-order skills and competencies in the experiment group.

The next chapter presents mixed-methods results on students' attitudes towards reading. The chapter presents quantitative results of the English Reading Attitude Survey (ERAS) administered across the three groups before and after playing games, followed by insights gained through qualitative data that contributed to changing attitudes towards reading.

CHAPTER 7: ATTITUDES TOWARDS READING

This chapter presents the results of students' attitudes towards reading before and after the DGBL intervention. The results partially contribute to answering the research question: *how do students and teachers perceive the use of digital games in changing behaviours and attitudes towards reading?* Literature suggests reading attitude as an essential aspect of developing reading skills. This research considers reading attitude as students' feelings or emotional state towards reading, which may positively or negatively impact the uptake of a reading task (Cooter Jr & Alexander, 1984). Results pertinent to change in behaviours were reported in Chapter 6 because behavioural data were collected using qualitative methods only (e.g. student group discussions, classroom observations and teacher interviews). The attitudinal data were collected using mixed-methods (quantitative and qualitative), including ERAS questionnaire, student group discussions and teacher interviews. Therefore, this chapter integrates quantitative and qualitative results of students' attitudes towards reading before and after the DGBL intervention.

Reading attitudes are divided into two categories: recreational reading and academic reading. Attitudes towards recreational reading refer to an emotional response to initiate self-motivating reading activities undertaken for pleasure at students’ own pace and will (Brendler & Tarulli, 2014; McKenna & Kear, 1990). Recreational reading refers to the independent reading of a self-selected continuous text for a variety of social or personal reasons with an aim to seek pleasure (International Reading Association, 2014). Text for recreational reading may include narrative fiction, nonfiction, newspapers, magazines, social media, and websites. Attitudes towards academic reading are pertinent to measuring students’ willingness to read for school purposes, such as preparing for tests, reading in class, and reading from workbooks (McKenna & Kear, 1990). Academic reading, on the other hand, refers to reading for academic or educational purposes. Texts for academic reading may include but are not limited to textbooks, worksheets, assignments, or tutorials.

The students who participated in the present study belonged to very low socioeconomic backgrounds and may not have access to reading resources besides their schoolbooks. Limited access to reading resources blurs the distinction between recreational and academic reading. Therefore, this research considers any form of volunteer reading for pleasure, even from textbooks, as recreational reading.

The chapter is divided into two main sections: quantitative results and qualitative results. Quantitative results are reported prior to qualitative results as the attitudes are underlying psychological conditions which can be measured quantitatively using reliable scales. The qualitative results complement the quantitative results by providing rich descriptions and a deeper understanding of causal factors behind the attitudes towards reading in the context of low socioeconomic background in a developing country. Section 7.1 reports the quantitative results related to the reading attitudes. Analysis of quantitative results begins with a reliability test of the reading attitudes survey used in this study with a rationale to assess the internal consistency of the survey items that will aid results interpretation with caution. Section 7.1 also presents a quantitative comparison of three groups, CG. EG and CMG, on reading attitudes before and after the intervention. Section 7.2 presents the qualitative results of the three groups. The chapter concludes by summarising the main inferences obtained through quantitative and qualitative results.

7.1 Quantitative Results

This section compares attitudes towards reading of three groups: control, comparison and experiment that differ on reading instructions received during the intervention period. The control group received traditional reading instruction for six weeks in addition to their routine literacy learning. The CMG students played the reading development digital game for six weeks, additional to their routine literacy learning with their teacher’s support, whereas the EG students played the same digital game for six weeks, additional to their routine literacy learning, without the teacher facilitation. The Elementary Reading Attitude Survey (ERAS), developed by McKenna and Kear (1990), was administered across the three groups before and after the intervention. The Elementary Reading attitude Survey (ERAS) (Appendix F) measured reading attitudes on two sub-scales: recreational reading (items 1-10) and academic reading (items 11-20). Section 3.11.1 provides specific details about the ERAS survey and the indicators used to assess academic and recreational reading attitudes. Although the use of ERAS to assess reading attitudes is established from the literature (Kazelskis et al., 2005; Kush & Watkins, 1996; Worrell et al., 2006), the present study also assessed the reliability of this tool for the selected sample, which may aid to generalise the results with some confidence to the target population. Moreover, ERAS was not trialled in a developing country like Pakistan; the reliability results add to the literature. The next subsection presents the reliability results of the ERAS survey used in this study.

7.1.1 *Reliability Testing of ERAS*

This section presents the reliability results of the Elementary Reading Attitude Scale (ERAS) used in this research. McKenna and Kear (1990) reported an overall moderate to high internal consistency coefficient for ERAS scores in a study conducted on primary school students. The present study translated this instrument into the Urdu language to be understood by the children participating in this research. Guidelines for translating instruments from one language to the other (World Health Organisation, 2019) were rigorously followed (Section 3.11.1). It is, therefore, important to test the reliability by assessing the internal consistency of the translated instrument to ascertain if the translated items within the scales measured the desired attitudes towards reading and how reliable the data were to draw an analysis for this study. The following subsection reports on the internal consistency coefficients (Cronbach's alpha) of the ERAS scale.

Internal consistency of the ERAS scale

SPSS Version 26 was used to calculate the internal consistency of ERAS (Urdu version) using Cronbach's alpha for a sample of 288 students participating in the study. Table 7.1 presents reliability statistics for the overall ERAS scale (20 items), as well as the recreational reading sub-scale (10 items) and academic reading sub-scale (10 items).

Table 7.1

Reliability Statistics of ERAS Scale (Urdu version)

	Cronbach's alpha	No of items
ERAS scale (20 items)	.763	20
Recreational reading sub-scale (10 items)	.701	10
Academic reading sub-scale (10 items)	.600	10

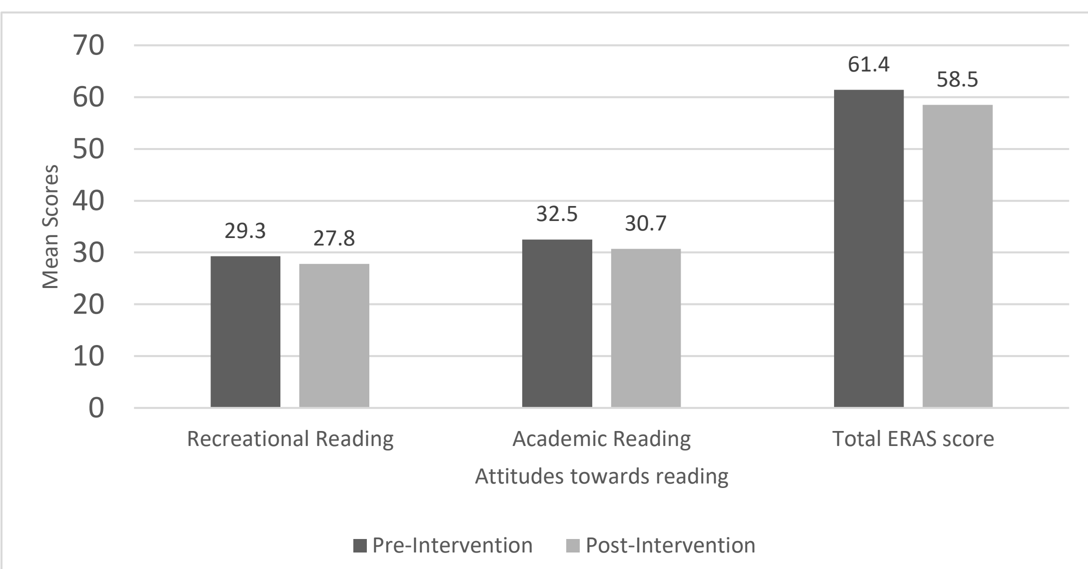
The internal consistency coefficient, Cronbach's alpha for the overall Urdu version of the ERAS scale (20 items), was 0.763, which shows a moderate to high measure of reliability. Similarly, Cronbach's alpha of 0.701 for ten items of recreational reading sub-scale(10 items) reveals a moderate to high internal consistency. However, Cronbach's alpha for ten items of academic reading (Q11 to Q20) portrays a lower value of 0.600. Hence, the results on academic reading attitudes must be interpreted with caution. The lower value of Cronbach's alpha on the academic reading attitude sub-scale may have occurred due to poor interrelatedness between the items or heterogeneity of variance in student responses. Heterogeneity of variance refers to a situation where the variance of one item is different from the other, which could impact reliability generalisations (Botella & Ponte, 2011). The qualitative results will provide insights into interpreting students' reading attitudes on both the sub-scales. The following subsections present the results of three groups: control, comparison, and experiment on the elementary reading attitude survey (ERAS).

7.1.2 *Attitudes Towards Reading of the Control Group*

This section reports on the comparison of attitudes towards reading of the CG students before and after the study. Figure 7.1 presents the attitudes towards reading of the CG before and after the study. The CG students possessed better recreational and academic reading attitudes prior to the study. However, the CG students experienced a decline in both categories of reading attitudes towards the end of the study. The recreational reading attitudes dropped from *M* = 29.3, *SD* = 5.2 to *M* = 27.8, *SD* = 3.8. Similarly, the academic reading attitudes dropped from *M* = 32.5, *SD* = 4.2 to *M* = 30.7, *SD* = 3.8. Consequently, the overall reading attitudes of the CG students also declined towards the end of the study from *M* = 61.4, *SD* = 8.4 to *M* = 58.5, *SD* = 6.4.

Figure 7.1

Distribution Of CG Scores On Attitudes Towards Reading Using ERAS



A further pairwise comparison using t-test (Table 7.2) revealed that the drop in recreational reading attitude was slight but statistically significant in the control group with M_{diff} = -1.5, 95% CI [-2.6, -0.4], $t(95)$ = - 2.7 , p =0.010 (P< 0.05). Similarly, the decline in academic reading attitude was slightly more, but statistically significant with M_{diff} = -1.9, 95% CI [-2.8, -0.9], $t(95)$ = - 3.8, p = 0.000 (p < 0.005). Consequently, the overall ERAS scores depicted a statistically significant decrease after the intervention with M_{diff} = - 2.9, 95% CI [- 4.8, - 0.9], $t(95)$ = - 3.0 , p = 0.003 (p < 0.005) from the beginning to the end of the study for the control group of students

Table 7.2

Paired Sample T-Test Of The Control Group On Attitudes Towards Reading

					95% CI of the Difference				Sig
		M_{diff}	*SD*	*SE*	Lower	Upper	*t*	*df*	*p*
Recreational reading	Post-Recreational Reading Score - Pre-Recreational Reading Score	-1.5	5.5	0.6	-2.6	-0.4	-2.6	95	.010*
Academic reading	Post-Academic Reading - Pre-Academic Reading	-1.9	4.8	0.5	-2.8	-0.9	-3.8	95	.000*
Total ERAS score	Post-ERAS score - Pre-ERAS score	-2.9	9.5	0.9	-4.8	-0.9	-3.0	95	.003*

Note. M_{diff} = Mean difference; *SD* = Standard deviation; *SE* = Standard error mean; *CI* = Confidence interval; *t* = t-statistics, *df*= degrees of freedom; **p* = Significance at 0.05 confidence level

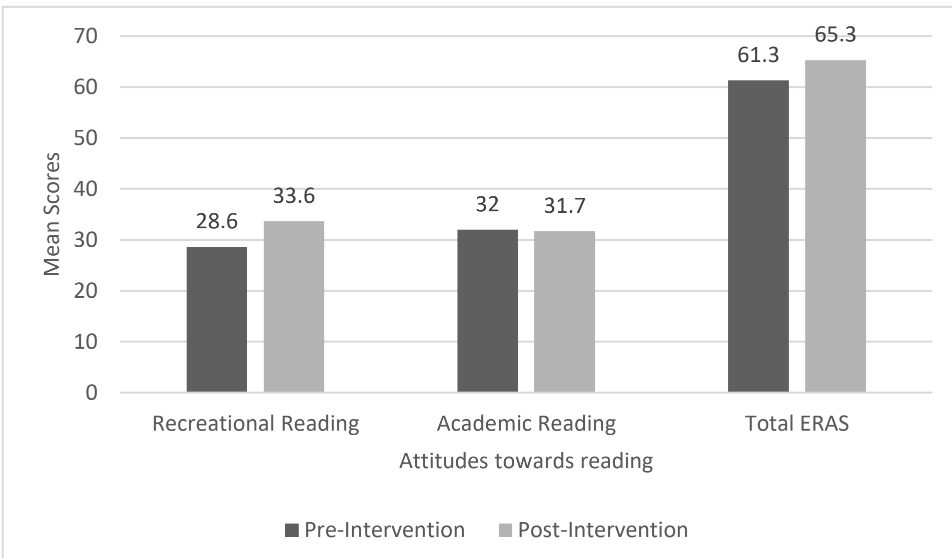
It is concluded that the traditional style of reading instruction adopted by teachers generated statistically significant negative attitudes towards recreational and academic reading in the control group. The next section reports reading attitude results of the comparison group.

7.1.3 *Attitudes Towards Reading of the Comparison Group*

This section compares reading attitudes in the comparison group before and after playing the digital game (TYMTR) with teacher facilitation. Figure 7.2 shows that the attitude towards the recreational reading of the CMG students improved; however, the attitude towards academic reading slightly declined after the intervention. Prior to the intervention, the CMG students demonstrated a slightly better attitude towards academic reading (*M*= 32, *SD*= 3.3) compared to recreational reading (*M*= 28.6, *SD* = 3.3). However, after the intervention, the attitude towards academic reading declined slightly (*M*= 31.7, *SD* = 4.2), whereas the attitude towards recreational reading improved (*M* = 33.6, *SD* = 3.9). The composite mean scores on ERAS scale show an improvement in overall attitude towards reading from *M*= 61.3, *SD* = 5.2 to *M* = 65.3, *SD*= 6.9.

Figure 7.2

Distribution Of Comparison Group Scores On Attitudes Towards Reading Using ERAS



A pairwise comparison using a t-test (Table 7.3) depicts a statistically significant improvement in recreational attitudes of the CMG students after playing the digital game. However, the slight decrease in the attitude towards academic reading was statistically non-significant. Nevertheless, the total ERAS score increased statistically significantly with a mean difference of 4.1 (M_{diff} = 4.1, 95% CI [2.6, 5.6], t(95) = 5.4, p = 0.001 (p < 005)).

Table 7.3

Paired Sample T-Test Of Comparison Group On Attitudes Towards Reading

		M_{diff}	*SD*	*SE*	95% CI of the Difference Lower	Upper	*t*	*df*	Sig *p*
Recreational reading	Post-Recreational Reading Score - Pre-Recreational Reading Score	4.4	4.2	0.4	3.5	5.2	10.1	95	.000*
Academic reading	Post-Academic Reading - Pre-Academic Reading	-0.3	4.8	0.5	-1.3	0.7	-0.6	95	.535
Total ERAS score	Post-ERAS score - Pre-ERAS score	4.1	7.4	0.8	2.6	5.6	5.4	95	.000*

Note. M_{diff} = Mean difference; *SD* = Standard deviation; *SE* = Standard error mean; *CI* = Confidence interval; *t* = t-statistics, *df*= degrees of freedom; **p* = Significance at 0.05 confidence level

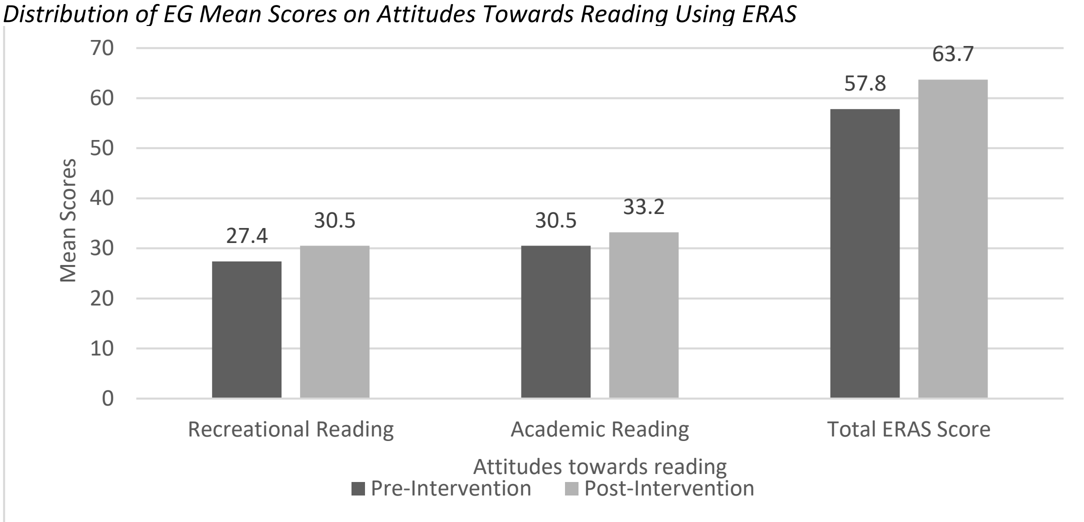
It is concluded that although there had been a slight decline in attitudes towards academic reading in the comparison group, the attitude towards recreational reading improved significantly after the intervention. Also, the overall attitude towards reading improved significantly after the intervention.

7.1.4 *Attitudes Towards Reading of the Experiment Group*

This section presents data that compares attitudes towards recreational reading, academic reading, and the overall attitude towards reading of the EG students before and after the DGBL intervention and is outlined in Figure 7.3. Before the intervention, the EG students showed better attitudes towards academic reading (M = 30.5, SD= 3.4) than towards recreational reading (M= 27.4, SD= 3.5). Nevertheless, after the intervention, the EG students illustrated a consistent pattern of increase in both attitudes, with an increase in attitude towards recreational reading at M= 30.5, SD= 5.4, and attitude towards academic reading with M= 33.2, SD= 4.7. The overall attitude towards reading increased from M= 57.6, SD= 5.7 to M= 63.7, SD= 9.6.

Figure 7.3

Distribution of EG Mean Scores on Attitudes Towards Reading Using ERAS



A pairwise comparison using a t-test was run to assess if the increase in attitudes was significant. Table 7.4 depicted a statistically significant rise in attitude towards recreational reading with M_{diff} = 3.1, 95% CI [2.1, 4.2], $t(95) = 6.1$, $p = 0.000$ ($p < 0.05$). Similarly, attitude towards academic reading increased significantly with M_{diff} = 2.7, 95% CI [1.7, 3.8], $t(95) = 5.1$, $p = 0.000$ ($p < 0.05$). Consequently, the overall ERAS score also improved statistically significantly with M_{diff} = -1.9, 95% CI [4.1, 7.7], $t(95) = 6.4$, $p = 0.000$ ($p < 0.05$).

Table 7.4

Paired Sample t-Test of EG on Attitudes Towards Reading

		M_{diff}	*SD*	*SE*	95% CI of the Difference Lower	Upper	*t*	*df*	Sig *p*
Recreational reading	Post-Recreational Reading Score - Pre-Recreational Reading Score	3.1	5.0	0.5	2.1	4.2	6.1	95	.000*
Academic reading	Post-Academic Reading - Pre-Academic Reading	2.7	5.3	0.5	1.7	3.8	5.1	95	.000*
Total ERAS score	Post-ERAS score - Pre-ERAS score	5.9	8.9	0.9	4.1	7.7	6.4	95	.000*

Note. M_{diff} = Mean difference; SD = Standard deviation; SE = Standard error mean; CI = Confidence interval; t = t-statistics, *df*= degrees of freedom; *p = Significance at 0.05 confidence level

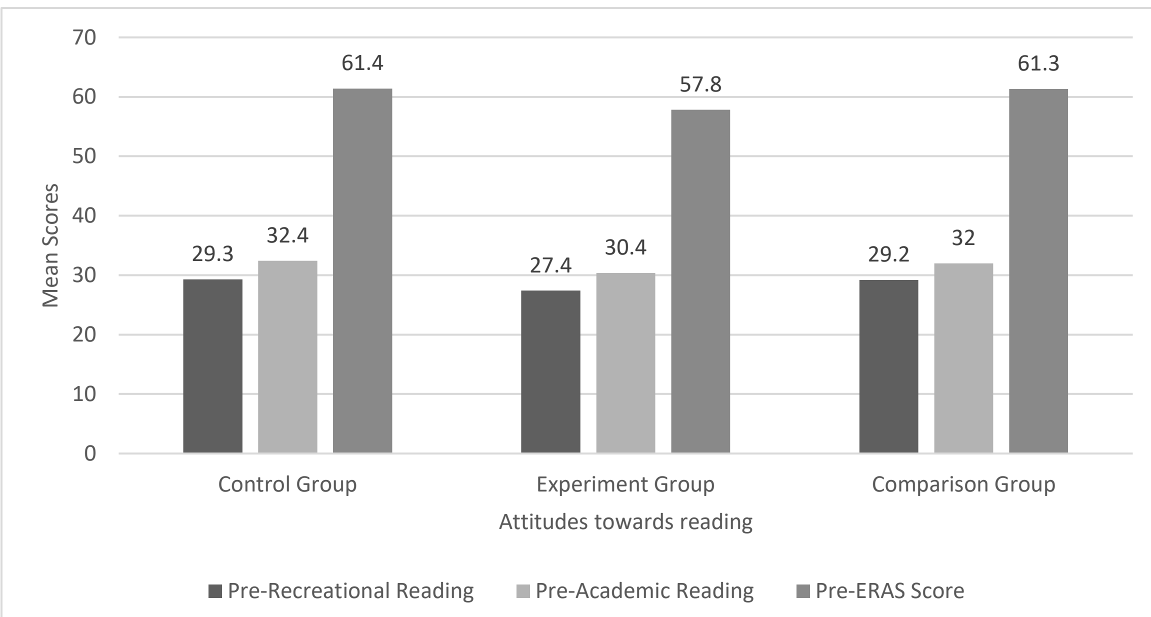
Hence, it can be concluded that the attitude of the EG students towards recreational and academic reading significantly improved after the DGBL intervention. The overall attitude towards reading in the EG also improved significantly after the intervention.

7.1.5 *Comparison of Attitudes Towards Reading Between Groups*

This section presents a comparison of reading attitudes between the CG, EG and CMG before and after the intervention. Before the intervention, the CG and CMG groups had approximately similar attitudes towards recreational and academic reading, whereas the EG had a slightly lower attitude towards recreational and academic reading, as seen in Figure 7.4

Figure 7.4

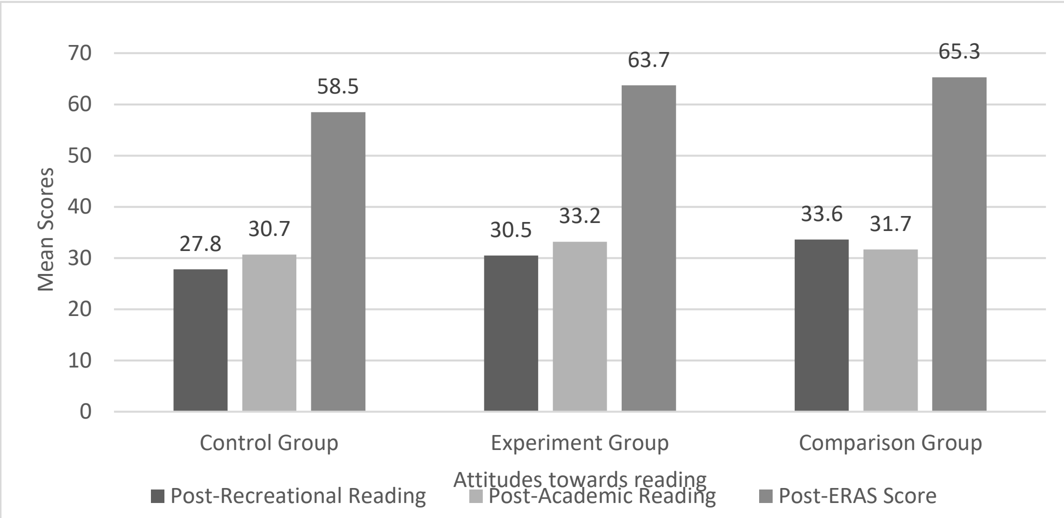
Pre-Intervention Comparison of Attitudes Towards Reading Between Groups



However, after the intervention, the experiment group showed an improvement in attitude towards recreational as well as academic reading (Figure 7.5). Overall, the CMG displayed the highest total score on ERAS at the end of the study. Interestingly, the attitude of the CMG improved on recreational reading but declined on academic reading.

Figure 7.5

Post-Intervention Comparison of Attitudes Towards Reading Between Groups



It can be concluded that attitudes towards reading amongst groups were changed during the intervention. The intervention using traditional instruction failed to bring any positive change in the reading attitudes of students belonging to the control group. In fact, the control group students experienced a decline in attitude towards recreational and academic reading after the intervention. On the other hand, the digital game-based intervention with and without teacher facilitation improved the overall reading attitudes of students belonging to experiment and comparison groups. Students who played the game without teacher facilitation had a more positive attitude towards recreational and academic reading than those who played the game with teacher facilitation.

7.1.6 *Section Summary – Quantitative Results*

Section 7.1 presented a statistical analysis of the Elementary Reading Attitude Survey (ERAS). The focus was to report any statistically significant differences between reading attitudes of the three groups: control, experiment, and comparison before and after the intervention. The reliability study of the Urdu version of ERAS yielded moderate to high Cronbach's alpha, indicating that the data obtained was reliable and interpretable for further analysis.

The findings from the three groups revealed that initially, the CG. CMG and EG students had similar attitudes towards reading, whereas the EG students had a slightly negative attitude towards reading compared to the other two groups. However, after the traditional style reading intervention, the CG experienced a statistically significant decline in overall reading attitudes and recreational and academic reading attitudes. A statistically significant improvement was noticed in the overall reading attitudes of the CMG students; however, the academic reading attitude of the CMG slightly declined after the DGBL intervention with teacher facilitation. On the other hand, the EG experienced a statistically significant improvement in overall reading attitudes and recreational and academic reading attitudes after the DGBL intervention. The next section presents the qualitative results pertinent to attitudinal data.

7.2 Qualitative Results

This section presents qualitative data related to students' attitudes towards reading after playing the digital game (TYMTR). The findings from this section provide insights into the role of teaching strategies, such as traditional style reading instruction, learning through the digital game without teacher facilitation, and learning through the digital game with teacher facilitation, in shaping students' attitudes towards reading. Reading attitudes are reported in the same two categories as in previous sections: recreational and academic reading. The following subsection presents the reading attitudes of the control, comparison and experiment groups on recreational and academic reading.

7.2.1 *Reading Attitudes of the Control Group*

This section reports on the reading attitudes of the control group students taught using traditional teaching methods. Attitudes towards reading were inferred from one group interview, three classroom observations, and a teacher interview for the control group.

The interview data indicate that control group students preferred playing outside instead of reading during holidays or weekends. Their preference for playing instead of reading appeared to be the outcome of a lack of comprehension skills from reading passages. Another reason for showing no interest in reading appeared to be a lack of support at home, and students with no help at home seemed least interested in reading in their free time. The following excerpts from the student group interview report students' feelings towards reading a book at home during the school holidays:

> I feel bored…because I don't understand the meaning of words in English…Also, I would prefer playing outside with my friends instead of reading at home….(SGI.CN1.4)
>
> On weekends or during school holidays, I would prefer to play outside with my friends… we live in a very small house… one-bedroom house.. so my mum would ask me to go out and play in my free time… (SGI.CN1.5)

> No one at home could help me with reading… I tried practising reading at home, but I don't understand what I am reading… I get bored when I don't know what I am reading….(SGI.CN1.8)

The student group interviews also indicate that reading was not something students liked to do in their free time at school. Students also reported that they do not enjoy reading unless they know the meaning of the text they are reading, "…reading is not fun… we don't understand what we are reading in English… unless someone tells the meaning of each word in Urdu…" (SGI.CN1. 11). This lack of interest in reading appeared to be linked to a lack of reading and comprehension skills. And no access to support at home to help with reading. The interview responses also indicate a nonexistent home literacy practice, where the parents may prefer their children to play outside rather than sit indoors to read, which could be attributed to the limited space in a one-bedroom house.

The students shared their feelings about reading different kinds of books. Control group students appeared to be more interested in doing fun activities, such as colouring in and watching pictures in magazines, rather than reading stories. One student shared,

> I don't have different kinds of books to read… just my school books… but I like to see pictures in magazines…My father is a tailor… he has fashion magazines in his shop… So when I go to his shop, I like watching models wearing nice clothes in magazines…(SGI.CN1.6)

It appears that the student's interest in looking at pictures of models wearing colourful clothes may stem from the lack of creativity and colour in their textbooks, as textbooks usually contain black and white images to save the costs of coloured printing. Also, the student's interest in looking at the pictures of clothes may be linked to their own clothing needs or desires to be dressed up like models.

Another student shared about the prospects of buying books for reading.

> I like to buy stationery from book stores, like nice pencils and fragranced erasers in different shapes and colours… I enjoy reading Urdu storybooks compared to the English… Sometimes, I read a few passages from storybooks while standing in the bookstore…but I won't buy it … I would buy a colouring book and colours instead… I feel I can be more creative in using colouring books and pencils compared to the books…(SGI.CN1.8)

It appears that students' interest in colouring or drawing may be an outcome of the teacher's strategy of reading by drawing pictures on the board. The following excerpt from the researcher's observation notes indicates that the teacher was drawing pictures on the board with some useful vocabulary to clarify students' concepts about the story they were reading.

> The story is about a fish. The vocabulary includes different parts of the fish body, such as fins, gills, scales, mouth, etc. The teacher draws a picture of the fish on the whiteboard, and labels body parts of the fish. Students are looking at the board with interest. Every time the teacher reads a word relating to the fish body, she points it to the picture drawn on the board (OB2.CN1.2)

The teacher interview also suggests that the teacher's strategy of drawing diagrams and pictures on the whiteboard helps students grasp the relational content within the reading text, such as the body parts of the fish. The students were able to relate words from the book to the images on the board,

> I try to explain the reading text in a variety of ways. I describe it first in Urdu. If there is something that I can draw on board, I will draw it, and write useful words on the board so they can visualise the vocabulary used in the text. But again, this depends on the nature of the text we are reading. I can't do it all the time… (TI.CN1. 5)

The data in this section indicates that students only showed interest in reading when they understood the meaning of the reading text. The data also suggests that students wanted to spend their free time creatively by playing games or doing fun activities. The following paragraphs present control group students' perceptions of academic reading attitudes.

The control group perceived academic reading as the most critical activity during school time. They appreciated the importance of reading. One student commented, "it is important to know how to read… if we don't know how to read, we will not be able to pass the exams" (SGI.CN1.1). The data indicates that students' attitudes towards academic reading were shaped by reading strategies their teachers adopted during classroom reading. The teacher created a traditional classroom environment where students were sitting in multiple rows facing the teacher; the reading session started with the teacher reading the passage, explaining the meaning in Urdu, while students listened to her read. The following researcher's observation notes describe a traditional style reading session:

> Today, students are starting a new story. The teacher asks students to sit in rows at a slight distance from each other, facing the teacher. She introduces the story title… asks students to listen to her read carefully. She says that she will repeat the difficult word three times. She starts reading in English and translates each sentence in Urdu. Students are interested in listening to the story. After completing the story, she is asking questions, but students are unable to answer the questions (OB3.CN1.1)

The researcher's observation notes show that the next step in reading was to involve students in repeating the reading passage after the teacher, as evident in the following observation excerpt:

> Now the teacher is asking students to repeat reading after her. She reads a sentence from the book; the students repeat reading after her. At one instance, she tells a student to stop fiddling with her water bottle. The teacher said to the student, "leave it!". The whole class could not differentiate between the teacher telling off a student or reading from the book. All students repeat after the teacher, "leave it"… A similar incident happens again when the teacher asks a student to sit properly. The entire class repeats after the teacher's instructions of sitting properly… (OB3.CN1.3)

The above excerpt from the researcher's observation notes shows that students were mindlessly reading after the teacher without differentiating when the reading ended and when the teacher was talking to the students, which has the potential to make reading aimless non-contextualised activity. Students' responses in group interviews also indicate that they did not enjoy reading sessions, especially when they could not comprehend the meaning of the passage read. For example, one student shared,

> I don't like reading in English… because I don't understand most of it… and if the teacher asks a question I don't know the answer to, the teacher gets very angry and tells us off… I feel very embarrassed by her telling us off in front of everyone… that's why I don't particularly appreciate reading in class. (SGI.CN1.12)

Another student shared, "the teacher asks us to practice reading… but we don't know if we are reading it correctly… we memorise everything in the book and read to the teacher without even understanding what the passage is saying" (SGI.CN1.14).

When students were asked about attending reading sessions daily for six weeks, they portrayed mixed feelings. Some students were apprehensive about attending reading sessions daily, while some were slightly encouraged to attend sessions, as they thought these sessions were helping them to read better. Two students were of the view that they get more practice time on reading during intervention-based reading sessions, "earlier, we used to read only two to three times a week, but now we read every day…this gives us more time to practice reading…" (SGI.CN1. 16). However, three students considered intervention-based reading sessions as a burden on top of their existing workload,

> ... the intervention-based reading sessions seem like extra work… these sessions happen in our activity period… earlier we used to do some creative work like drawing or making crafts in the activity period, but now we read from our textbook… the teacher asks us to practice and revise reading [from the first English session of the day]… so instead of having fun in the activity period, we now practice reading (SGI.CN1. 16)

The students appeared interested in reading when the teacher offered to read again and explained the meaning in Urdu. The researcher's observation notes indicate that students showed interest in reading when the teacher explained the word meanings in Urdu:

> The teacher reads the passage while students listen to her. She then explains the meaning of the passage in Urdu. The students are looking interested in knowing the meaning of the passage. The students are also responding to the questions the teacher is asking… (OB2. CN1.1)

Overall, the data in this section indicates a lack of a positive attitude towards academic reading in control group students, which may be attributed to their limited reading skills development and exposure to less creative teaching methods. The students did not appear to be confident in reading. Frequent teacher reprimands negatively impact students' self-esteem, which appears to generate slightly negative attitudes towards academic reading. The recreational reading attitudes are also limited to watching pictures in magazines or doing fun activities such as colouring rather than reading books, which may be attributed to control group students' limited reading and comprehension skills.

7.2.2 *Reading Attitudes of the Comparison Group*

This section reports the results of the CMG students on reading attitudes. Students' responses to the interviews pertinent to recreational and academic reading attitudes. This section intends to examine the impact of the digital game on recreational and academic reading attitudes due to the fun and challenging nature of the digital game.

Comparison Group Attitudes Towards Recreational Reading

The student group interviews suggest that attitude towards recreational reading was dependent on access to resources. Students who have access to reading material appeared to be better involved in reading for pleasure when compared to those who did not have reading resources other than their textbooks. Students appeared to make connections between reading for pleasure and reading for academic purposes. The data indicated that recreational reading raised students' awareness of the use of punctuation in written sentences. One student acknowledged the following comment:

> I have noticed in print material such as newspapers and magazines… and even on signboards that a sentence always starts with a capital letter, whilst the remaining letters are small. I used to make this mistake in my notebooks, where I used to start a sentence with a small letter and use capital letters within the words. My teacher would put a red cross on it… [the

> crosses] ruins my notebook… I used to rip off the page so nobody can see crosses on my work… but now I'm mindful of my capital and small letters in my writings (SGI.CP1:41).

It appears that learning through the digital game may have improved attention to detail. The students may have started to notice little details in reading and writing, such as using capital letters or appropriate punctuation marks, which indicates a positive attitude towards volunteer recreational reading.

The students shared their feelings about getting access to storybooks. Most of these students could not afford to buy new books; however, they expressed their joy in receiving books as gifts. One student said,

> … I like to get storybooks, colouring books and colour pencils as a gift… sometime my mother brings us used colour pencils and old books or magazines from the house she works in… she sells the books to old book shops… so we can't keep the books. (SGI.CP2: 14)

The CMG campus also does not have a library. So, the students appeared to read anything interesting that came across their eyes. For example, one student shared, "I read signboards when I am walking past the market" (SGI.CP3:37). Another student shared,

> I read all the posters displayed in the school corridor… these are quite informative… the one I like the best is about the landscape of Pakistan… it tells about the highest mountain peaks, rivers, and animals in Pakistan… I didn't know before that markhor [wild goat] is the national animal of Pakistan… it lives in mountains and it can kill snakes. (SGI.CP3:39)

Some students shared that they feel motivated to read ahead in their textbooks during school holidays. They also appeared to apply strategies to know the meaning of the words if they are stuck on something while reading. One student shared,

> After playing digital games, I feel motivated to read the stories in my English textbook during my free time. If I don't understand a word, I would ask my teacher, or elder brother at home, or even our next-door neighbour… Once I did not know the meaning of the word 'witches'. My brother was not at home, so I asked the next-door lady the meaning of the 'witches'. (SGI.CP1:18).

The data in this section suggests that the students appeared to develop a positive attitude towards reading for pleasure. They are also able to apply learning gained from recreational reading to academic reading. However, due to a lack of access to recreational reading material, the students appeared to read for fun from their textbooks. This may have blurred the difference between recreational reading and academic reading. However, some motivation for reading for pleasure was evident from the data.

The following paragraphs present qualitative results of the impact of the digital game on the academic reading attitudes of the CMG students.

Comparison Group Attitudes Towards Academic Reading

During the group interviews, the students shared their perceptions about reading. They believe reading is about reading for school; for example, one student said, "reading means to read for different subjects at school…" (SGI.CP1:9). Another student shared that, "…we read in different languages, such as Urdu, English and Arabic…other than that, we also read questions in Maths… where we have to understand the problem and apply division or multiplication [mathematical operation] to solve the question…(SGI.CP1:13). The students were aware of the importance of reading for different subjects; however, their awareness lacks the interactions between mental processes involved in reading, for example, extracting information and constructing meaning from the text. They believed reading is a core skill to grasp the knowledge of any subject. For example, a student responded during the interview, "reading is applicable to all subjects like English, Urdu, Islamic Studies, Social Studies, Math and Science. If we are able to read, we can understand and remember [the content of] all subjects" (SGI.CP1:14). However, none of the students discussed the strategies used to conduct the effective reading.

Data indicated that students experienced very little difference in their attitudes towards academic reading after playing the digital game. This was a surprising result and may be attributed to the learning environment and the teacher facilitation. The usual classroom norms did not allow students to experiment with new learning strategies, such as peer collaboration for solving problems and constructing meaning. They sought support from the teacher if they encountered a problem during playing games. One student shared,

> …I think the only difference in DGBL sessions was the use of playing games for learning… otherwise, the teaching method was kind of similar to our normal sessions… we were working on our own… we were not allowed to talk to each other…we asked the teacher if we didn't understand anything… (SGI.CP2:17).

In response to the questions of how students felt about reading their textbooks or workbooks after playing the digital game, the answer was mostly indifferent. The students found no noteworthy difference in their attitudes towards reading their textbooks. They showed the same motivation for reading their textbooks before and after playing games. One student responded, "… no doubt our English reading skills have improved after playing games but we have the same attitude towards reading before playing games" (SGI.CP1:8). Another student shared, "…we like to read stories from our Urdu book compared to the English book… because we understand the meaning of Urdu stories better than the English" (SGI. CP1:9). It was also evident from Sections 5.5 and 6.2.1 that the students were able to transfer reading skills from English (L2) to Urdu (L1). They found Urdu reading enjoyable when they successfully applied reading skills to read in Urdu. One student said that "Urdu was easy to read when we applied phonics techniques in reading Urdu… it was also enjoyable to read because we could understand the meaning… now we enjoy reading short stories in our textbook" (SGI.CP2: 15). However, reading in English remained difficult for these students even after playing games.

The students found a huge difference in the method of teaching reading with the digital game compared to the traditional methods their teachers used in regular sessions. The games were focused on developing reading skills using phonics methods, but the teachers were using whole word teaching techniques in regular sessions; therefore, students appeared to be confused as to which methods of reading they should adopt for reading in class.

One student shared,

> I feel I can read using phonics.. but while reading out-loud sessions in class, I am afraid to use phonics as the teacher disapproves it… she wants us to know the whole word… for example, I can read the word zebra by breaking into phonics as /z/ /e/ /b/ /r/ /a/, but if I don't know the word as a whole, I will not be able to read… (SGI.CP1:20).

The data indicates that the indifferent attitudes towards academic reading were the outcome of a lack of comprehension skills, especially in the English language. The students repeatedly mentioned during the interview their lack of comprehension skills. For example, one student commented, "… we don't know the meaning of all the words in our textbook… even if we remember the whole word or use a phonics method to read the word, we don't get the meaning… this makes reading unenjoyable" (SGI.CP1: 20).

The CMG students appeared to be unfamiliar with the use of a dictionary. Most of the students never saw a dictionary; more so, the word 'dictionary' was new for many students, "… no, we have never used a dictionary… our school does not have dictionaries", one student shared (SGI.CP2:10). Another student shared,

> … if we stuck on a word, we ask the teacher… also during English reading, the teacher tells us meanings of difficult words… the teacher tells us the meaning of the word in Urdu, so we understand" (SGI.CP2:11)

Attitudes towards reading may also be inferred from their motivation and experience of reading in class. Students demonstrated mixed opinions about reading in class. Four out of a group of six students did not enjoy reading in regular classes as they deemed those sessions boring and stressful, "…reading in the regular classroom is boring, especially when we have to read after the teacher and we don't understand the meaning of what we are reading…"(SGI.CP2:10). One student stated about her anxiety of attending a reading class due to constant telling off from the teacher,

> …I always feel stressed and anxious in our traditional style reading sessions… the teacher asks us to read in front of the whole class… if we don't read correctly, she humiliates us by telling us off in front of everyone… (SGI.CP1:12)

Another student compared this situation with game-based sessions,

> … game-based sessions were enjoyable… because, if we made a mistake, the game would give us feedback… corrected us using an example as what we were doing wrong… I liked that… it wouldn't hurt your feelings…(SGI.CP1:13)

In summary, the data suggest that DGBL seems to have no major effect on the academic reading attitudes of the CMG students. Students reported to have improved reading skills in both languages, but they enjoyed reading in Urdu more as they could comprehend the content better in their first language, Urdu. Data indicates that teaching methods also influenced student attitudes towards academic reading. Playing games independently without collaborating with peers appeared to have a declining impact on academic reading attitudes. Students viewed teacher facilitation within game-based sessions as something similar to their regular reading sessions, where they are reading independently and seek help from the teacher if needed. Independent playing of games with no collaboration with peers indicated a lack of meaning construction within a context. It is also evident from the data that teaching methods appeared to influence students' reading attitudes, as the digital game and teachers used different teaching methods for teaching reading. The digital game was focused on phonics strategy, whereas teachers were using whole-word techniques in teaching reading, which appeared to generate confusion when it comes to applying reading skills in regular reading sessions.

7.2.3 *Reading Attitudes of the Experiment Group*

This section reports the reading attitudes of the EG students as influenced by digital game-based learning. The results are again sub-divided into two categories: attitudes towards recreational reading and academic reading.

Experiment Group Attitudes Towards Recreational Reading

The student group discussions indicate that some students in the EG appeared to have better access to reading resources than others, which enabled them to reflect and share their feelings about reading. One student shared,

> In my free time, I like to read storybooks… my auntie brings me English and Urdu storybooks from her workplace… If I can't read a word, I apply phonics technique and blend the sounds to read a word (SGI.EX3:9)

Another student commented about the access to books through their class library corner, "…we have a little library corner in our class. I had never visited it before… but now I borrowed two storybooks from the class library…. One was 'Cinderella', and the other was 'The little red hen'." (SGI. EX3:24). Another student shared that she likes to read in Urdu, so she borrowed Urdu storybooks from the class library corner, "I borrowed Urdu storybooks, one was about fishes, the other one was called 'Babloo'… it was a funny story about a little boy who always gets into trouble…" (SGI.EX3:24). These students appeared to develop an interest in borrowing books from the class library after playing the digital game. One student commented, and the others agreed,

> … the library corner was always there in the class, but we had never borrowed books before… earlier, we used to see colourful pictures in the books rather than reading the books… but now we gain some reading skills… we are now able to use phonics technique to read the books… if we don't fully understand the meaning of the text, the pictures help us understand the story" (SGI. EX3:26).

This implies that improved reading skills resulting from game playing motivated the students to broaden their reading experience by borrowing books from the class library. They were looking for opportunities to read more as they were enjoying the experience of reading for fun. It also appeared as development in reading skills improved students' confidence that motivated them to read almost anything they could access at home. It was interesting to note that one student read the translation of the Quran and was able to make sense of it by reflecting on cultural practices in relation to religion,

> I did not have much to read at home… Once I went to my Quran lesson… for the first time ever, I tried to read the translation underneath the Arabic verses. It was about women's rights in Islam…that women have a right to inheritance… I thought to myself that if we are following Islam, then how come my mother was denied her right to inheritance after her father's demise… (SGI.EX3:7).

The above example shows that the student was able to think critically by making connections between Quranic reading and societal or cultural practices.

The EG students appeared to develop strategies to become more resourceful in reading. The students shared that they exchanged storybooks with each other so more students could be able to read for pleasure, "after reading a book, we exchange it with someone else in our friend's circle… this way, we can read more books without spending money…(SGI.EX3:25).

These students also showed a responsible attitude towards looking after the books. Another student mentioned,

> We look after each other's books… making sure they don't get ruined by accidents like spilling water or getting in the hands of young children…Once my storybook got into the hands of my baby brother, who ripped the pages apart… I got very upset about that... I want to make sure it won't happen to the books I exchange with my friends…(SGI.EX3: 26)

In terms of understanding the meaning of unfamiliar content, the EG students appeared to apply strategies to understand the meaning of the content. For example, one student shared she looks at the pictures before reading the passage to get an idea of the context of the passage, "…I try to infer meanings from the pictures in the book before I start reading… I like storybooks with lots of pictures…pictures give me an idea what the story might be about…" (SGI.EX3:10). The students also appeared to enjoy reading stories with a moral. One student said,

> "…I like moral stories conveying a message… I feel we can always apply that message to our life as well… I remember reading a book about scientists… most of these scientists were poor people; they struggled a lot to invent something new… they worked hard consistently…never gave up, and [eventually] they invented something new… (SGI.EX3:12)

The data in this section suggests that the EG students were motivated to read for pleasure. They appeared to develop strategies to gain access to the reading material and understand the meaning of the content. The following paragraphs report on the attitude of these students towards academic reading after playing the digital game (TYMTR).

Experiment Group Attitudes Towards Academic Reading

The EG students perceived reading as an activity of reading books for educational purposes. One student commented, "we read to gain education… we read for different subjects like English, Urdu, Social Studies, Science, etc..… we read the Quran to gain religious education… (SGI.EX1:6). These students appeared to appreciate the importance of reading. One student commented during the group interview, "...if we don't read, we won't be able to pass the exams… it is important to do reading practice at school and at home…" (SGI.EX1: 5).

The EG students appeared to have an improved attitude towards academic reading after playing the digital game. These students had some exposure to phonics reading strategy, but before playing games, they did not seem to apply the skill to read other subjects. A student said during the interview,

> … we knew about phonics… we thought it was only used to remember sounds… it was not fun at all… but after playing games, we know how to blend sounds to read a word… I like to read anything, like science or social studies by blending alphabet sounds… (SGI.EX1: 7)

These students also appeared to reflect on the mental processes involved in reading to make sense of the content, such as inferring meaning to make sense of the information, organising information and summarising the text. One student commented during the interview,

> I like reading stories in Urdu more than in English… I understand the meaning of the text better in Urdu because Urdu is my first language… When I understand the meaning of the text, I like to apply it to myself… just thinking about what I would do if I were in the same situation as the story character is… (SGI.EX2:10)

Another student shared about organising and summarising the information after reading the text,

> … I didn't like reading before because it wasn't fun at all… but now I enjoy the reading period, also enjoy reading in my free time at school… me and my friends take turns in reading. When we are reading a story together, I read a passage and describe in my own words to my friends… then they read the next passage and describe in their own words to us… this way we all understand what is the story about… (SGI.EX2: 12)

Another student further added to the discussion, "when we describe [reading content] in our own words to each other, we remember it for a long time" (SGI.EX2:12). This example shows that students were able to apply effective reading strategies of inferring meaning, summarising and organising information from the reading content. The EG teachers were also of the view that students had improved attitudes towards academic reading after playing the digital game. One teacher shared,

> one improvement in attitude [towards academic reading] is that earlier they [students] were reluctant to retell the reading passage in their own words… I had to ask many prompting questions, especially from the struggling students to get the gist of the passage… But now they are willing to describe the reading passage in their own words… it looks as if they are taking more interest in reading… often they get involved in discussions related to the story they are reading… (T1.EX1:14)

The students attributed the improvement in reading skills to the digital game-based sessions where they had the opportunity of peer learning and peer support,

> … before these DGBL sessions, we liked to keep our work to ourselves… we never shared with someone… and we never worked in groups… but now [after DGBL sessions] we like to work in groups… we help each other… we support each other… this may have helped to improve our reading skill…now reading is fun. (SGI.EX1:53)

Another factor that appeared to contribute to improved academic reading attitude is students' willingness to apply strategies to understand the meaning of new words. The EG students were familiar with the use of the dictionary; however, they may not have used it often. A student shared,

> .. we have seen a dictionary… we know how to use it, but we don't use it in class… our teacher dictates us the meanings of the new words in Urdu… we write it on our workbooks so we can remember the meaning… (SGI.EX1:13)

Another student commented about the strategy of finding the meaning of a difficult word at home,

> I seek help from my father if there is a new word or difficult word in the reading. If he is not at home, then I try to guess the meaning from the context of the story... still if I don't understand, I will then ask the teacher the next day at school (SGI.EX1:18)

The students commented on reading at school during reading time as non-engaging and boring, but they appeared to make reading fun during their free times, such as school breaks or free periods. One student shared, "the teacher reads aloud a sentence, we listen to her then the whole class reads after her… after we complete whole class reading, the teacher listens to read every student individually…" (SGI.EX1: 15). Another student further commented,

> … sometimes she [teacher] asks questions about the passage, but not always… she asks questions when she is cross with a student…or if a student doesn't know how to read… but if you are reading fine, she wouldn't ask questions… (SGI.EX1: 15)

The student reflections show that teaching strategies may contribute to developing academic reading attitudes. Students may not be able to acquire positive academic reading attitudes if teachers use non-engaging teaching methods or do not engage all students in question-answer-evaluation sequences to gauge students' comprehension skills.

In summary, the data from this section suggests that the EG students demonstrated improvement in attitudes towards academic reading after playing the digital games, which may be attributed to the student-centred DGBL environment that promoted collaboration and peer support. The students appeared to use peer support and collaboration to read and comprehend the chapters from their textbooks. Although the students found a disparity between the reading methods their teachers adopt in class compared to how they would like to read, they appeared to solve this issue by using peer learning strategies in their free time.

7.3 Summary

The chapter presented mixed-methods (quantitative and qualitative) results on attitudes towards reading before and after the intervention. A reliability test was conducted to assess the reliability of data to interpret results. The moderate to high internal consistency coefficient of the overall Urdu translated ERAS scale (Cronbach's alpha = 0.763) indicated the reliability of the scale in interpreting reading attitudes data. The quantitative results on students' attitudes towards reading revealed that traditional instruction failed to bring any positive attitude towards reading in control group students during the intervention period. On the other hand, the digital games brought a positive attitude towards overall reading attitudes in both the experiment and the CMG students. The study highlighted that the EG students who played the game without teacher facilitation demonstrated a more positive attitude towards recreational and academic reading. On the contrary, the CMG students who played the game with teacher facilitation experienced a slight decline in academic reading attitudes. These results have implications for improving traditional style reading instruction and the design of digital game-based learning environments that foster a positive attitude towards reading.

The qualitative results also demonstrated a great difference in reading attitudes of the control, comparison and experiment groups. Overall, the control group students lacked a positive attitude towards reading. They appeared to enjoy reading when they were able to comprehend the text. Most students could not comprehend the text; therefore, their preference for reading was lower compared to other creative activities, such as colouring or craft making. Their lack of favourable attitudes towards reading may be attributed to traditional style reading instruction that promoted rote memorisation instead of understanding and meaning-making.

The CMG students developed a better attitude towards recreational reading but found no difference in their academic reading attitude after playing games. This can be attributed to facilitation strategies adopted by teachers during DGBL sessions, where the independent playing of games with no peer collaboration mimicked a traditional classroom environment with books replaced by the digital games. Also, the CMG students appeared to be motivated to read for pleasure, but due to lack of access to reading resources, they struggled to reflect on attitudes between recreational and academic reading. These students appeared to read for fun from their schoolbooks which blurs the distinction between academic and recreational reading.

The EG students developed positive attitudes towards both recreational and academic reading. It appears that the DGBL learning environment of peer collaboration and support enabled them to develop creative solutions to their problems. To address the issue of accessing reading material, they developed a strategy of borrowing and exchange books with each other. They also appeared to apply effective reading strategies of inferring meaning from the text, sometimes by looking at the pictures, summarising and organising information and retelling the information in their own words.

The next chapter, Chapter 8, synthesises and discusses the findings from Chapters 4 to 7, including quantitative and qualitative results in relation to reading achievement and attitudes towards reading due to digital game-based learning with the relevant literature. The significant findings will be described and discussed pertinent to the discipline of digital game-based learning and acquiring reading skills in a developing country where English is the official language but not the lingua franca for most people.

CHAPTER 8: DISCUSSION

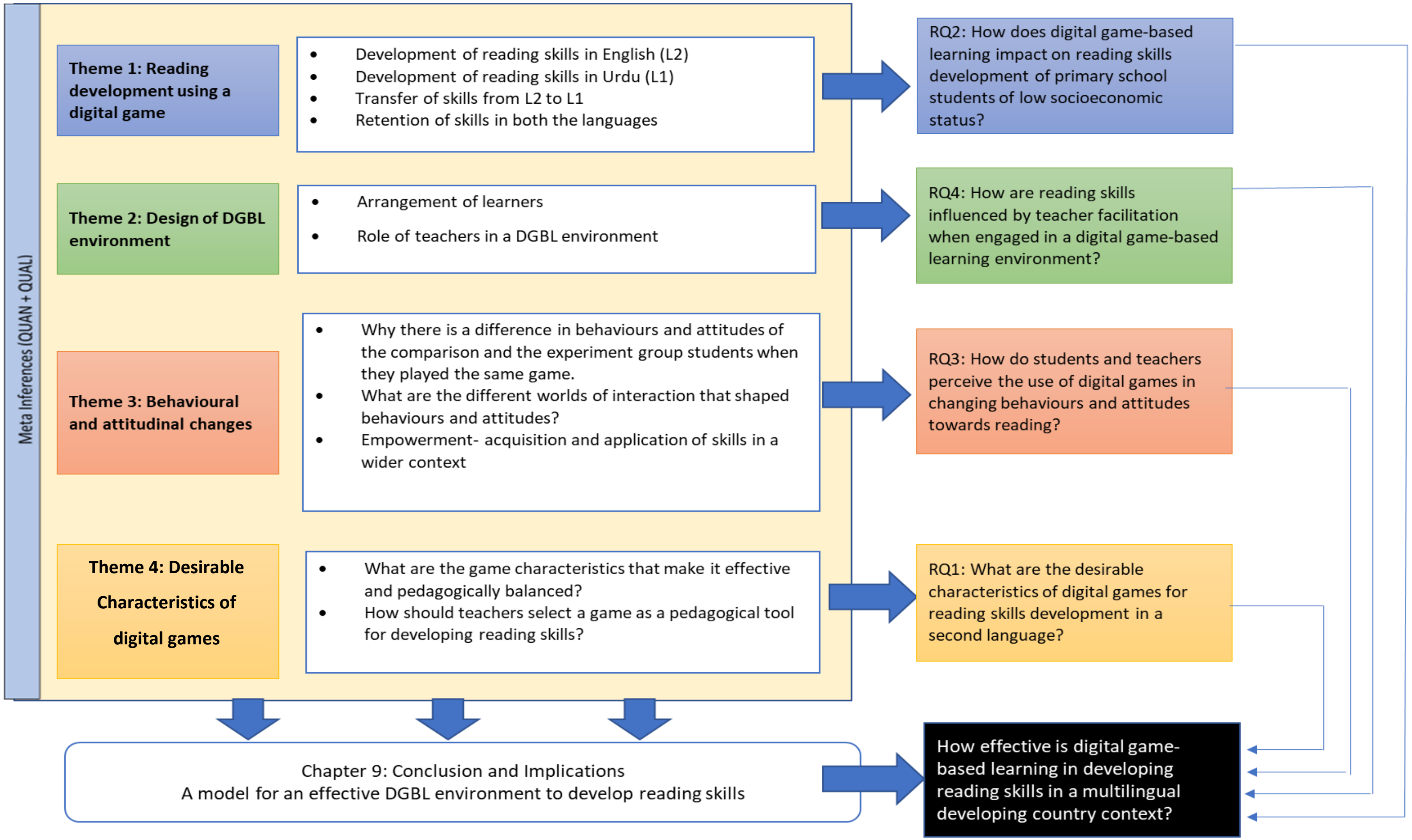
This chapter discusses the results described in Chapters 4-7 in light of the relevant literature reviewed in Chapter 2 to answer the research questions identified in Chapter 3 and restated below concerning the effectiveness of digital game-based learning (DGBL) in improving the reading skills of students belonging to low socioeconomic status (SES) in Pakistan.

1. What are the desirable characteristics of digital games for reading skills development in a second language?
2. How does digital game-based learning impact on reading skills development of primary school students of low socioeconomic status?
3. How do students and teachers perceive the use of digital games in changing behaviours and attitudes towards reading?
4. How are reading skills influenced by teacher facilitation when engaged in a digital game-based learning environment?

This chapter highlights four prominent themes that emerged from the interpretations and triangulation of meta-inferences from quantitative and qualitative data. Each theme contributes to answering one or multiple research questions. The themes are sequenced in the order to describe a story of the impact of the digital game on reading development, the factors that may have contributed to the impact and how the skills gained through DGBL were transferred to the wider society. Section 8.1 discusses the impact of the digital games from different perspectives on developing reading skills. Section 8.2 discusses and elaborates upon the design of a digital game-based learning environment that may have fostered effective reading skills in students, followed by Section 8.3 justifying the change in behaviours and attitudes resulting from digital game-based learning. A discussion on desirable characteristics of a reading development game to foster effective reading skills in students is discussed in Section 8.4. An overall chapter conclusion is presented at the end of the chapter, answering the overarching research question to develop an effective DGBL environment for reading development. The discussion in this chapter leads to recommending a DGBL model for enhanced teaching and learning, which will be discussed as an implication for teachers in creating effective DGBL environments in the concluding Chapter, Chapter 9. Figure 8.1 presents a visual overview of the discussion pertinent to indicated themes and associated research questions.

Figure 8.1

Overview of the Discussion Chapter in Regards to Themes, Subthemes and Research Questions



8.1 Theme 1: Reading Development Using a Digital Game

The discussion under this theme draws on the evidence of developing reading skills in English (L2) using a pedagogically balanced digital game. The findings in this section contribute to answering RQ 2: *How does digital game-based learning impact the reading skills development of primary school students of low socioeconomic status.* The effect of DGBL is discussed from various perspectives, such as the impact of the game on developing different components of reading skills, the ability to transfer skills from one language to the other, and how students were able to retain reading skills once the DGBL was discontinued and students returned to their routine traditional style teaching. The sub-themes discussed in this section are the development of early reading skills in English as a second language (L2), the cross-linguistic influence of L2 on L1, and retention of skills in English (L2) and Urdu (L1).

8.1.1 *Development of Early Reading Skills in English as a Second Language (L2)*

This section discusses reading skills between the game groups, i.e. comparison group (CMG) and experiment group (EG), and the non-game group, the control group (CG). Initially, students in all three groups possessed similar L2 reading skills. After the intervention, the results indicated improvement in all components of reading skills: phonological awareness, word decoding, word recognition, oral fluency, and comprehension reading, across three groups (Section 5.2.4). However, the improvement in reading skills across all components in game groups (CMG and EG) was far more significant with a large effect size (Pearson r ranges between 0.6 and 0.9) than in the non-game group (CG). To some extent, these results are consistent with earlier DGBL studies that showed a positive impact of digital game-based learning on acquiring L2 reading skills with medium-to-large effect size compared to different conditions in instruction (e.g. Acquah & Katz, 2020; Görgen et al., 2020; Hung et al., 2018; Ronimus et al., 2019; Tsai & Tsai, 2018; Van de Ven et al., 2017). For instance, Görgen et al. (2020) reported a significant medium effect size of improvement on phoneme-grapheme mapping in students who played a multi-component reading game compared to those who played unspecified mind games focused on logic and attention. Nevertheless, their study showed no significant effect on students' reading comprehension. Similarly, Hung et al. (2018) performed a scoping review of 50 DGBLL studies from 2007 to 2016 to examine the effectiveness of digital games for learning English as a foreign language. They reported a medium effect size of a wide genre of digital games (e.g. MMORPGs such as World of Warcraft, COTS drill and practice games, and simulation games) on vocabulary development.

In the present study, the CG students showed a significant improvement in phonological awareness and comprehension reading but insignificant gains in word recognition, pseudoword (non-word) reading ability and oral fluency. The improvement in phonological awareness in the CG may be the outcome of rote memorisation encouraged by traditional style teaching. It was also observed that the CG teacher provided meanings of the difficult words in Urdu while practising reading in English, which might have helped students improve their comprehension skills. The use of the translation method is consistent with earlier studies (Ashraf, 2018; Creese & Blackledge, 2010; Karimian & Talebinejad, 2013), suggesting that teacher's pedagogical approach to using L1 to expand students' knowledge of vocabulary, syntax, and semantics may improve reading, writing and speaking in L2. Therefore, the teacher's strategy of providing word meaning in L1 may be the predictor of improved comprehension reading ability in the non-game group. However, the lack of blending and segmenting activities in traditional-style teaching may have limited the CG students in developing pseudoword reading, thus leading to a lack of reading accuracy and fluency.

In this study, the CMG played the game with teacher facilitation and outperformed the other groups on all reading skills. However, the difference between the achievement of comparison and the experiment group was not statistically significant, with a negligible effect size ($r = 0.09$), which implies that the EG performed equally well on reading skills despite not being facilitated by their teacher. This result resonates with the findings of a systematic review (Acquah & Katz, 2020), indicating that DGBL positively impacts L2 acquisition in the studies conducted in a formal learning environment with or without teacher facilitation. Further discussion on the role of teacher facilitation in a DGBL environment will be included in Section 8.2.

On the development of L2 reading skills components, the analysis of pre-and post-test of EGRA in this study (Section 5.2) indicates that the students in the game groups (CMG and EG) significantly improved word decoding (pseudoword reading) and word recognition (familiar word reading) skills after the DGBL intervention. In contrast, the non-game group (CG) students showed a slight but non-significant improvement in word decoding and recognition skills. This finding may be ascribed to letter-sound recognition, segmenting and blending activities in the TYMTR game. Since pseudoword reading is related to phonological decoding (Van de Ven et al., 2017), the game TYMTR positively impacted on students' phonological awareness, ultimately improving word recognition and pseudoword reading skills. Hulme and Snowling (2013), in L2 early reading acquisition, show a causal relationship between phonological awareness and letter-sound knowledge, which is a predictor of reading accuracy and fluency. The gains in oral fluency and comprehension skills in the present study are probably the causal effect of improved phonological awareness in students who played the game. These findings are consistent with other grapheme-phoneme conversion games, e.g. Little Prince cited in Van de Ven et al. (2017); GraphoLearn cited in Ronimus et al. (2019); Antura and the letters and Feed the monster cited in Cornings (2018) that aim to develop students' speed and accuracy of letter-sound recognition.

The findings discussed in this section resonate with earlier studies (Ronimus et al., 2019; Van de Ven et al., 2017), arguing that a pedagogically balanced digital game may improve components of reading skills that the game is targeting to improve. If the game embeds phoneme-grapheme mapping, it may contribute to improving phonological awareness and subsequently improve word recognition and reading fluency. A plausible explanation of these findings may be linked to the selected game that offered opportunities to learn and practice multiple components of reading skills in one complete game across multiple levels. The positive results of the EG group students, which performed well without teacher support, indicate the possible use of a pedagogically balanced game as a stand-alone solution in schools where there is a sheer dearth of trained teachers and resources such as appropriate books, but the schools have access to tablets technology. Such games engage students in practising reading skills, which may impact the learning of other subjects as well. The following subsection discusses the impact of games on transferring reading skills from L2 to L1.

8.1.2 *Cross-Linguistic Influence of L2 on L1 Reading*

Cross-linguistic influence (CLI) refers to how one language impacts on learning of another language in a multilingual context (Jarvis & Pavlenko, 2008). This study used EGRA-Urdu to assess students' Urdu reading skills before and after the DGBL intervention. The students received no explicit instruction for Urdu reading using the digital games. The study findings revealed that after playing games in L2 for six weeks, the EG and CMG gained a statistically significant achievement with a large effect size in Urdu (L1) reading compared to CG (Section 5.5.4).

Overall, the EG outperformed the CMG on phonological awareness, word decoding, and oral fluency, whereas the CMG performed better on Urdu word recognition and comprehension reading. Nevertheless, there was no significant difference between the Urdu (L1) reading skills of EG and CMG, which corroborate Cummin's (1979) linguistic interdependence hypothesis that languages share common transferable characteristics. Most studies hypothesised the transfer of reading skills from L1 to L2 (Gebauer et al., 2013; Kim et al., 2020), particularly when the target languages have similar orthographies. In contrast, the cross-linguistic transfer may be language-specific (Wang et al., 2009) and might not readily occur in languages that share different orthographies or writing systems (Kim & Piper, 2019). The present study's findings are consistent with those of Akbulut (2019), suggesting that the transfer of reading skills from L2 to L1 in a language pair (English-Urdu) sharing different orthographies may be possible if students develop a metalinguistic awareness in L2 from direct and explicit instruction on the components of reading skills.

In EG, the explicit instruction of reading was delivered through the digital game without teacher facilitation; but explicit game instructions were enhanced through additional teacher facilitation in CMG. In this group, the teacher facilitated students in identifying a deliberate relationship between phonological similarities between English (L2) and Urdu (L1) reading. Both the languages are phonetic but differ in orthographies. The teacher raised students' metalinguistic awareness by corresponding similar sounds to letters in both languages (Section 6.2.1). Her deliberate pedagogical approach to finding similarities between languages may have enabled students to establish a connection between letters with similar sounds in both languages, which may have encouraged them to use segmenting and blending sounds to read in Urdu (L1). These results resonate with Akbulut (2019), suggesting that explicit instruction on morphological rules improves metalinguistic awareness in students learning to read in L2. Nevertheless, explicit instruction would depend on the teacher's competence in metalinguistic awareness of the L2, which plays a pivotal role in providing the input for L2 reading (Andrews, 1999). This highlights the need for teacher training in L2 teaching in developing countries like Pakistan.

The EG students who did not receive teacher facilitation also developed metalinguistic awareness by playing games in a hugely cooperative and collaborative learning environment. These students had the opportunity to understand or discuss game instructions and tackle problems without the teacher's support, which compelled them to collaborate and solve problems. They appeared to acquire metalinguistic awareness at a deeper level compared to the CMG students. This was exemplified in Section 6.2.2 by their reflections on identifying multiple sounds for a letter, e.g. sound of /u/, as in 'cut' and 'put'. The EG students compared the phonetical feature of English (L2) with Urdu (L1), where they reflected on the use of diacritical marks on Urdu letters to pronounce the correct sound. Students thought diacritics add a linguistic consistency, making reading easier in Urdu than in English. This is not surprising given that students were traditionally taught reading Urdu (L1) using diacritics to identify the sounds letters would create. Such student reflections may have been held during discussions within small groups while playing games, which suggests that learning through a pedagogically balanced digital game in L2 within a collaborative environment improved something beyond phonological awareness, i.e. metalinguistic awareness - students' understanding of alphabet principles in both languages. One possible explanation for this finding could be self-correction behaviour, which positively correlates with L2 learning gains (Golonka, 2006). The present study findings indicate that in-game feedback encouraged students to self-correct their errors and repeatedly practice reading skills until they mastered them, which may have improved their metalinguistic awareness to draw parallels between L2 and L1 reading.

Hence, the findings from the present study support previous studies on cross-linguistic influence (e.g. Akbulut, 2019; Kim & Piper, 2019; Wawire & Kim, 2018; Wise et al., 2016), suggesting that explicit instruction using pedagogically balanced digital games may improve students' understanding of alphabet principles in one language, which could positively transfer to L1 language despite the differences in orthographies or letter sounds across languages. A potential advantage of using such games with explicit instructions on phonological awareness could support students' reading in areas with teacher scarcity.

The present study further adds to the literature by providing empirical evidence of cross-linguistic transfer of all components of reading skills: phonological awareness, word decoding, word recognition, oral fluency and comprehension from English (L2) to Urdu (L1). The findings also align with Sato and Ballinger (2012), suggesting that students may acquire critical metalinguistic awareness through corrective feedback in a collaborative environment where they work together to co-construct meaning. In the present study, the digital game provided instant corrective feedback for every instance of an incorrect response, which may have helped improve metalinguistic awareness. Secondly, the EG students' collaborative DGBL environment may also have contributed to developing metalinguistic awareness, which agrees with previous research that students could be more confident in giving peer feedback on the transfer of reading skills if the learning environment is collaborative and trusted to protect students' self-esteem (Memari & Asadi, 2021). Further discussion on the design of the learning environment and its impact on the retention of skills will be undertaken in Section 8.2.

The findings discussed in this section have important theoretical and practical implications for learning to read using pedagogically balanced digital games. Previous studies have widely conceptualised the linguistic interdependence hypothesis (Cummins, 1979) in the context of L1-to-L2 transfer of skills. The present study contributes to extending this hypothesis to an L2-to-L1 relationship to validate the two languages' common underlying proficiencies (Cummins, 1979), particularly with different orthographies. The next section discusses the retention of reading skills in both languages acquired through DGBL.

8.1.3 *Retention of Skills in English (L2) and Urdu (L1)*

This subsection discusses the sustainability of DGBL on long-term outcomes of reading skills. Ten weeks after discontinuing DGBL, the between-group analysis showed that the experiment and the comparison groups markedly outperformed the control group in retaining reading skills in L2 and L1. The findings echo Chen et al. (2019), asserting that digital games help students practice and retain acquired knowledge longer than traditional instruction. The focus group interviews of the EG and CMG students indicate that learning through digital games was a favourable learning approach that improved engagement and motivation for reading texts other than textbooks, which may have helped retain reading skills. For example, one student shared to read informative posters pasted in school corridors, which enlightened them with information about the landscape of Pakistan (Section 7.2.2). Similarly, another student shared about reading the translation of the Quran in the Urdu language (Section 7.2.3), which affirms students' engagement and willingness to reading texts other than their textbooks, which might have improved their retention of reading skills.

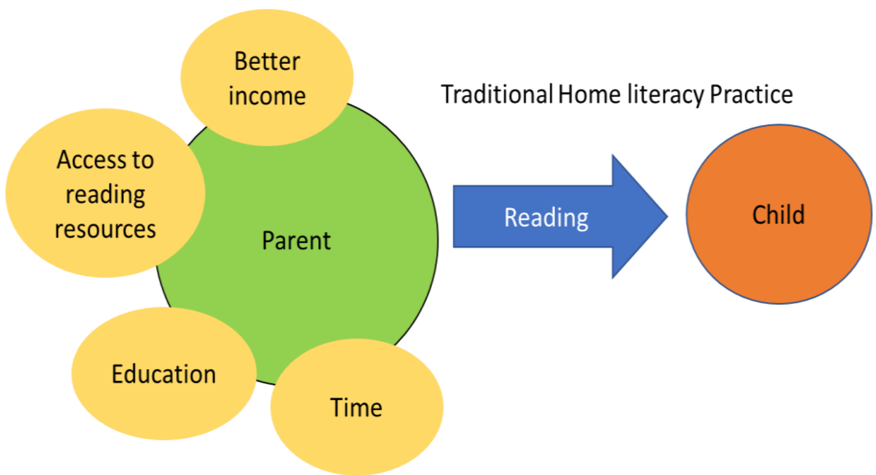
The within-group analysis revealed that the CG students made little progress on reading skills; however, this progress was continued post-intervention. By contrast, the other groups, which had made substantial progress previously (in Phase 2), saw a slight decline in reading skills after the discontinuation of DGBL. Nevertheless, the progress of the game groups was still better than the control group. The decline in the skills resonates with the literature on the summer slide (e.g. Allington & McGill-Franzen, 2013; Rasinski et al., 2017; Tiruchittampalam et al., 2018), indicating a loss in reading development of students after a long period of reading inactivity, e.g. after summer holidays. Based on the present study results, it can be argued that the discontinuation of DGBL had a slightly negative effect on the progress of reading skills in the game groups (CMP and EG). All three groups continued to receive regular traditional instruction after the research intervention. In the case of the CG, the traditional instruction remained the same, except for the discontinuation of an additional reading period; therefore, they did not experience the summer slide effect. In the case of game groups, the DGBL intervention stopped, and the students continued to receive the regular traditional style instruction on reading, which led to a shift in learning conditions. The change in learning conditions within game groups might have contributed to a slight loss in reading skills. This finding resonates with Hibert and

Taylor’s (2000) argument that no intervention, however well-founded both pedagogically and theoretically, can be a magic bullet to support future learning challenges. The author concluded that the immediate effect of reading interventions, in general, steadily regresses over time after the intervention. Therefore, it is suggested that continued and consistent support through effective digital games beyond the intervention timescales might help retain acquired reading skills.

The EG students retained more reading skills in both languages than the CMG students who received teacher facilitation during the gameplay. This draws the attention that there is more to the game that helped the EG students develop long-term reading skills than the CMG students. Literature on L2 acquisition considers home literacy practices and parental education as factors contributing to improving the L2 reading skills of their children, which may be an aspect of retention of skills (e.g. Peets et al., 2019; Quiroz et al., 2010). In the present study, the student sample was drawn from low-SES families, presenting a homogenous parental background in income and educational level. Student interviews indicated that their parents were not educated enough to help them with homework or reading practice at home, and neither could they afford to buy books to encourage reading. Therefore, usual home literacy practices and parental education seem not to impact EG students' long-term retention of skills. However, the reversal of this phenomenon was evidenced in student group interviews where they shared stories of helping parents in doing chores that involved reading, which could also have contributed to retaining skills. This may be one of the key contributions of this study that digital games empowered EG students with transferable skills that might have influenced their home literacy practices where students were helping parents with activities that involved reading skills, for example, reading instructions on ATM to pay energy bills or using digital apps to adding parent’s information to register on an app (Section 6.2.2). Students may have found authentic reasons for reading at home or outside the school context to assist their parents in reading-related or digital literacy-related tasks. So, a reverse of usual home literacy practice happened where instead of parents, children were assisting parents in reading-related or digital literacy-related tasks, which may have contributed to the retention of reading skills. Figure 8.2 shows a traditional home literacy practice, where educated and better-resourced parents find time to read to their children, which improves their child’s literacy skills (Peets et al., 2019).

Figure 8.2

Traditional Home Literacy Practice

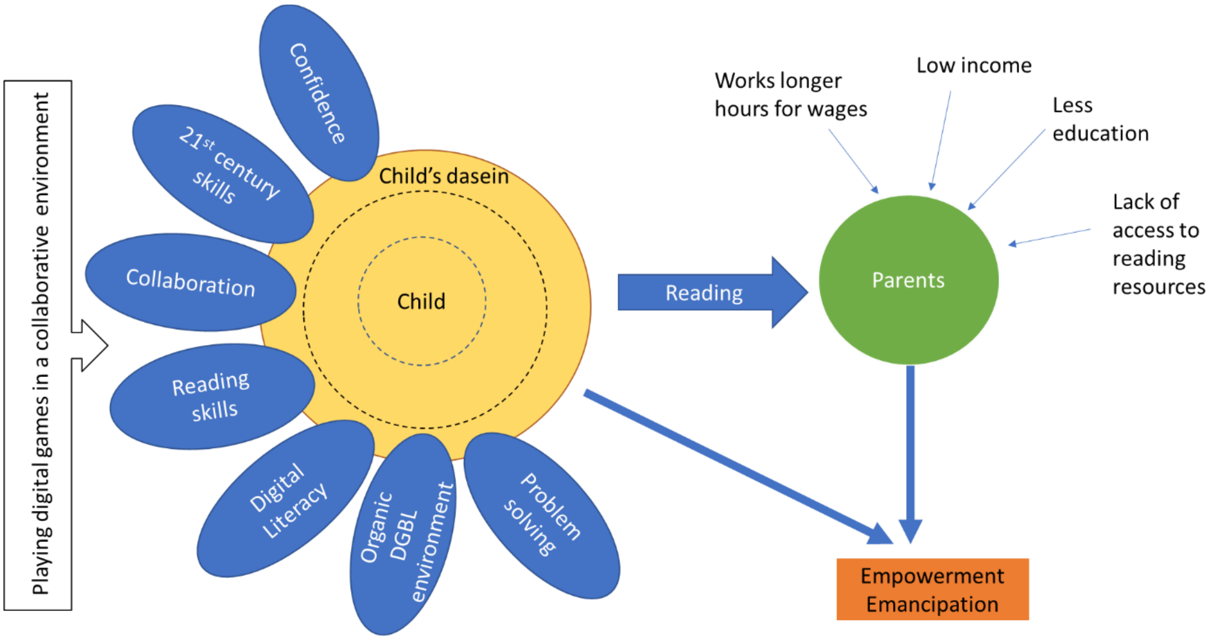


Note. This image shows a model of traditional home literacy practice where educated and well resourced parents read to their children. Adapted from the findings of Language proficiency, reading comprehension and home literacy in bilingual children: The impact of context. (2019). by K.F Peets,Y.Odilia and B. Ellen. International Journal of Bilingual Education and Bilingualism. 226-240. https://doi.org/10.1080/13670050.2019.1677551

In contrast, the findings from the present study depict a model of reverse home literacy practice in Figure 8.3, where students may have experienced a growth in their 'dasein – the mode of being' (Heidegger, 1967) (Section 3.3.3) by acquiring skills through their experience of participation in a collaborative DGBL environment. The students socially co-constructed meaning by collective problem-solving using digital games and acquired meta-cognition on how skills can be transferred from one context to the other. The growth in their 'dasein' may have empowered them with multiple worldviews to become confident in utilising skills outside school and helping parents in reading-related activities. The blue-coloured ovals in Figure 8.3 represent the behaviours and skills students acquired by participating in a collaborative DGBL environment. These skills may have contributed to enhancing the modes of being (dasein) represented by dotted circles in the yellow circular shape in Figure 8.3, which could have contributed to students' ability to help their parents in reading activities.

Figure 8.3

Model Of Reverse Home Literacy Practice In EG Students



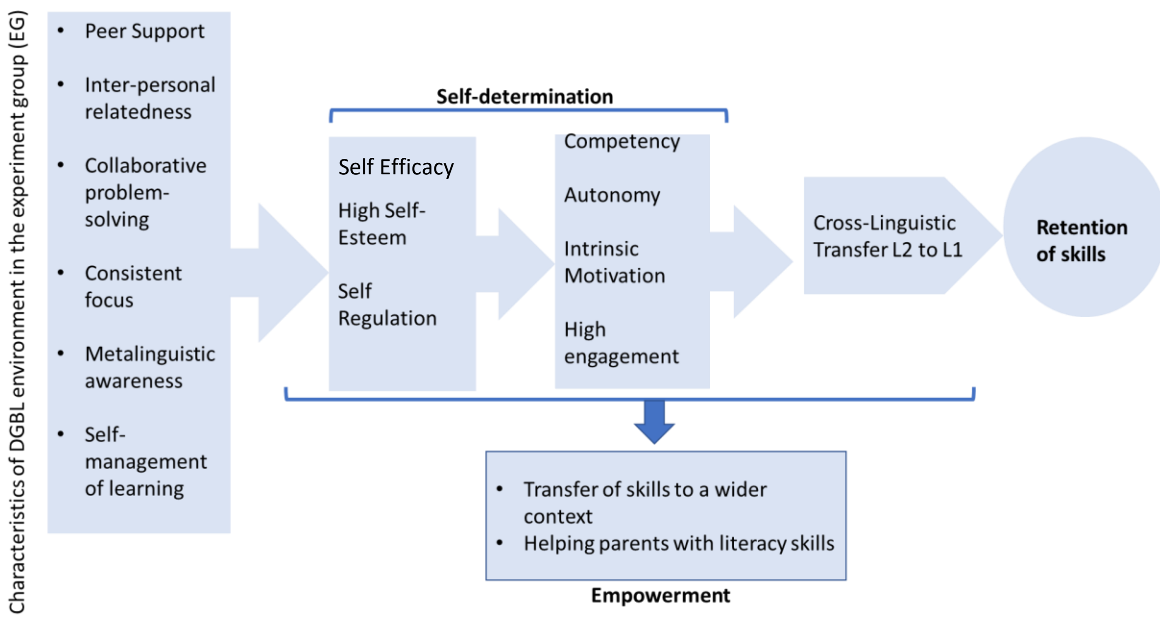
Note. Image created by the researcher based on the findings of this study, showing reverse home literacy practices where students used their acquired skills from DGBL to help parents in reading related activities.

The other aspect that led to the retention of skills could be the difference in the design layout of the learning environment during the intervention, which may impact motivational aspects resulting in the retention of skills. The design of the DGBL environment consisted of the seating arrangement, facilitation and support, use of resources, and interaction, which may have an impact on motivation and engagement in learning through digital games. In CMG, the teacher was the designer of the learning environment and acted as the sole source of support to the students; peer interaction was highly discouraged. In contrast, the students in EG designed their own learning environment through social interaction and peer support in solving problems. The focus group interviews indicated that the CMG students wanted to share the game achievement with peers or wanted to ask for help from a peer instead of the teacher; however, the teacher discouraged peer interaction, which was frustrating for students. The wait time to get help while the teacher was busy helping other students and the lack of opportunity to share the joys of game achievement with a peer or friend resulted in low motivation to play games. On the contrary, the EG students engaged in self-managed learning and appeared to show excitement in playing games, which might have contributed to the cross-linguistic transfer and retention of skills. This finding resonates with Li et al. (2021), suggesting that students who are able to self-direct their learning show greater engagement and motivation in reading activities.

Figure 8.4 presents a model for the retention of reading skills, as evidenced in the present study. The model shows the characteristics of a DGBL environment influencing psychological needs and motivation that could lead to developing cross-linguistic transfer of skills as a contributor to retention and empowerment.

Figure 8.4

Model For Retention Of Reading Skills



Note. The model for retention of reading skills is created by the researcher based on the findings and discussion of the present study

The model shows that the characteristics of the DGBL environment may have enabled EG students to develop high self-esteem and demonstrate self-regulation practice, due to which they chose to collaborate to solve problems and continued playing games with persistence despite not being facilitated by a teacher. Their decision to sit in groups and help each other while playing games confirms Jeno et al. (2019) argument that a learning environment supports or impedes students' psychological needs for autonomy, competence, and intrinsic motivation. The students developed interpersonal relatedness (Deci & Ryan, 1985) by establishing a peer support system to help each other and solve problems together. Their excitement of playing games without being disciplined by a teacher may have elevated their self-esteem and satisfied their psychological needs for motivation to collaborate in solving problems and continue playing games with consistent focus. These results align with self-determination theory (Deci & Ryan, 1985) which refers to a person's ability to decide how to satisfy their psychological needs, subsequently performing actions guided by their self-regulation to gain competency and autonomy.

The dynamics of interaction between student-teacher and student-student may affect the motivation and engagement in learning through games, thus increasing autonomy and competency. The improved reading competency and autonomy may have resulted in the transfer of skills from L2 and L1, consequently leading to the long-term retention of skills. These findings corroborate Yang and Chen (2021), suggesting that students with enhanced self-efficacy and improved focus, who tend to review learning concepts after answering questions incorrectly, could retain the acquired knowledge for longer. The long-term sustainability of skills in the EG students in the present study may be due to the increased motivation to read and consequent competency and self-efficacy achieved after playing digital games, which empowered them to transfer skills to the wider context, for example, helping parents to do chores involving reading. The sequence of events aligns with Rappaport's (1987) view of empowerment as a self-transformational process that comes from within the individual and is not dependent on others (e.g. professionals) for its achievement. Rappaport also suggested that dependency on professionals to fulfil needs limits the discovery of resources out there and reduces the likelihood of people helping each other. In the present study, the EG students did not rely on the teacher to get help. They became a supporter of each other and utilised the available resources to co-construct meaning and fulfilling their needs. The classroom dynamics and impact of interactions between students and teachers on achieving and retaining reading skills are discussed in the next theme.

8.2 Theme 2: Design of Digital Game-Based Learning Environment

Theme 2 includes a discussion on the factors that contributed to acquiring reading skills in a DGBL classroom environment. Several factors shape students' learning experiences, such as teachers' roles, the use of resources, peer interactions, and social relationships (Nuthal, 2007). Therefore, it is essential to discuss how such factors may have influenced students' acquisition of reading skills when engaged in

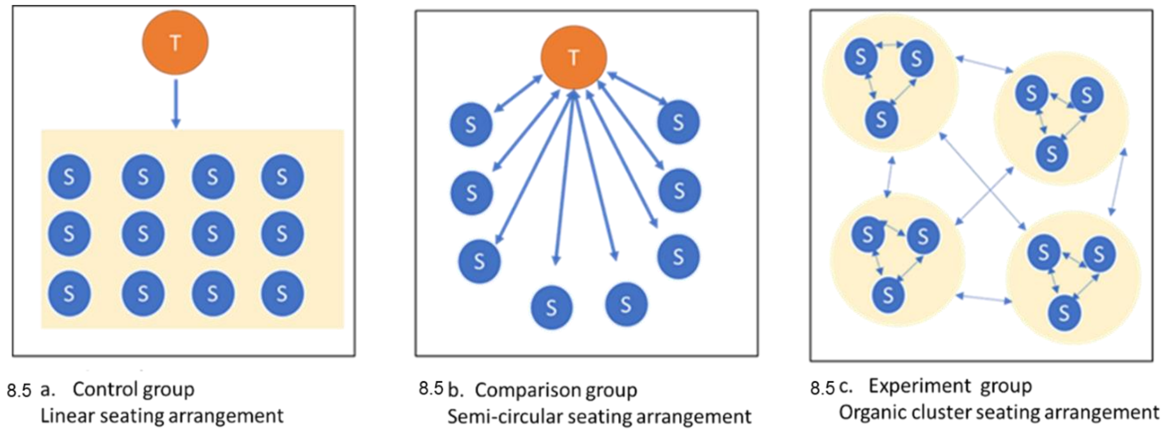
DGBL in a classroom environment in the present study. Using Scollon & Scollon's (2003) geosemiotic analysis framework, this theme examines the development of a classroom culture that may have contributed to the knowledge construction through the use of visual semiotics (e.g. digital games), place semiotics (e.g. classroom design, seating arrangements), and interaction (e.g. peer-to-peer, student-teacher). Discussion under this theme contributes to answering RQ4 as to *how reading skills were influenced by teacher facilitation in a DGBL environment.* Two sub-themes emerging are: *Arrangement of students*, and the *Role of teachers in a DGBL environment*. This section concludes by drawing together discussions on the arrangement of students and the role of teacher facilitation in developing reading skills using digital games.

8.2.1 *Arrangement of Students*

In this study, the arrangement of students refers to the spatial seating arrangement, which according to Parnell and Procter (2011), may impact the flexibility of teaching and learning within a sociocultural classroom. Findings from the present study (Sections 6.1.1, 6.1.2 and 7.2.1) revealed three types of seating arrangements (Figure 8.5), consistent with earlier studies exploring the effect of seating arrangement on student achievement and behaviours (Fernandes et al., 2011; Norazman et al., 2019; Simmons et al., 2015): linear, semi-circular, and organic cluster seating arrangements. Each classroom was equipped with a mat, a fixed blackboard, a teacher's desk, and a chair. The students sat on the mat; however, the seating arrangement varied across the three groups. Figure 8.5 presents the arrangement observed in each group. The blue coloured circles with "S" indicate students, the orange coloured circles with "T" indicate teachers, the yellow shaded areas indicate a group of students, and the arrows indicate interactions and directions of teacher-student or student-student interactions.

Figure 8.5

Arrangement of Students in the CG, CMG, and EG



According to Fernandes et al. (2011), variance in the seating arrangements may be reflective of teachers' pedagogical beliefs and instructional styles. The present study findings indicate that teachers preferred a more structured, linear and semi-circular seating arrangement for the CG and CMG students, respectively (Sections 7.2.1 and 6.1.1). Contrastingly, the EG students used an organic approach to sitting in groups forming small clusters (Section 6.1.2), suggesting their preferred way of learning and interacting with peers while playing the games.

The study findings corroborate with Norazman et al. (2019), suggesting that the seating arrangement of students was one of the key factors that could have implications for teacher facilitation and social interaction in the classroom, which eventually may have influenced the achievement of reading skills. These findings also concur with (Manca et al., 2020), who found that a flexible spatial arrangement with opportunities for students' decision-making promotes self-directed learning and increases student autonomy.

The following subsections discuss the impact of seating arrangements on reading skills

Linear Seating Arrangement in the Control Group

For the control group, the seating arrangement of multiple rows facing the teacher and the blackboard (Figure 8.5a) reflects the educational philosophy of essentialism (Şahin, 2018), which focuses on transferring content from teacher to students. In the present study, the CG teacher adopted a whole-class teacher-centred pedagogy that may have restricted individualisation and one-to-one support. Simmons et al. (2015) argue that a linear seating arrangement is better suited to managing disruptive student behaviours and optimising on-task behaviours using knowledge transmission from the teacher to students while limiting collective knowledge construction. The observation data (Section 7.2.1) revealed that students were mindlessly or mechanically repeating after the teacher without distinguishing between the reading content and the teacher's verbal instructions. The researcher's observation notes indicate that in two instances during the same session, the teacher instructed a student to stop fiddling with the water bottle while the whole class repeated the teacher’s instructions to stop fiddling with the water bottle (Section 7.2.1). This teaching approach to engaging students in mindless repetition after the teacher may not be effective in improving reading comprehension. The students may not establish a one-to-one teacher-student interaction, which could be due to their seating arrangement (Fernandes et al., 2011), showing that linear seating arrangement perhaps was inadequate in engaging students in whole-class reading comprehension strategy.

Linear seating arrangement could be more appropriate to improve on-task behaviour, such as compliance with the teacher’s instructions or focusing on the transmission of learning materials, but it may not be suitable for comprehension and reflection, which requires individualised teacher-student interaction (Wannarka & Ruhl, 2008). Earlier studies indicate the impact of seating arrangement on student achievement (Fernandes et al., 2011), such as students sitting in the front of the class have a higher likelihood of achieving higher grades than the students sitting at the back (Benedict & Hoag, 2004). The quantitative findings from Sections 5.2.4 and 5.5.4 revealed a far less non-significant improvement in the reading skills of the CG students compared to the other two groups, which could be due to the traditional teaching style, and the linear seating arrangement with no teacher-student interaction to discuss ideas around the readings. Linear seating arrangements may promote rote learning and passive student engagement, resulting in achieving learning outcomes at a deficient level.

Semi-Circular Seating Arrangement in the Comparison Group

The teachers in the CMG used a semi-circle seating arrangement specifically in DGBL sessions (Figure 8.5b). The researcher did not advise teachers on seating arrangements; the teachers decided to arrange students in a semi-circle. A semi-circle arrangement could be suitable to improve on-task behaviour and student-teacher and student-student interactions (Fernandes et al., 2011). The change in the seating arrangement that occurred due to the use of digital games and the teacher’s intention to provide support (Section 6.1.1) aligns with earlier studies indicating that the nature of the learning task, use of resources and teachers' pedagogical beliefs tend to influence the seating arrangement (Wannarka & Ruhl, 2008). The present study delivered the learning content through digital games that challenged the essentialist philosophy of education pertinent to traditional knowledge transmission from teachers to students, with digital games being the primary source of information, while teachers supported students on a needs basis (Usman, 2013). The students were engaged in one-to-one interaction with games, comprehending game instructions and performing actions to acquire reading skills. The seating arrangement was suitable for the teacher to observe each student from a distance and support them when needed, which agrees with Simmons et al. (2015) that a semi-circle arrangement improves students' on-task behaviour and student-teacher interaction to provide support.

The teachers expected students to display on-task behaviour (e.g. staying focused in individual game playing) and minimise off-task behaviours, such as peer discussions, even if the discussion was game-related (Section 6.1.1). The teachers appeared to consider peer discussions as off-task behaviour. The strict teacher control in maintaining discipline negatively impacted the excitement among students as they wanted to express joy and share game experiences with peers. Although the use of games on tablets encouraged teachers to experiment with a change in seating arrangement to provide one-to-one facilitation, their mindset remained essentialist, requiring students to maintain discipline and concentrate on individual work without disturbing others. The disparity in the pedagogy and teaching belief corroborates Thomas's (2013) findings stating that qualified and unqualified teachers in Pakistan lack pedagogical content knowledge, and their beliefs about teaching methods inhibit the adoption of constructive and student-centred pedagogies. The present study indicates that teachers could not detach themselves from the essentialist philosophy to adopt the flexible teaching approach in a DGBL environment and struggle to adjust to their new roles undermined the aspect of play in the DGBL environment, which reinforces Elkordy's et al. (2017) argument that teachers' lack of knowledge in using digital games as pedagogical tools limits opportunities to engage students in complex social interactions to gain different levels of understanding, creative thinking and problem-solving in an enjoyable way. The findings (Section 6.1.1) indicate that teachers reprimanded students for collaborating with peers, which, according to Dipinto et al. (2014), may have discouraged the natural phenomenon of social interaction in playing games.

In terms of flexibility, the CMG semi-circle seating arrangement appeared flexible for the teacher due to her access to each student but still felt controlled for students. Although students could access the teacher if they needed help, they were not allowed to seek peer support when the teacher was busy facilitating other students, which according to Fernandes et al. (2011), counters the purpose of a semi-circle seating arrangement. It may be argued that delay in getting the teacher's support disrupted the 'flow experience' and created a state of psychic entropy, leading to apathy, boredom or anxiety (Csikszentmihalyi, 1997), giving a reason for losing interest in playing games (Section 6.1.1). Also, students were given daily game targets by the teacher, which hampered students' self-directed learning (Section 6.1.1). Students followed the teacher's instructions in playing games, which again restricted students from planning or managing their learning. Hence, the present study findings suggest that while the arrangement of students in the CMG was flexible enough to initiate one-to-one teacher-student interaction, it remained relatively controlled, preventing peer interaction. For some students, the lack of flexibility in accessing peer support resulted in frustration and lack of engagement with DGBL, which had potential implications for long-term retention of reading skills. It can be argued that one-to-one teacher facilitation may have helped the CMG students achieve outcomes better than the other groups immediately after playing games (Section 5.2.4 and Section 5.5.4); however, they experienced a statistically significant decline in the retention of skills after the discontinuation of the games (Section 5.3.4). The decline in skills corroborates Nicholson and Tiru (2019) summer slide effect on reading, stating that removing a reading intervention results in a reading loss, especially in low-income students.

Organic Cluster Seating Arrangement in the Experiment Group

The EG was given the freedom to create their own learning space and sit in whatever configuration they liked to play games on tablets. Since there was no teacher involved in DGBL intervention with the EG, the researcher established the classroom routine of picking up and returning the tablets. The students established an organic seating arrangement with students sitting in small clusters to interact within or outside the groups if they needed support. The students were using the digital games on tablets for the first time in school; therefore, they might be anticipating the need for support, which encouraged them to sit in clusters.

Figure 8.5c shows a flexible learning space with peer support mechanisms where students spoke freely, seeking help from each other or more knowledgeable and experienced peers. This arrangement appeared to encourage students to establish positive relationships and think outside the box. These findings concur with earlier studies (e.g. Chiu et al., 2012; Young & Wang, 2014) that the flexible learning environment positively affects students' educative engagement to facilitate language acquisition. The dynamics of the DGBL environment in the EG demonstrated Charles Pierce's pragmatism philosophy (Peirce & Turrisi, 1997).

The experiment group's self-constructed organic seating arrangement coincides with Parnell and Procter's (2011) definition of a flexible learning space that gives students physical and social freedom to take active roles in forming and reforming the learning space to meet their learning needs. The findings indicate that students took ownership of their learning by setting up daily targets and planning how they wanted to learn through the assigned digital games. They thought that the organic cluster seating arrangement empowered them to interact, establish a strong bond with peers, and support each other when facing challenges. Some students were replaying the games to master the skills before moving on to the next game level, which also resonates with literature (e.g. Gee, 2003; Ghani et al., 2022; Young & Wang, 2014) about the affordances of digital games to provide practice opportunities and motivation to engage students in repeated gameplay, which gradually helps in internalising the targeted reading skills. Their self-directed nature of learning, like organic seating arrangements, willingly collaborating to solve problems and taking ownership of learning is consistent with Jiménez Raya et al. (2007), suggesting that flexible learning environments promote student autonomy where students become competent, self-determined and socially responsible individuals, able to direct their own learning with a vision to seek personal empowerment leading to social transformation.

8.2.2 *Role of Teachers in a DGBL Environment*

The findings highlighted a shift in teacher roles, which coincided with Molin (2017) arguing that teacher roles can be split into two categories when using digital games in an educational setting. The first category is related to the roles performed before the game sessions, and the second is associated with the actual game playing session. Before the session, teachers play the roles of content specialists and technical and gaming administrators. The role of the content specialist involves shortlisting the games mapped to the learning outcomes. The role of the technical administrator involves arranging and testing hardware resources, such as tablets, internet, and charging facilities and ensuring devices are ready for the next stage of DGBL. The role of the gaming administrator requires teachers to evaluate games to be linked to the intended learning outcomes and plan and arrange infrastructure to implement the games in the sessions (Molin, 2017). In the present study, the roles of the technical and gaming administrators were performed by the researcher, who arranged hardware resources (e.g. tablets, internet, charging units), selected a curriculum-aligned and pedagogically balanced game using the PEGS tool developed in Phase 1 of the research (Section 4.5). The researcher's prior arrangement of the resources and game selection addressed critical barriers identified by (Marklund & Taylor, 2015) that could marginalise the use of digital games in an educational setting, namely access to resources, teachers' game literacy, and available class time, and school infrastructure.

Once the game-based sessions started, the researcher observed transitions in a couple of CMG teachers' roles (Section 6.1.1), which reflected what Shah and Foster (2015) considered pivotal for DGBL. Shah and Foster (2015) summarised teachers' roles as expert guides to help students link games with learning outcomes, as facilitators of pedagogical approaches to engage students in reflection and feedback, and as connectors to help students understand the relevance of acquired skills in the real world. In the current study, the CMG teachers transformed from 'passive spectators', controlling students to maintain discipline in early DGBL sessions to 'active facilitators' by utilising 'teachable moments' (Watson et al., 2011) to engage students in self-reflection and later acquired the role of an 'anchor' (Molin, 2017) to enable students applying the acquired skills to the real-world learning environments. However, the challenge in the CMG was to prepare students for the world outside the schools, which requires teachers to acquire another role; that of a mentor. A mentor may be defined as a teacher who sees the ability and talent in students of which students are unaware and helps create opportunities to bring out that talent and abilities to apply in the real world outside schools (Mullen & Klimaitis, 2021)

In the present study, the CMG teachers were not trained in managing game-based sessions; however, the findings revealed that CMG teachers considered the DGBL intervention an opportunity to challenge their pedagogical beliefs. This concurs with earlier studies (Hayak & Avidov-Ungar, 2020; Lim & Chai, 2008; Molin, 2017), where teachers reported a positive shift in their pedagogies after they attended workshops to integrate digital games for inquiry-based learning. Teachers' reflections on the need to change their pedagogy for DGBL sessions (Section6.1.1) may indicate their readiness to accept change in their teaching practice.

Initially, the CMG teachers remained passive in managing DGBL sessions, emphasising maintaining strict classroom discipline. One possible explanation for demonstrating passive role could be their lack of game literacy. Molin (2017) argues that teachers remain passive and confused about their roles when they lack sufficient game literacy. Moreover, the nature of the game may also impact the role of the teacher. Hanghøj and Brund (2010) argue that although a good game design fostering self-directed learning is seen as a strength of an educational game, it coerces teachers to assume passive roles with limited possibilities for guiding and scaffolding students while playing games. In the present study, only a couple of CMG teachers could engage students in a self-reflection process (Section 6.2.1). It could be inferred from the findings that teachers who may lack game literacy remained passive and ineffective in eliciting student self-reflection because they may not know the game content, the strengths and the limitations of the game. Therefore, these teachers may not be able to facilitate students in establishing links between the game content with classroom learning. Such teachers focused more on maintaining classroom discipline than creating a space for reflection and feedback. However, the CMG teachers who played the game before the sessions engaged students in a self-reflection process and established links between the learning gained from the games to reading opportunities using phonics in other languages such as Urdu and Arabic (Section 6.2.1). This finding aligns with Molin (2017) and Hanghøj and Brund (2010), arguing that effective learning through games occurs when the teachers can actively facilitate the game whilst empowering students to transfer the skills acquired in the virtual gaming world to real-world scenarios. Possible implications of this finding could be to train teachers on game literacy before using games in educational settings; understand their roles to guide students better in linking games with learning outcomes, and find teachable moments to help students transfer skills acquired from the virtual gaming world to the real world outside the classrooms (Watson et al., 2011). Previous studies report that teacher training workshops focused on integrating digital learning games have positively impacted teachers' ability to use games for learning (Takeuchi and Vaalan 2014).

A possible explanation for transition in teachers' roles is concurrent with Lim and Chai (2008), who posit that teachers' existing belief structures shift when they experience a cognitive conflict by realising that their pedagogy is unsatisfactory for effective learning. This realisation may disrupt their belief structures and create a niche to replace with innovative pedagogical approaches to regain coherence in their beliefs. In the present study, teachers may have experienced a cognitive conflict when they realised that their passive support was ineffective in DGBL sessions. This may have challenged their existing pedagogical belief structure and encouraged them to replace it with a better approach to reflection and linking learning acquired through digital games to the real world. Lim and Chai (2008) indicated that cognitive restructuring may have occurred when they discovered better constructivist-learning experiences to compensate for passive support in DGBL sessions.

The EG lacked teacher presence, but the EG students were still able to acquire and transfer reading skills from L2 to L1. Nevertheless, the researcher's presence may not be underestimated. The researcher established the classroom discourse on accessing individual tablets and setting the rules for the duration of gameplay each day. Although the virtual presence of the researcher on the iPad lacked power in managing students, it may have empowered students to self-manage their learning using the digital games. It may also be argued that the researcher's virtual presence could be one of the factors that led students to demonstrate on-task engagement, but it may be the peer collaboration in solving problems that led to patterns of organising, revising and practising reading skills to achieve mastery (Duke & Pearson, 2009).

The freedom to design the DGBL environment and the opportunity to share and interact with peers appeared to instil reflectiveness, reciprocity, resourcefulness, and resilience in students defining the characteristics of learning-powered environments (Claxton et al., 2011). It may be argued that the pedagogically balanced nature of the game in the present study engaged the EG students in learning whilst solving problems collectively, empowered them with 21st century skills of team working, analysing, problem-solving (Qian & Clark, 2016) and transferring skills in a wider context outside the gaming world (Mozelius et al., 2015). Additionally, the transfer of skills was need-based for some students whose parents needed help with reading or digital literacy, which created an authentic context for students to apply the transfer of skills.

8.2.3 *Drawing Together both Groups*

This section draws together the discussions on the arrangement of students and the role of teachers in facilitating the development of reading skills using digital games to have a holistic understanding of how teachers' beliefs inform facilitation in DGBL environments. The discussion under this theme is primarily linked to the research question about the influence of teacher facilitation on reading skills in a DGBL environment. Scollon & Scollon's (2003) geosemiotics lens was used to explore the factors contributing to developing an environment conducive to DGBL. The analysis showed that students and teachers used DGBL classrooms as an "ecological totality" (Pierce, 2012), where the digital games and the arrangement of students shaped interactions. In this study, one of the overarching factors that may have influenced reading skills was teachers' pedagogical philosophy, which led to a specific arrangement of students and the management of social interactions in the CMG. These findings concur with earlier studies, Hayak and Avidov-Ungar (2020) and Lim and Chai (2008), who posit that teachers' pedagogical beliefs influence their practice in computer-mediated and DGBL lessons. The CG teachers exhibited essentialist philosophy based on knowledge transmission (Şahin, 2018), which resulted in the most passive form of cognitive engagement that encouraged rote learning. Teacher-directed whole-group teaching pedagogy appeared to have led to lower levels of reading skills in CG students. In CMG, the primary source of knowledge was the digital game, which shifted the role of teachers from knowledge bearers to facilitators as the teachers were not delivering the content but were supporting students who needed help in understanding the game instructions or handling the tablets. In fulfilling their roles, the teachers may have experienced a conflict between their pre-existing essentialist philosophy of knowledge transmission and the empiricist approach for facilitation in a DGBL environment within which they tried to combine strategies from both philosophies. They appeared to maintain strict discipline by discouraging peer interaction while trying to provide one-on-one facilitation on a need basis. The use of games as a primary source of information is likely to have compelled the teachers to arrange students in a way that could enable one-on-one student-teacher interaction. The teachers mostly retained their pre-existing pedagogical beliefs grounded in essentialist philosophy by reserving them as authoritative sources of support while discouraging peer support. This appeared to have caused frustration for the students and lack of engagement in playing games. However, towards the later sessions, the CMG teachers appeared to engage students in linking learning gained from the games to other subjects, e.g. applying the same concept in reading Urdu langauge (Section 6.2.1). The CMG students who received teacher facilitation and prompted self-reflection appeared to be cognitively engaged and applied acquired reading skills in newer game contexts and real-world scenarios. Whereas those who did not receive timely support remained passively engaged for some time, later got frustrated and lost interest in playing games. Teachers' expectations for students to focus on individual games may have resulted in immediate gains in reading skills. However, lack of timely facilitation possibly led to a significant decline in the retention of reading skills of CMG students.

The EG students received no teacher facilitation. They demonstrated an organic arrangement that facilitated peer collaboration for collective problem-solving. The findings concur with Fleck et al. (2021) that effective collaboration happens when the learning technology offers opportunities to engage in meaningful conversations. In the present study, playing digital games in L2 without prior exposure and no teacher facilitation in the EG led to cognitive overload and subsequently engaged students in collective problem-solving and constructing shared knowledge. It may be inferred that self-management of learning with timely peer collaboration for problem-solving probably resulted in better gains in reading, transferring skills across languages (L2 to L1) and long-term retention of reading skills. Teachers' pedagogical beliefs and subsequent arrangement of students in DGBL sessions may have implications on students' behaviours and attitudes towards reading which is discussed in the next theme.

8.3 Theme 3: Behavioural and Attitudinal Changes

This theme answers the research question: *How do students and teachers perceive the use of digital games in changing behaviours and attitudes towards reading?* The discussion in this section is premised to include perceptions of behavioural and attitudinal changes due to game playing in just the experiment and the Comparison group. The control group was not involved in playing games; therefore, the perceptions of the control group are not included in this section.

The study findings indicate that students in both groups shared a similar reading experience due to traditional pedagogies prior to the study; however, their reading experiences differed because of playing digital games in contrasting learning environments, which may have an impact on their behaviours and reading attitudes. The observation data indicate increased positive emotions in the EG students, e.g. excitement, engagement and motivation in learning through games till the end of the intervention period. Contrastingly, the CMG students started playing with excitement, but some students appeared to lose excitement and experience negative emotions that led to frustration and lack of motivation to play digital games. A possible explanation for the differences in behaviours could be grounded in the classroom dynamics of interaction and how it shapes behaviours (Havik & Westergård, 2020).

Similarly, the quantitative comparison of reading attitudes (Section 7.1.4) indicates that prior to the study, the EG had a slightly negative attitude towards academic and recreational reading compared to the CMG. However, after the intervention, the CMG significantly improved in reading skills but experienced a significant decline in academic reading attitudes, while the EG improved significantly in both types of reading attitudes. This highlights a need to discuss the factors that may have impacted the decline in academic reading attitude in the CMG. Although the data showed a significant improvement in reading skills, the declining attitude towards academic reading in the CMG is concerning and may have implications for learning sustainability through digital games.

DGBL studies from the last decade indicated a positive change in student behaviours and attitudes about using digital games as a learning resource (Ahmad & Tsai, 2018; Breien & Wasson, 2021; Khan et al., 2017; Sung et al., 2016; Sykes & Reinhardt, 2012). The positive behavioural changes were primarily attributed to effective game-design elements, e.g., collaboration, flow experience, role-playing, narrative, curiosity, challenge, and feedback and rewards (Qian & Clark, 2016). However, the present study findings indicate that effective DGBL may not be restricted to just game-design elements; other factors may influence learning effectiveness through games, such as student behaviours and attitudes towards reading. These factors may be ascribed to teacher-student, student-student, and student-tablet interactions, which aligns with Nuthall's (2007) idea of three "worlds" of interactions students live in classrooms that could shape behaviours: public, semiprivate, and private world (Section 2.2.6). Nuthall (2007) argues that each of these worlds intertwines while having a substantial effect on shaping students' learning experience; the interaction of these worlds makes it impossible to separate their respective effects. Similarly, the present study found that distinct behaviours that led to reading attitudes in the three worlds of interactions may have implications for designing effective DGBL environments. The following subsections elaborate upon the effects of digital game playing on students' behaviours and attitudes while interacting in different contexts of DGBL environments and discuss how these behavioural changes led to transformative emancipation of the study participants.

8.3.1 *The Public World of the DGBL Environment*

The study orchestrated two different types of public worlds in the EG and CMG (Section 6.1.1 and 6.1.2). The absence of teachers in the EG drew in the researcher to establish a public world to set the rules of picking up labelled tablets, playing the selected game within the prescribed time, and returning the tablets when the session was over. This public world was short-lived with one-time researcher-student interaction, which lasted for a few minutes at the beginning of the first DGBL session, followed by the non-communicative virtual presence of the researcher on iPad for the entire six weeks. The impact of this public world on student behaviours was positive as they appeared to be motivated to follow the rules until the end of the DGBL intervention. The strong impact of the one-time public world may be due to two possibilities. First, the use of simple instructions by the researcher that students unpacked into a sequence of actions to collect tablets, play games and return tablets when the time was up. Second, freedom of interaction with peers and sitting wherever they like led to collaborative problem-solving. The researcher-led public world in the EG was grounded in the Self-determination theory of motivation (Ryan and Deci, 2017), which offered self-management of learning activities through games (autonomy), employing strategies to gain mastery of reading skills (competence), and establishing effective interactions with peers for collaborative problem-solving (relatedness). Findings suggest that the routine of picking up and returning tablets and self-management by setting game targets developed a responsible attitude in students, which ensued in their regular sessions, where students reported handling their books and other people's belongings with care (Section 7.2.3). They also thought of being in charge of their learning, which helped them plan, and implement effective learning strategies to achieve mastery of reading skills. For instance, some students reported using shared reading strategies with peers outside the class time (Section 7.2.3), which shows a positive change in attitude towards reading where students were making choices to use free time effectively to practice reading skills.

On the contrary, the CMG students experienced a thick layer of the public world established by their teachers that engulfed other types of worlds. The teachers demonstrated a controlling motivating style of instruction (Jang, 2019) by using a tone to pressure students to think, feel and behave in a certain way (Reeve, 2009). For example, asking students to sit properly without leaning towards each other. Another example was to restrict peer interaction and reprimand students if found talking to each other (Section 6.1.1). The CMG students were instructed to produce socially-valued indicators of worth (Reeve 2009), such as maintaining high discipline in class, completing assigned game targets each day, achieving high scores, and accumulating more rewards. The findings indicate that a teacher-controlled environment focused on extrinsic goals resulting in students losing interest in playing games. For example, some students were seen bored, yawning, and looking outside the window while aimlessly tapping on the tablets to pretend they were playing games (Section 6.1.1). A possible explanation for these behaviours may resonate with Jang's (2019) findings that teachers' socially-valued extrinsic instructional goals do not satisfy student needs of fun, curiosity, challenge, and relatedness (Ryan and Deci 2017), thus arousing frustration in students.

Nevertheless, the study found that playing a pedagogically balanced digital game in a teacher-controlled environment raised students' awareness of their needs and how they wanted to play and learn better using the digital games. Findings indicate that the CMG students were comparing their DGBL sessions with traditional sessions and thought their DGBL environment was a mere replica of their traditional learning environment, where the books were replaced by the games, while the classroom dynamics were similar. The expectations of tight discipline and focusing on individual games in a DGBL environment compromised the fun aspect of playing and sharing, which resulted in losing interest in playing games. This finding resonates with Havik and Westergård (2020) and Nguyen et al. (2018), explaining that teachers' control and monitoring to maintain discipline in the classroom, with lesser opportunities given to students for making choices and self-management of learning, are the possible reasons of low student engagement.

Research further indicates the factors that may explain the use of controlling motivating style of instruction, such as school policies (Taylor et al., 2009), teachers' pre-and- in-service training experiences, teachers' pedagogical beliefs, societal demands (Lim & Chai, 2008), teachers exposure to daily administrative supports and pressures (Pelletier & Sharp, 2009). However, research also suggests that teachers who set intrinsic goals for their students instead of extrinsic goals tend to adopt a more autonomy-supportive motivating style leading to satisfying student needs (Reeve, 2009). The public world in the present study reveals a variation between an autonomy-supportive public world in the EG and a controlled motivating public world in the CMG depicting contrasting student behaviours in both groups. The CMG students tried to comply with the rules of their teacher controlled public world by staying focused on individual activities and avoiding interacting with peers. However, occasionally these students were seen breaking the rules by interacting with peers when the teacher was busy helping other students. Nuthall (2007) termed this spontaneous interaction with peers as the semiprivate classroom world, discussed in the next subsection, which plays a crucial role in shaping learning and behaviours.

8.3.2 *The Semiprivate World of the DGBL Environment*

Classroom culture and social interactions form the basis of students' semiprivate world, where students continuously participate in collaborative activities that facilitate the co-construction of knowledge (Nuthall, 2007). Interactions in such environments may enthuse certain behaviours in students, which could have a lasting impact on their learning. In the present study, semiprivate worlds observed in the CMG and the EG differed hugely, predominantly due to their contrasting learning environments. While Vygotsky's sociocultural learning theory forms the foundation of interactions in the semiprivate world, the motivational theory for learning, e.g. Maslow's hierarchy of needs theory (Maslow, 1987), provided a lens to understand student behaviours within the semiprivate world. The study uses the lens of motivational theory to understand changes in behaviours and attitudes within the semiprivate worlds of the EG and the CMG.

Behaviours and Attitudes Emerging in the Semiprivate World of the Comparison Group

The CMG's semiprivate world lacked peer interactions and collaboration to establish trusting relationships for the co-construction of knowledge. The semiprivate world in CMG appeared to be influenced by their teacher's pedagogical beliefs that perhaps were shaped by outside agents, such as training, school policies, administration, societal expectations, parent pressure, and cultural norms (Reeve, 2009) or could have been influenced by internal factors such as values, beliefs, and personality dispositions (Lim & Chai, 2008). Restriction on peer interaction in the CMG resulted in students establishing their semiprivate world powered by non-verbal communication using facial gestures, rolling of eyes, and nudges (Section 6.1.1). Some students discreetly interacted with peers to satisfy their social roles in the classroom and to generate more learning experiences from spontaneous peer conversations around their learning activities. However, teachers disapproved of their interactions and deemed them disruptive to other students learning (section 6.1.1). From the perspective of Maslow's hierarchy of need theory (McLeod, 2007), these findings confirm a gap in fulfilling students' psychological needs of sharing or relatedness in a DGBL environment, where they could freely share their feelings, seek peer approval on the game, share joys and form trusted relationships to feel part of the DGBL environment.

The semiprivate world in the CMG was reflected in secretive behaviours, indicating students' awareness of social roles, norms, expectations and rules in the classroom context. The CMG students acknowledged teacher's expectations of maintaining discipline and demonstrating the best behaviour while focusing on individual games. Nevertheless, they also seemed to understand the playful nature of the game and wanted to adapt their roles to suit the game-based environment. However, the playful nature of digital games clashed with traditional classroom norms and expectations set by their teacher, resulting in some students breaking the norms by engaging in peer conversations. These findings augment Molin's (2017) argument that using digital games in an educational setting requires coherent role definitions and expectations that accord with the social norms of the classroom context and the playfulness of the DGBL environment. The study findings indicate a disparity between teachers' behavioural expectations and the students' needs to interact with peers to enhance their gaming experience, which probably caused a lack of motivation in students to play games. This finding corroborates with Molin (2017) that DGBL in an educational setting may lead to confusion and frustration if the expectations and roles are not coherent within the classroom norms and the game-based environment.

The teacher-controlled DGBL environment and the restriction on peer interaction impacted students' reading attitudes, showing no difference in academic reading attitudes before or after the DGBL intervention (Section 7.1.5). However, the findings indicate a better recreational reading attitude of these students (Section 7.1.3), which could be attributed to students' improved reading skills and engagement with recreational readings, which they enjoyed more than academic readings. One possible explanation for improved recreational reading could be linked to Gallik's (1999) argument that recreational reading is associated with improved academic achievement. The improvement in CMG students' reading skills (Section 5.2) could have resulted in positive attitudes towards recreational reading. The second explanation could be linked to the teacher-pressure. Most recreational readings happened in low-stakes environments outside the classroom or at home, where the students were not under the teacher's strict supervision (Section 7.2.2) and did not have to meet the teacher's expectations by showing their best skills. This allowed students to utilise their cognitive resources to experiment with new text without worrying about reading it incorrectly and being reprimanded and humiliated by the teacher. However, such opportunities to enjoy recreational reading appeared to be limited in teacher-driven schools. The next section discusses the behaviours and attitudes of the EG students that emerged in their semiprivate world.

Behaviours and Attitudes Emerging in the Semiprivate World of the Experiment Group

The EG students established a sustainable semiprivate world where they sat in small groups and spontaneously acquired and maintained social roles to interact and respond to each other. The very nature of the semiprivate world in the EG was publically oriented; however, from the perspective of the researcher observing them virtually, student interactions were semiprivate as the interactions were mainly confined to small groups and occasionally occurred between groups. Within this publically oriented semiprivate world, the EG students acquired roles based on their knowledge, experience or collection of rewards in the game. The study findings indicate that students with more experience or knowledge appointed themselves as 'gurus' for others; they supported struggling students voluntarily (Sections 6.1.2). They shared their knowledge and experience to overcome a game challenge with peers as soon as they saw someone struggling in playing the game. From the perspective of Maslow's Hierarchy of needs theory (McLeod, 2007), the findings indicate that the structure and dynamics of the DGBL environment in the EG contributed to fulfilling their deficiency needs and ignited a desire to fulfil growth needs to become better members of their DGBL community. The EG students formed a support network through collaboration that fulfilled their need for belongingness, which pushed them to the next level on Maslow's Hierarchy of developing higher self-esteem and self-regulation, leading to self-determination (Section 8.1.3).

The spontaneous peer interactions in the semiprivate world of the EG may have developed creativity and solution-oriented behaviour amongst students (Section 6.2.2). This finding corroborates with Behnamnia et al. (2020) that digital games alone do not enhance creativity in students unless the learning environment is conducive to nurturing the creative components through enjoyment, increased interaction, motivation and shared knowledge construction. The present study findings reveal that collective problem-solving in DGBL sessions built confidence and positive attitudes towards reading in the EG students, which empowered and encouraged them to find innovative solutions and ways to get the work done. Instead of hammering out the problem, these students used their confidence and positive attitude to find solutions to the problem. For example, findings in Section 7.2.3 show that students formed a creative solution to address the lack of reading resources; they did not raise funds or rely on adults to buy new books but set up a book exchange system to pool the available resources to enjoy reading. This example demonstrates students' ability to think out-of-the-box to find solutions to their problems and significantly improve their academic and recreational reading attitudes (Section 7.1.4).

Peer interactions in the EG also infused a sense of collective achievement in the students rather than individual gains (West & Williams, 2017). Student interview data indicated that prior to the DGBL intervention, the EG students were more focused on personal achievements; they were wary of sharing ideas and helping others in learning activities (Section 6.1.2). However, DGBL provided an opportunity to solve problems together and help each other play challenging game levels, changing students' perspectives from individualism to collectivism. Their focus shifted from personal gains to collective achievement, which converted the classroom space into a learning community, demonstrating relationship-building based on trust and care, confidence in sharing ideas, and having fun while playing games. These characteristics of the semiprivate world coincide with West and Williams (2017), who described that a learning community is identified by a sense of belonging and the quality of relationships that exist between the members; interdependence and reliance among members as to how they feel emotionally connected, and whether they can feel trusted, able to share ideas, rely on, and experience fun and joy in their learning environment.

Regarding reading attitudes, the EG students' perception of change in behaviour and attitude towards reading (Sections 6.2.2 & 7.2.3) after playing digital games portrayed a growth mindset, as they were trying different strategies and seeking help from peers when facing challenges (Dweck, 2015). Their interactions in the semiprivate world empowered them to build a "learning power" (Claxton et al., 2011) by demonstrating perseverance through the focused commitment and learning from their mistakes, showing resilience by never giving up despite the challenges they faced, collaborating with others to find solutions to the problems, organising and prioritising their learning, and being flexible in managing their learning through games.

In line with the theoretical perspective of pragmatism and transformative emancipation for this study, the nature of the semiprivate world of EG students using digital games transformed their learning experience and empowered them to transfer skills to the wider context, which was evident from student interviews. For example, in Section 6.2.2, one student indicated the ability and confidence to read instructions on an ATM machine to pay the energy bill. In another instance, a student mentioned supporting her parent in creating a profile on a mobile app to find work. Such examples of empowerment through acquiring digital literacy skills endorse the 'learning power' (Claxton et al., 2011) embedded in the semiprivate world of the EG students.

Comparing the nature of semiprivate worlds in the CMG and EG highlights a need to improve teachers' professional development in adopting a DGBL classroom culture in the CMG that could foster student risk-taking, collaborative problem solving and developing opportunities for students to transfer skills from the virtual gaming world to the real-world context. The co-construction of knowledge developed and the associated behaviours and attitudes shaped in the semiprivate worlds influence the private world of the students, as explained in the following section.

8.3.3 *The Private World of the DGBL Environment.*

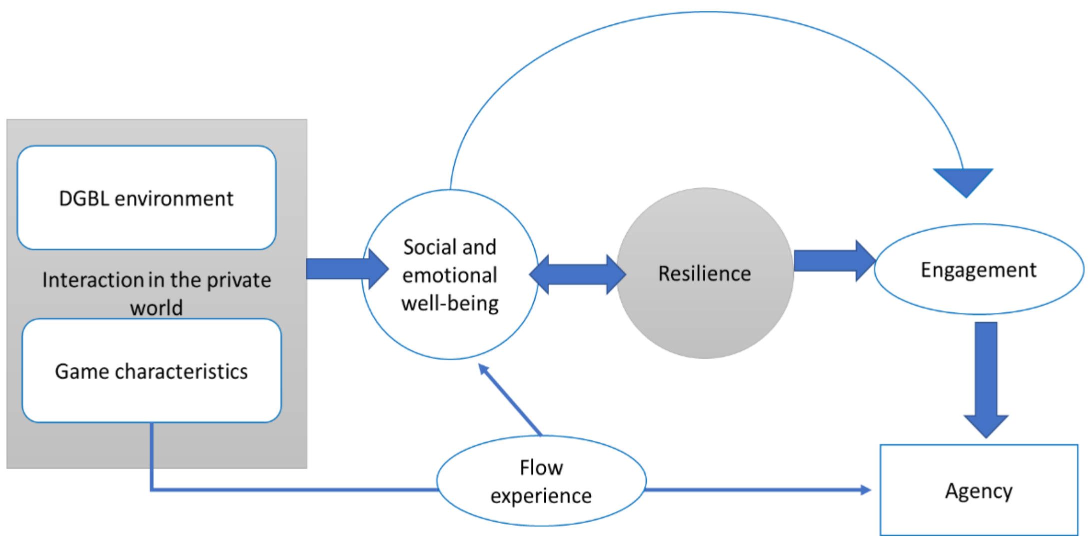
The student interaction with the game on the tablet constituted their private world. According to Nuthall (2007), it is the private world of students where knowledge develops, beliefs are shaped, and attitudes are acquired. The study findings indicate that behavioural attributes of the private world included agency, self-efficacy, resilience, social and emotional well-being, and motivation that sparked learning in the private world. At times, the behaviours shaped in other worlds (e.g. public and semiprivate) permeate the private world as the classroom interactions frequently switch between public to semiprivate and the private worlds. However, the discussion in this section focuses mainly on behaviours that indicate the level of engagement in the private world.

Low engagement and interest were the precursors of the public world behaviours tarnishing the private world. However, the present study findings indicate that despite some students losing interest and engagement in DGBL sessions, the CMG demonstrated positive achievement in reading skills (Section 5.2.4). This finding may imply that the selected digital game immersed students in a flow experience (Csikzentmihalyi, 1990) using effective game characteristics which engaged them in challenging gameplay that captured their imagination and engaged them back in the gaming experience. Consequently, the positive gaming experience built learning power (Claxton, 2011) by uplifting students' emotional state, improving their concentration and ability to overcome setbacks, and enabling them to bounce back from frustration to complete their game, demonstrating resilience. The effective game characteristics that may have contributed to the positive gaming experience will be discussed later in Section 8.4 of this chapter.

Recent literature (e.g. Anderson et al., 2019) suggests that resilience is the predictor of student engagement, which possibly means that students do not necessarily engage in classroom activities due to agency. However, they stay engaged in activities despite challenges because of their resilience. Based on the discussion in this section, Figure 8.6 presents a relationship between resilience and agency established as an outcome of DGBL environment and game characteristics.

Figure 8.6

Relationship Between Resilience And Agency due to DGBL



The present study found resilience as another prominent behavioural trait of the private world in both groups. The EG students demonstrated stronger resilience by overcoming challenges in playing games without a teacher's support. At the same time, the CMG students also demonstrated resilience in completing the games in a teacher-controlled environment. Some CMG students appeared to be somewhat emotionally strained by the teacher's harsh comments and frequent disciplining, which overlapped with their public world, as discussed in earlier sections under Theme 3 (Section 8.3.1), resulting in disengagement and losing interest in playing games for these students. This finding supports Knight's (2007) argument that resilience directly influences social and emotional well-being; students with low resilience may get emotionally strained and demonstrate low engagement. The CMG students' disengagement may also be linked to their low emotional state because "emotions drive attention and attention drives responsive decision and behaviours" (Sylwester, 2006, p. 35). Students who do not feel good about themselves show low engagement with the learning content, consequently impacting their academic achievement (ibid).

Another behavioural characteristic found in the private world was the nature of motivation that could lead to deep or surface learning. Roberts and Iyer (2020) believe that surface learning involves students memorising content with limited critical engagement, while deep learning critically engages students with the content to unpack and connect the underlying concepts and ideas to real-world situations. The engagement of the EG students in self-evaluation, planning, and practising of reading skills in their private world demonstrated their intrinsic interest in learning to read through the game. The findings indicate that the EG students set daily game targets based on mastery of their reading skills; they tended to review their existing skills and practise any weak areas in reading before moving on to the next level targets (Section 6.2.2). These findings resonate with DiBenedetto and Zimmerman (2010) and Taub et al. (2020), suggesting that students with high self-efficacy, being confident in their abilities and expected outcomes, show increased intrinsic interest in the learning content, which results in the utilisation of deep learning strategies leading to long-term learning gains (Sung et al., 2018).

The CMG students were also aware of their abilities but were bound to follow teacher-set targets. Some students needed to practice prerequisite reading skills before moving on to high game levels; however, teacher-set targets did not give them enough opportunity to practice the required skills. As such, these students applied surface learning strategies (e.g. memorising) to meet the targets without developing a deep learning approach to retain reading skills for longer. A possible explanation for the adoption of deep or surface learning approaches may be pertinent to the demands of the learning environments as to how the environments stimulate or inhibit learning approaches students intend to use. Gijbels et al. (2014) posit that approaches to learning relate more to the demands of the learning environment or classroom climate rather than personal characteristics, e.g. conceptions of learning, perceived self-ability, or learning approaches. Previous studies (e.g. Dart et al., 2000; Marambe et al., 2012) indicate that deep learning approaches usually are prevalent in learning environments perceived as personalised, participatory and safe for creating trusting relationships. Such classroom environments can lead to personalised investigative approaches to facilitate problem-solving, leading to the adoption of deep learning strategies. In the present study, the DGBL environment of the EG enabled students to utilise deep approaches to learning in their private world. In contrast, the teacher-controlled DGBL environment of the CMG lacked characteristics of deep learning and coerced them to use surface learning strategies by using extrinsically motivated measures to remain engaged in the learning process. It may be assumed that high engagement in games may have improved students' self-efficacy, which could eventually lead to intrinsic motivation for learning in the CMG. The notion of initiating a game with extrinsic motivation but later developing an intrinsic desire to gain skills from the game aligns with Lee et al. (2010) and Mitchell et al. (2020), who posit that when the extrinsic motivation is internalized through self-efficacy and a sense of personal worth, it may morph into intrinsic motivation.

The discussion in this section (Section 8.3) demonstrates that behaviours in the private world of the CMG students were infused with some attributes derived from their public world that could lead to low agency, low self-efficacy, low resilience and low motivation. However, the pedagogically balanced digital game supplemented the private world by offering opportunities through its characteristics, such as a pictorial interface, exciting storyline, adaptive game challenges (Bawa et al., 2018), scaffolding through immediate feedback and rewards (Liao et al., 2019). These game characteristics possibly engaged students in an immersive experience of flow to take decisions on game actions by using informed choices based on the knowledge and skills gained through the game, which improved their self-efficacy (through improved confidence in their abilities) and increased agency and possibly led to the achievement of reading skills (Section 5.2.4). Nevertheless, the collaborative DGBL environment in the EG supplemented the game characteristics by enhancing student agency, motivation and engagement to make exceptional gains and long-term retention of skills without a teacher's support. This may suggest that a pedagogically balanced game may fill the gap posed by the limitations of a DGBL environment for effective learning and vice versa. A DGBL environment may also incorporate elements of effective games if the game is not pedagogically balanced. Further discussion on the characteristics of the digital games and DGBL environments complementing each other for effective student learning is presented in Theme 4.

8.4 Theme 4: Desirable Characteristics for Digital Games

This section answers the research question: *What are the desirable characteristics of digital games for reading skills development in a second language?* The discussion assisted in understanding the elements of effective digital games as listed in the PEGS tool and the DGBL environments conducive to developing early grade reading skills, especially for second language learners in a developing country context. Finding and selecting a game that closely matches the curriculum and embeds effective game design and pedagogical aspects is a challenge for teachers (Becker, 2017), especially if teachers do not possess sufficient game literacy (Marklund & Taylor, 2015).

The study revealed that a pedagogically balanced digital game has the potential to produce different outcomes if administered in diverse DGBL environments. The findings indicate that the DGBL environments may provide opportunities to embed pedagogical characteristics lacking in digital games. This underscores the need to discuss the aspects of the DGBL environment and the game characteristics that produce effective outcomes for reading development. This section commences by discussing desirable characteristics for game pedagogy in Section 8.4.1. The next sections discuss the characteristics of educational components (Section 8.4.2), game design aspects (Section 8.4.3), and skills and knowledge embedded in a pedagogically balanced digital game in Section 8.4.4.

8.4.1 *Characteristics for Game Pedagogy*

A literature review of game-based studies conducted by Qian and Clark (2016) indicated that digital games are likely to yield positive results when incorporated with learning theories. They found that most drill and practice games in language learning were underpinned in behaviourism and cognitivism, but games targeted to foster 21st-century skills were grounded in constructivism and constructionism (Qian & Clark, 2016). The game (TYMTR) selected for this study incorporated characteristics of learning by exploring, learning by being, and learning by building better than another competitive game (Section 4.5) while presenting fewer in-game opportunities for learning by collaborating and learning by expressing. These pedagogical characteristics are grounded in learning theories of constructivism and constructionism (Vygotsky, 1978), depending on which characteristics are included in the game. The constructivist view holds knowledge as constructed through personal experience based on prior knowledge, while the constructionist view refers to knowledge construction when students are engaged in creating a meaningful artefact within a social context. The game (TYMTR) in the present study appears to be underpinned by constructivism, actively engaging students in making meaningful connections with knowledge gained at each level of the game. However, in the EG, the DGBL environment provided an additional sociocultural context for collaborating and negotiating socially constructed knowledge (Vygotsky, 1978) by collective problem solving, which maked learning through TYMTR a constructionist activity.

Lim et al. (2018) purport that effective game pedagogy for educational games can be placed on a spectrum of open-endedness that allows students to express creativity and imagination by setting up their own goals and planning strategies to achieve them. They suggested designing games that encourage students to learn through social interaction, sharing and discussing in-game creations with peers, and giving teachers the ability to customise game activities to match their curriculum needs. An example of designing sandbox-style literacy games could follow the concept of Minecraft (Hébert & Jenson, 2019), where players may have to find letters to build words, sentences, stories and poems (Lim et al., 2018). A counter-argument to using such open-ended literacy games would be students' prior skills and knowledge to use letters and words creatively to create sentences, let alone stories and poems. In this study, a comparison of pre-and-post tests on English (L2) and Urdu (L1) reading showed students were deficient in reading skills prior to the DGBL intervention (Sections 5.1.1 & 5.4.1), which could have limited their creativity if they were to play open-ended sandbox-style games effectively. Their lack of creativity in playing challenging games beyond their zone of proximal development (Vygotsky, 1978) might have potentially resulted in their losing interest and engagement. This finding also supports Zosh et al. (2017) argument that pitching content at appropriate levels in educational games pushes children just out of their comfort zone little by little, in contrast to pushing them to the deep-end-of-water increases engagement and reduces anxiety.

Like most COTS games, TYMTR was not open-ended but a linear game that required students to overcome a series of challenges embedded in a fantasy storyline. Although the game was of a closed manner, which limited some creativity in exploring the game environment, the analysis of the DGBL environment in the EG showed it allowed flexibility of sharing and facilitated discussion with peers. This finding aligns with Vygotsky's (1968) concept of socially constructed learning, where learning is actively constructed through interactions situated in a sociocultural environment. The study provided evidence of peer interaction to solve problems collectively in the EG, potentially resulting in the achievement and long-term retention of reading skills. These results coincide with the notion of Science of Learning (Sawyer, 2005). Learning is maximised when students are actively engaged with the content to construct meaningful knowledge in socially interactive contexts (Zosh et al., 2017). Contrarily, the lack of peer interaction in the CMG limited their creativity; however, the in-game pedagogical aspects of learning by exploring, being and building provided them with some opportunities to interact with the game character and demonstrate creativity in using rewards to decorate their monsters (Lim et al., 2018), which may have resulted in the achievement of reading skills. Although decorating the monster was a non-reading activity, the motivation to collect rewards to make in-game purchases encouraged students to practice their reading skills repeatedly in multiple game contexts. This feature of practising the same content in different game scenarios aligns with Hirsh-Pasek et al. (2015) stating that children learn best when they repeatedly encounter the same learning content in multiple contexts. It is also argued that a flexible DGBL environment that provides opportunities to learn by exploring, building, being, expressing, and collaborating (Kiili, 2005; Lim et al., 2018) may result in developing better readers who can monitor their progress by setting goals (Becker, 2017), understanding the nature of the text, and making adjustments through revisions and practice in reading skills (Duke & Pearson, 2009).

The study revealed that it was not simply a pedagogically balanced digital game that engendered engagement to achieve mastery in reading skills but the characteristics of the DGBL environment also complement games to improve student engagement and desire to achieve autonomy and competence in reading skills. This finding emphasises the need to move beyond evaluating just games; the DGBL environment may complement the shortcomings of the games. As listed in Table 4.2 (Section 4.2.1), the pedagogical considerations from the PEGS tool may enable teachers to incorporate missing characteristics into the DGBL environment. Most effective COTS games are likely to be costly (Montazami et al., 2022), which may not be afforded by schools with limited budgets in developing countries. Knowing ways to create DGBL environments to embed most aspects of desirable game pedagogy may encourage teachers to use COTS games even if scoring low on the pedagogical aspects of the PEGS tool.

8.4.2 *Characteristics for English Reading Skills*

Another category of desirable game characteristics is having educational content embedded in an intriguing storyline with instructional strategies (Becker, 2017). Most of the existing game development frameworks (e.g. Arnab et al., 2015; Carvalho et al., 2015; De Freitas et al., 2010; Lim et al., 2018; Roungas & Dalpiaz, 2016) suggested similar characteristics such as instructional strategies grounded in learning theories, game design elements, and mechanics (e.g. rules, goals, rewards, challenge, fantasy, storyline, feedback, and choice) embedded in the learning content for developing effective games. In the present study, the PEGS tool contributed further to the existing game design frameworks by explicitly including curriculum-aligned reading sub-skills for game selection, e.g. phonological awareness, word coding/decoding, reading fluency, vocabulary, and comprehension (Ministry of Federal Education and Professional Training, 2020; National Institute for Literacy, 2009) (Section 4.2.2). The desirable components of reading skills are listed in Table 4.3.

The study findings resonate with Ronimus et al. (2014), indicating a positive impact on reading acquisition when the game includes all components of reading skills and when game activities and reading content are enjoyable without being overly challenging for new readers. A comparison of TYMTR and GGUK in Section 4.5 indicates almost equal ratings on the inclusion of all the reading sub-skills listed in the PEGS tool. Nevertheless, TYMTR rated comparatively better on the vocabulary component by providing explicit opportunities to practice word knowledge and word meanings. Kuhn et al. (2010) argue that reading acquisition requires students to build expertise in each reading sub-skill to achieve automaticity, i.e. reading fluently without being consciously aware of individual sub-skills. The present study's quantitative results on reading achievement (Section 5.2.3) indicate that the selected game offered affordances to practice all the reading subskills to achieve automaticity, leading to fluent reading, and cross-linguistic transfer of skills from L2 to L1 (Section 5.5.3). This could imply that the educational category of the PEGS tool may help teachers in finding games that focus on all components, a few or maybe just one component of reading skills. It may help them plan lessons better based on the targeted components of skills. Knowing which components are missing from the game, teachers may enhance the DGBL environment by introducing constructionist activities, such as role-plays or other collaborative activities to introduce and practice additional reading skills.

While the educational components listed in the PEGS tool are based on research into skills for reading in the English language, the components may be adapted to any phonetic language using specific orthographies, e.g. Urdu, Arabic, Māori, and Spanish, to name a few. Cross-linguistic transfer of skills indicates that students may benefit from playing games in their first languages (L1). Lim et al. (2018) stressed the need for collaboration between game developers, instructional designers, linguistics, and teachers to understand the orthographic complexity of the target language they intend to design the game. These orthographic complexities would influence the decision of when and how letter combinations in certain orthographies should be introduced in the game, as the best practice in reading development is to start with words that are easy to decode (Georgiou et al., 2008; Lim et al., 2018). The PEGS tool may offer a framework to game developers to build games in regional or national languages to improve reading standards in developing countries, with English being their second or third language.

8.4.3 *Characteristics for Game Design*

The game design aspects listed in Table 4.4 may be considered desirable for designing effective educational games for reading skills. Possible reasons for considering design aspects desirable for reading development games are the positive results on students' reading skills and sustained engagement and motivation in playing games, which were evident from their behaviours whilst playing games. The design aspects included in the PEGS tool are consistent with earlier studies (e.g. Gunter et al., 2008; Kiili, 2005; Lim et al., 2018), suggesting that educational games that focus on including theory-based instructional strategies with targeted learning content using effective design elements to improve self-efficacy are most likely to achieve their pedagogical aims. Such games, however, may not be effective based on their educational content alone; games must have the element of fun with clear rules and goals (Hong et al., 2009). Moreover, effective games must engage and motivate players to attain a state of flow and immersion, which encourages them to take on the challenges and stretch their existing skills (Csikzentmihalyi, 1990). To achieve the state of flow, game developers and instructional designers need to embed design characteristics as listed in the PEGS tool, such as challenges, goals, rules, feedback, rewards, choices, graphics, fantasy, and interactivity that could engage and motivate students, immersing them into a flow experience (Gunter et al., 2008; Kiili, 2005; Lim et al., 2018). Qian and Clark (2016) indicate that drill-and-practice games do not capture students' engagement for the long term, but games using design aspects of the adaptive challenge, curiosity, discovery, clear goals, immediate feedback, rewards, control, and immersion keep students motivated and actively involved throughout the game. The category of design aspects in the PEGS tool enabled teachers to compare game designs in addition to pedagogical considerations and educational content. A comparison of TYMTR and GGUK revealed that TYMTR was better on the majority of design aspects to engage students in a state of flow through exploration in the storyline.

Moreover, the PEGS framework also included technological considerations as part of the design for evaluating games in a developing country context. Conditions like game platforms, hardware and software requirements for game devices, access to games, internet requirements, and technical support may also impact the decision on using games in schools, especially in developing countries like Pakistan. Such considerations may allow teachers to make informed decisions about the games they can use in classroom settings. A comparison of TYMTR and GGUK on technological aspects within the game design category showed an equal rating on all indicators except for free upgrades and provision of technical assistance. The teachers rated GGUK as better in providing free upgrades and technical support. However, in reality, both games had the option of free upgrades and technical support. This implies that the design of TYMTR on the provision of upgrades and support needed to be improved as it may not be clearly visible compared to GGUK. A thorough and early usability testing may address such anomalies. Lim et al. (2018) suggest creating and testing rough working prototypes as early as possible with students, teachers and parents from the target environment to identify any issues with the game. This example shows how game developers can also use the PEGS tool for usability testing during the prototyping of games with children, teachers and parents as soon as possible to improve upon the pedagogical and design aspects of the games.

8.4.4 *Characteristics for Skills and Knowledge Development*

Central to DGBL are the skills and knowledge acquired through the games. The current study aimed to find a game to help students build on their existing skills and develop the knowledge needed to improve their reading ability. For this reason, the PEGS tool included a category for the development of skills and knowledge as desirable game characteristics underpinned in Bloom's Taxonomy (Krathwohl & Anderson, 2009) pertinent to cognitive, affective, and psychomotor domains of learning. The purpose of adding this category aligns with Nino and Evans (2015) research highlighting the need to raise awareness of teachers and other stakeholders on evaluating the affordances and features of games to foster 21stcentury skills, e.g. collaboration, self-regulation, higher-order thinking, creativity, and decision-making. The indicators to assess characteristics of skills and knowledge, listed in Table 4.5, may assist teachers in designing DGBL environments to activate higher-order thinking if games are lacking in building specific skills, knowledge and attitudes. A comparison of TYMTR and GGUK demonstrates mixed results.

An interesting finding that stemmed from the study was the role of the DGBL environment in supplementing the skills gained through the games. One characteristic lacking in both games (TYMTR and GGUK) was the collaboration and interaction with other players. Qian and Clark (2016) found collaboration and interaction as the most prominent game design features in the literature reporting 21st-century skills outcomes through DGBL. In the present study, the organic DGBL environment of the EG filled this gap through peer collaboration and collective problem-solving, while this gap continues to exist in the CMG, and may have accounted for better retention in the EG.

Similarly, the TYMTR analysis on psychomotor skills indicators of the PEGS tool revealed a low rating on imitation, modelling, and recognising standards compared to GGUK. However, the EG students overcame this limitation by effectively using their DGBL environment to observe peers performing game actions. These findings corroborate with earlier studies suggesting that DGBL increases students' motivation and willingness to communicate in L2 (Lee & Drajati, 2019) and makes communication enjoyable by reducing stress and anxiety (Reinders & Wattana, 2015). In the present study, students' self-confidence and skills acquisition encouraged them to transfer skills to real-life scenarios. These findings are also consistent with earlier literature on virtual reality, proclaiming that skills acquired in virtual reality can be transferred to the real world if both environments share common elements (Alexander et al., 2005; Rankin et al., 2008).

While the CMG students also demonstrated some changes in behaviour and attitude towards reading, those changes were mainly related to playing games or reading for entertainment. Yet, they appeared to have a positive attitude towards recreational reading. These results may complement All et al. (2014) findings that a change in behaviour acquired through games does not necessarily imply that the behavioural change will be transferred to the real world, which further strengthens the notion of teachers' role in creating opportunities in DGBL environments for fostering transferable skills.

The discussion in this section aligns with Molin (2017) and All et al. (2015) that role of teachers in the DGBL environment may bridge the gap between skills acquired in the virtual gaming world and transferring of skills to solve real-world problems. If digital games do not offer opportunities to foster higher-order skills, teachers may create opportunities to engage students in constructivist activities within the social environment of DGBL classrooms (Lim et al., 2018; Qian & Clark, 2016). Nevertheless, the desired value of educational games is to develop the transferability of skills from the gaming world to real-world settings, which requires a shift in student behaviours and attitudes more than learning outcomes (All et al., 2015).

In conclusion, this theme has highlighted the desirable characteristics of digital games to develop reading skills in English as a second language (L2). The evidence on learning achievement and retention of reading skills, changes in behaviours and attitudes towards reading purports games characteristics listed in the PEGS tool as desirable to design and evaluate COTS reading games. It is argued that the categories (Pedagogical aspects, Educational components, Game design aspects, and Skills and knowledge considerations) should not be taken as discrete entities; instead, these factors intertwine to provide a balanced effect to a game. The purpose of categorisation is to explicitly acknowledge the role of each category and associated sub-categories to aid the process of tool development. At the core of playing games is the holistic development of skills and competencies (Qian & Clark, 2016). It is anticipated that the PEGS framework may provide a unique perspective in developing and evaluating games by integrating the crucial factors of instructional strategies, educational components, and game design elements. It is argued that PEGS is not an objective but a subjective tool. It does not specify an overall score for games because an overall score may be misleading. For example, a game may score highest due to extraordinary game design and pedagogical components, but it may score below average on educational components. Such games may be of no use to teachers who want to use games for specific learning purposes in their classrooms. On the other hand, PEGS is best used for making comparisons between two or more games to inform the choice of using better games for learning. The PEGS tool may also be adapted to evaluate educational games in any language or related to any subject by replacing the educational components with appropriate intended learning outcomes. The reliability and validity testing of the PEGS tool makes it appropriate to train teachers to evaluate the effectiveness of digital games for reading development.

8.5 Summary

This chapter answered the research questions by discussing the key findings in the results chapters, Chapters 4, 5, 6 and 7. The research questions were answered with the ultimate goal of answering the overarching research question: *How effective is digital game-based learning in developing reading skills in a multilingual developing country context*? Four themes relating to the sub-questions were identified in the study. The first is pertinent to the reading development using a digital game, which reviewed the game using three lenses. The first lens looked into developing early reading skills in English (L2) after playing digital games. The study concurs with earlier research on the acquisition of reading skills using digital games (e.g. Ghani et al., 2022; Tsai & Tsai, 2018; Yang & Chen, 2021; Young & Wang, 2014). The study expands the notion of acquisition of skills to the next level by using a second lens to discuss the effects of digital games on the cross-linguistic influence of L2 on L1 reading skills. Research into the cross-linguistic transfer from L2 to L1 and its causal relationship is sparse. This study contributes to this gap in the literature by studying the causal effect of DGBL reading instruction in English (L2) on acquiring reading skills in Urdu (L1) in multilingual low SES primary school students of varying ages enrolled in OSC school from Grade 1 to Grade 5 in Pakistan. For most children, L1 is Urdu, the lingua franca, and L2 is English which they learn at school. Affordances of digital games in providing explicit instruction on understanding morphological rules improve metalinguistic awareness to read in L2, facilitating cross-linguistic transfer across phonetic languages, even with different orthographies. A collaborative learning environment promoted critical metalinguistic awareness in students compared to a teacher-controlled non-collaborative learning environment, with implications for the long-term sustainability of skills.

The third lens evaluated the impact of digital games on the retention of reading skills once the DGBL was discontinued. The results of the present study are consistent with Yang and Chen (2021), suggesting that the environmental and social interactional factors created a cheerful and stress-free environment that might have contributed to the long-term retention of skills. A decline in CMG's skills retention was significantly more than the EG, drawing attention to factors that may have contributed to this trend.

A prominent factor was the design layout of the DGBL environment and the support mechanism established in the two groups. The teacher-controlled design of the learning environment in CMG with no opportunity for peer support resulted in low motivation to play games. Contrastingly, the collaborative design of the DGBL environment with opportunities for peer learning in the EG improved motivation, consequently increasing competency, agency and autonomy, which may have led to better sustainability of reading skills.

The discussion under Theme 2 explored the design of effective DGBL environments and the shift in the role of the teacher to scaffold learning. The findings corroborate with literature (e.g. Hayak & Avidov-Ungar, 2020; Lim & Chai, 2008), showing that teachers' pedagogical beliefs impact social interaction and support classroom dynamics, which may influence behaviours. The analysis of findings revealed that effective DGBL environments might achieve 'ecological totality' (Pierce, 2012) through a collaborative interaction between students, games and teachers, where the content is delivered through the game, knowledge is co-constructed through collaboration and shared understanding, while the teacher facilitates to transfer skills gained from the virtual world to the real-world scenarios.

This chapter also discussed behavioural and attitudinal changes, which signifies the importance of interactions within a DGBL environment. The study expanded Nuthall's (2007) view of three interactional worlds of the classroom to explore how behaviours were shaped in each world, public, semiprivate, and private world. The findings revealed that the semiprivate world had the most substantial impact on student behaviours. The teacher restriction on peer interaction limited the semiprivate world in the CMG, but the findings revealed that students established a hidden semiprivate world that could have implications for designing a DGBL learning environment.

This chapter also discussed the desirable characteristics of digital games for developing reading skills. Due to a scarcity of research in identifying benchmarks of quality to evaluate digital games for reading skills (Montazami et al., 2022), this study initiated the development of the PEGS framework in Phase 1 of the research based on existing literature on pedagogical aspects (Becker, 2017; Kiili, 2005; Lim et al., 2018), educational components (Department for Education, 2013; FCRR, 2006; Ministry of Education, 2010), game design aspects(Gunter et al., 2008; Kiili, 2005; Lim et al., 2018), and knowledge and skills development (Krathwohl & Anderson, 2009). The PEGS framework led to the development of the PEGS tool that yielded high validity and reliability measures. This tool was used to evaluate COTS games to select one effective game deployed in schools during phase 2 of the research. This chapter discussed the findings in relation to the effective game aspects found in the games and supported by literature that may have contributed to achieving positive results in reading development. Based on the discussions, this chapter introduced the idea of complementing the limitations of digital games with the DGBL environment, where the teacher designs strategies to address any gaps identified in any aspects of the digital games and creates opportunities to expand and transfer skills from the virtual gaming world to the real-world scenarios.

The next chapter, Chapter 9, concludes with findings and contributions from the study by discussing the implications for teachers in creating effective DGBL environments for enhanced learning experiences, the implications for game developers to design effective games, and the implications for researchers in the field of digital-based learning for reading development, including insights into strengths and limitations of the methodology and research processes.

CHAPTER 9: CONTRIBUTIONS, IMPLICATIONS AND CONCLUSIONS

This chapter discusses the implications of key findings for teachers in designing effective DGBL environments in schools, for the game industry to design pedagogically balanced educational games, and for researchers to conduct further research in reading development using digital games. This chapter is divided into seven sections. The first section restates the aims and significance of the study (Section 9.1), followed by an account of the original contributions of this study (Section 9.2). Implications for teachers and other stakeholders are discussed in Section 9.3, leading to recommendations for policy, practice and the game industry in Section 9.4. This chapter also provides a critique of the study design by discussing the strengths and limitations of the study design and data collection methods (Section 9.5). The chapter concludes by presenting recommendations and future research areas in Section 9.6 and concluding thoughts in Section 9.7.

9.1 Restatement of Aims

This research has attempted to investigate the role of digital games in improving reading skills in multilingual societies within Pakistan - a developing country context, where English is the second or sometimes third language, while the medium of instruction in schools, specifically at the textbook level, is English. This study referred to English as a second language (L2), while Urdu, the lingua franca, is considered the first language (L1). The study also intended to explore the factors essential to developing an effective digital game-based learning environment to develop reading skills for students belonging to low socioeconomic status.

The broader aim of the research was to gain a better understanding of how innovative use of digital technology, such as digital games, may contribute to achieving Sustainable Development Goal (SDG) 4 set out by the United Nations to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" (United Nations, 2015, p. 21). According to SDG4, one of the targets is to "ensure by the year 2030 that all primary school children complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes" (*ibid*). An overarching question that guided this research was, *How effective is digital game-based learning in developing reading skills in a multilingual developing country context?*

The research findings provide empirical evidence to contribute to the existing knowledge base and stimulate a national and international debate on how pedagogically balanced digital games can provide an equitable, quality, and efficient solution to develop and retain reading skills and facilitate the cross-linguistic transfer of skills from the second (L2) to the first language (L1).

9.2 Original Contributions

Through the lens of constructionist epistemology and theoretical frameworks of pragmatism and transformative emancipation, this section discusses two significant aspects in relation to the original contributions of the study. The first is pertinent to selecting games to use as a pedagogical tool for developing reading skills, and the second is the Design of the DGBL Environment that compliments the game to enhance the learning experience using games.

In the Selection of Games aspect, there are two prominent findings. The first is that game selection is grounded in four overlapping optics: pedagogical aspects, educational considerations, game design elements, and skills and knowledge development. The PEGS framework and the associated tool developed in this study identified desirable characteristics of the digital games that help teachers select pedagogically balanced games aligned with curricular needs. The second finding in the Selection of Games is using the PEGS tool to improve teachers' game literacy, which may enable them to design effective DGBL environments that help students acquire twenty-first-century skills to become lifelong learners.

In the design of the DGBL Environment aspect, there are two key findings that influence students' behaviours and attitudes towards reading. The first is the arrangement of learners that facilitates peer interaction. The second is the teacher's role in designing the DGBL learning environment to foster transferable qualities in students, such as critical thinking, initiative-taking, collaborative problem-solving, communication, empathy, and effective decision-making and preparing them for the world outside schools. The study also explored perceptions of behaviours and attitudes resulting from the game playing and found that behaviours are not just shaped by playing games, but the social interactions within the DGBL environment hugely contribute to shaping student behaviours and attitudes towards reading.

The original contributions of this study are:

a) The study contributed to the existing gap in the literature in relation to evaluating digital games for developing reading skills. One of the major contributions of this study was the development of the PEGS tool to evaluate reading development games. The PEGS tool may compare two or more digital games on the desirable characteristics to develop reading skills. The PEGS tool was tested for validity and reliability, which returned high item-level content validity (I-CVI = 0.85), and high reliability on three reliability indicators (Section 4.4), test-retest (r= 0.79 > 0.6), inter-rater reliability (ICC > 0.8 at 95% confidence interval), and high internal consistency ($\alpha > 0.9$ for overall PEGS tool; and $\alpha > 0.7$ for the sub-scales).
b) The data from this study has challenged the current understanding of if and how cross-linguistic transfer occurs using pedagogically balanced digital games from L2 reading to L1 reading, even if languages differ in orthographies.
c) The study has offered an expanded notion of the role of teachers in DGBL environments by highlighting the different roles teachers adopt at various stages of DGBL and the need for extending these roles to the level of mentorship to bridge the gap between virtual and real learning environments, and the wider context outside schools. Based on the findings and discussions, this study recommends a model for an effective DGBL environment (Section 9.3).
d) This study developed an understanding of the design and nature of a DGBL environment in a developing country context, especially concerning the utilisation of digital resources, the arrangement of learners, and creating opportunities to transfer skills to the wider real-life context. Through the lens of geosemiotic analysis framework (Scollon & Scollon, 2003), this study demonstrated that the design of DGBL space influenced the social interactions, e.g. teacher-student, student-teacher, and student-student, classroom discourses, identities and social practices in the co-construction of knowledge.
e) The study also identified that a DGBL environment that encourages peer support, collaborative problem-solving, and co-construction of knowledge while using a pedagogically balanced digital game may foster transformative emancipation in students despite their social and economic status. This empowerment through emancipation may liberate students from a restrictive worldview of learning using traditional methods and prepares them to participate effectively in

real-life outside schools. The theoretical framework of pragmatism and transformative emancipation adopted for this study may have contributed to restructuring the educational experience of the study participants by completely rewiring their beliefs, perceptions, and experiences into a newly transformed learning experience and enhancing self-awareness and a deeper self-understanding of their needs.

The study findings have implications for policy, practise, and further research to improve the literacy outlook in developing countries like Pakistan, which are looking for innovative approaches or interventions to raise literacy standards, quality and access to education in a short time to be able to meet SDG targets in the year 2030. The following section discusses the implication of this study.

9.3 Implications of the Study Findings

Implications for stakeholders, such as policymakers, students, parents, teachers, and teacher educators associated with DGBL to improve the literacy outlook in a developing country context are discussed in this section. The following subsections discuss implications for policymakers first, followed by implications for students and parents, and then for teachers and teacher educators.

9.3.1 *Implications for Policymakers*

A review of the National Education Policy on digital technologies in Pakistan (Section 2.7) shows that effective integration of digital technologies is subjective to the political agenda of the reigning government and funding allocations for educational reforms in the national budget. Therefore, major barriers to integrating digital technology in improving access and quality of education could be financial constraints, access to technology, capacity building, and social and cultural aspects that limit the development and implementation of new ideas (Leal et al., 2020). On the other hand, the Pakistan telecom industry has seen a boom in smartphone users as the smartphone penetration increased five times higher from 2014 to 2020, while smartphone users included people from all income groups (PTA, 2021). Smartphones with mobile data are available on cost-effective plans, encouraging low-income people to own at least one smartphone to access free video and audio calls using apps like WhatsApp and Messenger (ibid). The access and affordability of mobile technology situate the use of current research to implement DGBL to improve the reading outlook in the country, which may require comparatively less investment than setting up a computer lab at primary schools. The following are the implications for policymakers to integrate DGBL to improve reading skills for students belonging to economically marginalised societies:

- The study findings suggest the bringing together of all stakeholders, including policymakers, non-government organisations, educators and the game industry, to collaborate and develop pedagogically balanced educational literacy games. Many international donors and non-government organisations are committed to improving Pakistan's educational outlook. The game industry is also gaining strength in developing entertainment games in the country; however, there is a potential to collaborate with researchers, educationists and game developers to develop effective literacy development games (Ahmad & Tsai, 2018).
- The collaboration between stakeholders may establish a centralised DGBL unit to develop pedagogically balanced digital games. This centralised unit may develop digital games according to the curriculum needs of the country, considering the cultural and social aspects, language barriers and technological infrastructure to design pedagogically balanced digital games.
- The centralised DGBL unit may introduce collaboration between teachers as content specialists, instructional designers, game developers, and researchers to develop pedagogically balanced digital games to suit the educational needs of the target populations. The PEGS framework developed in this study may contribute to designing, developing and evaluating the games. The games can be subscribed to schools at a low cost that may generate some revenue for the sustainability of the centralised DGBL unit; however, the games may be made available to the students free of cost.

This study identified that teachers struggled to facilitate the DGBL environment effectively due to their pre-existing teaching beliefs and societal expectations. However, the study results revealed the willingness to challenge their existing beliefs and facilitation strategies that were new to their practice. Teachers should be provided in-service training on using DGBL, understand role definitions, and become competent in enacting multiple roles required in DGBL environments. Further discussion on teachers' roles within DGBL is presented in Section 9.4.3.

9.3.2 *Implications for Students and Parents*

The implication of this study's findings for students and parents could be to create multiple means of engagement for students to establish informal reading activities at home using free COTS digital games on smartphones, tablets or computers. Playing games at home may give more opportunities to engage the whole family with the fun and challenging content of the game to practice reading skills at home. Continued access to pedagogically balanced digital games may decrease the summer slide effect for students that usually happens after the school holidays.

Students could be encouraged to design their learning environment and be allowed to choose how they want to learn, individually, in small or large groups. In partnership with other students, they may be allowed to interact to give or take feedback, reflect and enact to make informed choices. Moreover, students could be encouraged to establish a parent-child partnership where every student is tasked to help parents in reading-related activities in the real world, which could be considered authentic learning scenarios. Additionally, students may use games at home to read in collaboration with their parents, which could improve their parents' reading skills.

9.3.3 *Implications for Teachers and Teacher Educators*

The study findings indicated that effective DGBL environments comprise multiple layers, requiring a transformation of the teacher's role at each subsequent layer. These findings have implications for teachers and teacher educators to understand the role definitions and transformations at each layer of the DGBL environment. There is a risk of losing opportunities for teaching and learning if teachers are not competent in adapting their roles at each layer of a DGBL environment.

Figure 9.1 presents a model of the DGBL environment depicting the layers and the roles of teachers at each layer. The layers evolve from the centre connecting the curriculum outcomes to the skills transferable to the wider scenarios outside schools. The suggested DGBL model for reading development is grounded in Bandura's social learning theory (Bandura, 1977) and Vygotsky's social-cultural theory (Vygotsky, 1978), which theorise the implicit and explicit impact of the environment in acquiring attitudes for the co-construction of knowledge. The suggested DGBL model may be used to plan and create a powerful learning environment for students that enables them to identify their potential, acquire positive attitudes and skills, and empower them by transferring their knowledge, skills and attitudes to the wider context outside the schools. The layer-by-layer implementation of this model may inform teachers to plan their game-based lessons effectively to provide better support and engage students in critical reflection on the use of skills outside the game environment.

Layer 1: Planning and identifying needs

Layer 1 is the core of the DGBL environment that guides the selection of the game. This layer may be invisible to students as it involves planning for establishing a DGBL environment. At this layer, the teacher wears multiple hats to play a range of roles. The first hat is that of a content specialist, which requires teachers to review the curriculum documents, scheme of work, and students' needs to decide upon the learning content that should be embedded in the game, then apply the PEGS tool to identify a game. For instance, if the purpose is to improve phonological awareness and non-word recognition, the teacher may find games that provide better opportunities to practice these skills.

The teacher's second hat at this layer is that of a game evaluator, which requires them to search for relevant games from the Internet and evaluate for effectiveness using the recommended PEGS tool. The teachers still act as content specialists when they wear the hat of game evaluators. In this role, teachers are required to play the games and evaluate them on the indicators of the PEGS tool. The implication for teachers is to be able to evolve from one role to another. They should be able to assess the specialist content embedded in the storyline using instructional strategies to promote learning by doing, building, expressing, exploring or collaborating.

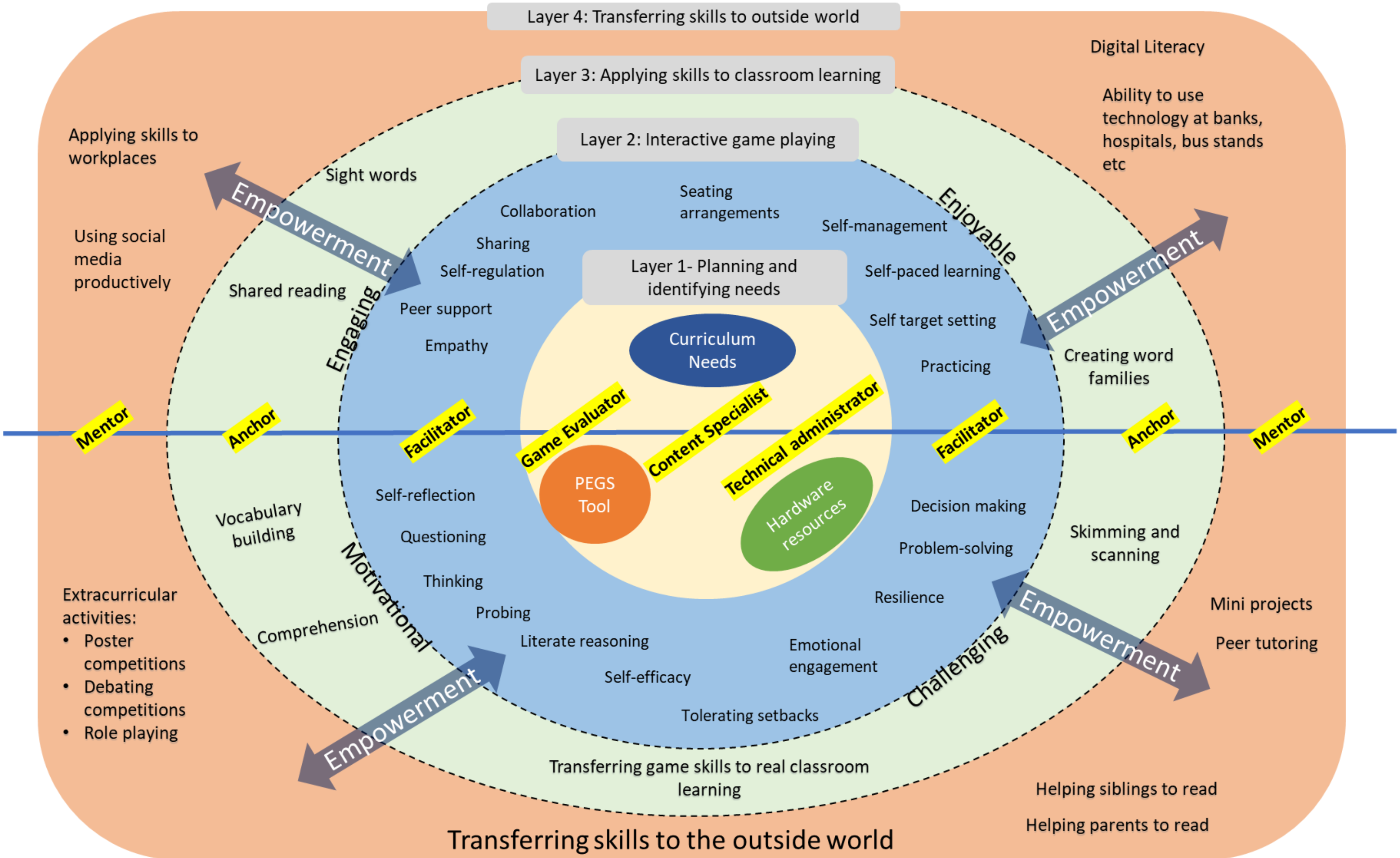
As discussed in Section 8.4, PEGS is a subjective and evaluative tool that compares two or more games on evaluation criteria of pedagogical aspects, educational content, game design aspects, and skills and knowledge considerations. Recent research indicates that teachers use generic criteria, e.g. game ratings, costs and advertisement, technical support, and user reviews, but they seldom look at the educational value of the game (Montazami et al., 2022). The PEGS tool could assist teachers in looking for and identifying specific educational content a game may have embedded in it within an interesting and challenging storyline. The PEGS tool could also be used as a game literacy tool for teachers, especially those whose language of instruction is not their first language. Playing games while evaluating various aspects of the PEGS tool may provide teachers with appropriate game literacy to help them plan and manage their DGBL sessions better (Molin, 2017). They would have a better idea of the strengths and limitations of the selected games, which can help them create a DGBL environment that complements the digital games in imparting effective skills and attitudes.

The third hat teachers wear at this layer is that of a technical administrator, which requires them to arrange hardware and software resources. DGBL requires access to technology, including smart devices with appropriate screen size, storage capacity, processing power, extended charging capacity or battery life, and availability of broadband, which can provide a non-disruptive gaming experience for the class duration. Preparation of resources would include charging devices and ensuring devices are fully charged for the session, installing games on individual tablets before the session to save up time and avoid bandwidth issues, and registering on the game by creating accounts using generic usernames and passwords which are easy to remember and retrievable in case forgotten.

It is argued that wearing multiple hats at this layer may empower teachers with game literacy as they will interact with and evaluate the game using the PEGS tool before disseminating it to students. This prep time will enable teachers to identify limitations in the game pedagogy and may provide them with an opportunity to plan an activity to address that pedagogical limitation in the game. Once the teachers have their plans and game resources ready, they will be moving on to designing the next layer of the DGBL environment.

Figure 9.1

Recommended Model of Effective DGBL Environment



Layer 2: Establishing interactive DGBL space for playing games

Once the game is selected, the next step is to establish a DGBL environment that complements the digital game in building learner power by offering a space to enjoy the game, experience challenges, be imaginative, ask questions and collaborate with peers to find solutions, and be supportive towards each other. The role of the teacher in this layer is that of a facilitator that establishes classroom dynamics to initiate and facilitate communication, collaboration and support whilst adhering to some ground rules about handling devices and noise levels, as a boisterous class may disrupt the listening of game instructions. The interactional dynamics of this layer may resonate with Claxton's (2011) Building Learning Power (BLP) framework that provides an opportunity to develop characteristics of powerful learning, e.g. resilience, resourcefulness, reflectiveness and reciprocity, by engaging in collaborative problem-solving through playing games.

The study findings suggest that resilience may be developed through self-management of learning, setting up targets, coping with challenges to meet targets, resisting distractions, tolerating setbacks, and bouncing back from frustration and failures. Claxton (2011) linked resourcefulness to cognitive skills and dispositions of learning. In the suggested DGBL model, resourcefulness capitalises on the private world of students' minds (Nuthall, 2007), where they imagine, think methodically, and connect the dots to establish links between their prior and acquired knowledge. Relatedness is another crucial characteristic highlighted in the discussion. It activates the semiprivate world of students (Nuthall, 2007) by encouraging peer interactions in a DGBL environment to learn from others, sensitising students to use peer support constructively, and developing empathy to listen to others and offer support. The study findings suggested reflectiveness as a crucial factor in an effective DGBL environment. It links to 'meta' of learning, including self-regulation and meta-linguistic awareness, enabling students to monitor their progress and transfer reading skills across languages. An implication of this layer for teachers is to acquire skills to create opportunities to build learner power. These opportunities can be created by engaging students in question-answer-evaluation sequences or orchestrating classroom routines to develop positive learning habits, such as helping students set and monitor their targets. This will require teachers to get training and gain competencies to become effective facilitators able to create learning environments that foster creativity, support, freedom of thought and expression.

Layer 3: Bridging the virtual gaming world to the real classroom learning

This layer acts as a bridge to link skills acquired in the virtual gaming world to real classroom learning. The role of a teacher is that of an anchor that links game acquired skills to classroom learning. In this layer, the teacher plays the central role in orchestrating such an environment (Molin, 2017). Teachers design opportunities for students, e.g. shared reading, vocabulary building, sight-word skills, etc., to develop learning habits and monitor their learning targets. At this layer, teachers scaffold students with constructive feedback to take learning to the next level of progression and create opportunities to transfer their acquired skills from the virtual game environment to the actual classroom environment leading to a wider context outside school boundaries. An implication for teachers at this layer of DGBL is to transition from their roles of facilitators to anchors. The role of an anchor involves creating scenarios for students where they can apply the information learned through games or use skills acquired through DGBL to solve the problem. The role of an anchor puts students in the centre of solving a problem to help students become reflective thinkers who can have self-confidence and self-efficacy to use skills acquired through games to solve problems.

This layer of the DGBL model should be used to provide anchoring support on an equity basis; teachers would identify students who need more support at any stage of their learning development. Their support should include commentating on student's learning by noticing and appraising the strategies used by students in handling a problem(e.g. a game level), encouraging students to become more thoughtful about the approaches they used to solve a problem, engaging them in thinking of alternative approaches to solve a similar problem in a different context. This will help them become more resourceful and equipped with a variety of ways to tackle a problem. A consistent approach to utilising this layer for engaging students to become reflective and thoughtful about learning will create an authentic learning experience that could improve their confidence in transferring skills to the wider context.

Layer 4: Transferring skills to the wider context outside schools

This layer refers to creating opportunities for students to utilise acquired attitudes and behaviours to transfer skills to the wider context outside schools. An implication for the role of the teacher would be to act as a mentor who identifies potential in students and creates explicit opportunities in the form of mini-projects, extracurricular activities linked to broader literacy skills, e.g., poster competitions, debating competitions, etc., peer tutoring, or activities that involve students' interaction with their sociocultural environment outside schools where they could exploit their skills in wider society, at the workplaces or at homes, e.g. helping family members with reading, or utilising digital technology at banks, hospitals, or bus stations. The interaction dynamics at this layer are grounded in Vygotsky's sociocultural theory (Vygotsky, 1978). The social interactions with the sociocultural environment established at this layer may empower students in developing higher mental functions that enable students to internalise methods of thinking or problem-solving strategies. The current study's findings suggest that the EG students who collaborated to solve problems developed work-ready skills, including resilience in facing challenges, demonstrating solution-oriented reasoning to solve problems, taking initiatives to perform a task, contributing and participating as effective team members, and active listening and reciprocal communication skills. It is argued that the teacher's role as a mentor at this layer may empower students in acknowledging their strengths and developing 21st century and work-ready skills (McManus & Rook, 2021), which primarily refers to students' capabilities to get the task done effectively.

The model of an effective DGBL environment (Figure 9.1) requires a comprehensive training programme to introduce the role definitions for teachers and teacher educators and equip them with strategies to implement at each layer of the DGBL environment. The next section discusses recommendations for policy, practice and the gaming industry in Pakistan.

9.4 Recommendations for policy, practice, and the gaming industry

One of the biggest challenges developing countries face is political instability. Pakistan also faces the challenges of political instability where no government completes in full term, negatively impacting the country's developmental reforms, including education and health (Bano et al., 2019). Four years ago, when the present study was initiated, the then government supported educational reforms to use digital and mobile technologies to improve access and quality of education. Various initiatives were taken to study the impact of digital content and games to increase motivation, engagement, achievement and access to education for students of different socioeconomic statuses, cognitive levels, genders, and abilities (Ahmad & Tsai, 2018). The efforts were targeted to improve the quality and access of educational outlook in Pakistan to meet the targets of SDG 4 by 2030 (United Nations, 2015). However, the present government has paused the previous government's initiatives to reassess and implement better strategies (Hayder, 2022). Therefore, it is recommended that the school management focuses on local authorities or reforms for education development independent of the central government; central authorities may cause problems with regime changes as the previous initiatives may not be supported by current authorities. There are multi-stakeholder partnerships between private sectors, philanthropic organisations and NGOs working in Pakistan to support innovative approaches to improve the educational outlook for out-of-school children (Ahmad & Tsai, 2018), which may provide support and resources to the schools at the local level.

This study's results may be helpful for such multi-stakeholder partnerships in developing business models to support DGBL to improve education quality, access and equity. Such partnerships may support start-up businesses and the emerging game industry seeking to improve the quality of education by designing contextualised digital games using the PEGS framework and teacher-training workshops to create effective DGBL environments, as recommended by the present study.

In collaboration with multi-stakeholder organisations, these start-ups may scale up their ideas to reach out to the wider population and improve educational outcomes on a large scale through DGBL interventions, which may lead to meeting SDG4 targets set by United Nations (2015). Moreover, the Covid -19 pandemic exacerbated the challenges of increased school dropouts and access to education due to lockdowns. In such circumstances, it is argued that the present study's findings have implications for improving access and quality of education using mobile technologies and pedagogically balanced digital games. While the government decides upon new reforms, digital games on low-cost tablets or smartphones can still impart better 21st century skills and reading development. Reading skills are considered core skills that may form the basis of knowledge development (Hulme & Snowling, 2015). The use of reading development digital games in and out of schools may help improve the skills, which subsequently may impact knowledge development in other subjects.

9.5 Strengths and Limitations of the Study Design

The quality of a research study may be determined by the validity and reliability of the research design (Neuman 2011). Like most other studies, this study has strengths and limitations in the research design. This section briefly highlights the strengths and limitations of the research design, which may have implications for the generalizability and transportability (replicability) of the research to the target populations and external populations in varying contexts.

9.5.1 *Strengths of the Study*

One of the study's main strengths was the use of multi-phased mixed-methods embedded design using quantitative and qualitative methods of data collection with three independent groups: experiment, comparison and control group studying the impact of games, including the DGBL environment and the role of teacher facilitation on reading skills in L2. Much of the recent literature in DGBL studies adopted experimental and quasi-experimental research designs focusing on comparing digital games as a medium to support effective learning (e.g. Clark et al., 2016). A review of a meta-analysis conducted by Tsai and Tsai (2018) investigating the effect size of DGBL on second language (L2) vocabulary learning revealed three primary research conditions. The first condition was cognitive-consequence comparing digital games with traditional instruction. The second condition was the feature-added-or-changed, which compared a game with a specific feature added or changed to the basic game design without that particular feature. The third condition was media-comparison, which studied the effectiveness of digital games with equivalent content delivered through other non-game media. The literature lacks studies on the efficacy of DGBL on L2 reading skills in divergent classroom environments and support conditions. Therefore, the current study design was slightly nuanced and differentiated from the three research conditions found in Tsai's meta-analysis. The current study investigated the impact of DGBL in a teacher-facilitated and non-teacher facilitated environment compared to the traditional instruction for developing early reading skills in English (L2) and studied the cross-linguistic influence of English (L2) reading skills on Urdu (L1) reading. At the data analysis stage, the use of ANCOVA while considering pre-tests as covariates further strengthened the intervention design to control for the effects of pre-existing between-group differences on subsequent analysis to prevent over-or under-generalisations of study results and to calculate the effect sizes to understand the magnitude of the impact games had on developing reading skills.

Another strength of the study was the adoption of mixed methods to draw inferences by triangulating quantitative and qualitative data to improve the validity of the findings (Creswell & Plano Clark, 2011). The qualitative findings provided insights into the empowerment and emancipation of the study participants due to DGBL intervention. Internal and external threats to validity were anticipated prior to the study, and measures were taken to reduce the threats. The measures included adequate content validity by using valid and reliable instruments, which have been widely used in early research.

The use of reliable instruments, the Elementary Reading Attitude Survey (ERAS) for measuring reading attitudes, and the Early Grade Reading Assessment tool for conducting pre-post-and-delayed-post tests may have reduced the threat to the content validity of the study design. To assess reading skills in Urdu (L1), EGRA-Urdu was developed by the researcher in collaboration with experts in the Urdu language, following the guidelines provided to adapt EGRA to other languages.

The ERAS instrument was translated into the Urdu language to improve understandability by students. The guidelines prescribed by World Health Organisation (World Health Organisation, 2019) were rigorously followed to translate into Urdu (Section 3.10.1). As a measure of reliability, the internal consistency of translated ERAS indicated moderate to high reliability of the overall scale (Cronbach's $\alpha > 0.7$), which may support generalising this study's results with caution. However, the internal consistency of sub-scales revealed mixed results where the Recreational reading attitude resulted in Cronbach's $\alpha = 0.70$, and the academic reading yielded Cronbach's $\alpha = 0.57$ ($\alpha < 0.7$). The low value of Cronbach's $\alpha < 0.7$ (Field, 2018; Leech et al., 2011) shows the low internal consistency of items in the academic reading sub-scale, which may be caused due to the blurring of the distinction between academic and recreational reading. The study findings indicated that non-availability of resources for entertainment reading, some students considered academic reading as reading for entertainment, likely to blur the difference between academic and entertainment reading, leading to a low internal consistency of the sub-scale.

The PEGS tool for game evaluation was also tested for validity and reliability and appeared to be a valid and reliable tool (Section 4.5). The tool was developed as no appropriate tool to assess the educational value of a reading development game was found in the literature.

The study's external validity was maintained using an appropriate sample size and sampling technique, which may contribute to generalising the results to the target population. The calculation of the sample was based on the size of the target population with a 5% margin of error and a 95% confidence level. The random selection of clusters of campuses and random assignment of clusters to independent variables, i.e. EG, CMG and CG may have reduced the threats to the external validity of the study (Section 3.14.3). The cluster of campuses demonstrated similar attributes in terms of resources, teachers' characteristics (e.g. qualification, training, age, experience, socioeconomic status, and training), and students' socioeconomic status. Moreover, the pre-test results also established a baseline of reading skills for the participants demonstrating similar skills prior to the intervention.

The strengths of the study design, sample size, and random assignment of clusters to the independent variables (groups) to maintain external validity may allow generalising study results with some confidence to the target population. Since the research was restricted to the context of Pakistan, focusing on out-of-school children enrolled in charity schools, caution must be taken to generalise the results to the wider population with similar attributes as the target population.

9.5.2 *Limitations of the Study*

The study design and processes of data gathering may have some limitations, which can be improved in future studies replicating the same research design as the present study. The following paragraphs present the limitations.

One of the study's significant limitations was the researcher's financial and immigration circumstances for not being able to go to Pakistan for Phase 2 and Phase 3 of data collection. Nevertheless, the researcher considered this an opportunity to establish processes and practice to collect data using video-conferencing technologies with the help of assistants trained in using data collection tools during Phase 1 of the study. The researcher's reflections on data collection from home via distance were published (e.g. Ahmad, 2020) as sharing of a viable practice whilst maintaining authenticity, validity and reliability to inform novice researchers and other doctoral students who may have struggled to collect data due to access or border restrictions due to COVID-19 pandemic. However, it was assumed that the researcher's physical presence while conducting classroom observations and interviews might improve the data's richness.

While the data collection (e.g. classroom observations, interviews, group discussions) held using video-conferencing was successful and may be considered a strength of the study, it may also be a limitation for developing a better rapport with the study participants to engage them in more insightful discussions.

In regards to the PEGS tool, a detailed reliability analysis was conducted by utilising three test procedures: test-retest, inter-rater, and internal consistency. However, only content validity was assessed to establish the validity of the tool. The lack of validity analysis of the PEGS tool may be considered a limitation of this study.

Another limitation could be the researcher's own perceptions of using digital games as an effective pedagogical tool for language development. For example, the researcher's professional background and past research experiences may have provided lenses for the participants to view the phenomenon of learning through DGBL, which could lead the discussion in a specific direction (Mercer, 2007). Objectivity was maintained to avoid the researcher's bias using inter-subjective reasoning and shared meaning-making by considering multiple perspectives on learning to read using digital games from the study participants. Furthermore, member checks and triangulation from other data sources helped reduce researcher bias in the study, consequently improving the validity of the study design.

Another limitation could be creating EGRA Urdu pre-and post-test assessments, which could influence the reliability of the assessment tool. Although an expert panel reviewed the EGRA Urdu for content validity, the reliability was not calculated using statistical analysis, which can be considered a limitation. Therefore, caution must be taken while generalising results related to Urdu reading. The next section presents recommendations for further research.

9.6 Recommendations for Further Research

To some extent, the current study contributed to the research gaps identified in Klimova and Zamborova's (2020) review by evaluating low-cost COTS games from the Google PlayStore for reading development and creating an experimental design comparing two groups (playing games with and without teacher-facilitation) against the controlled group for a target population of out-of-school children in Pakistan. This study's findings suggest further studies to expand the knowledge base in the use of DGBL for reading development. Some suggestions for further research are listed below.

Extending the study to larger populations

The findings of this study and the recent literature reviews (e.g. Klimova & Zamborova, 2020; Tsai & Tsai, 2018) demonstrated the possible potential of using pedagogically balanced digital games to develop reading skills, especially in alphabetic languages. However, to gauge the effectiveness of the DGBL intervention on wider populations, randomised controlled trials may be recommended, which may provide the most reliable evidence for the effectiveness of the intervention by controlling the confounding factors (e.g. age, gender, socioeconomic status, parental education, home literacy practices, and access to technology) influencing the results. The intervention period may also be extended to ascertain the long-term effects of DGBL on reading skills.

Conducting a psychometric analysis of the PEGS Tool

The PEGS tool was evaluated for content validity only. Although the reliability statistics indicate that the PEGS tool returned consistent results at a high degree over time and across multiple raters (Section 4.5), it is imperative to conduct a validity study to establish a psychometric evaluation of the PEGS tool. Validity analysis of the PEGS tool can be established through convergent correlation analysis, which compares some substantial positive correlations of the PEGS tool with other similar questionnaires. Since there were no similar questionnaires to evaluate digital games for reading development, it was nearly impossible to conduct convergent validity during the research period. Second, the PEGS tool has 63 items which may be overly time-consuming for teachers or parents to evaluate different games for effectiveness. A reduction of items can be performed using Exploratory Factor Analysis (EFA) to identify the items to retain or discard; however, this was again beyond the scope of the present study as it required a large data set. Further studies are required to refine the existing framework and conduct a psychometric evaluation of the usability of the PEGS tool.

Further research on the role of teachers in a DGBL environment

The study findings indicate that teachers adopted different roles in the comparison group DGBL environment. Most of the time, they were passive spectators maintaining discipline and order in the classroom while students were playing games. However, as the sessions progressed in the intervention, they appeared to transform their roles from passive spectators to facilitators by helping students solve problems to anchors by enabling students to reflect and link game-acquired skills to reading in other subjects, e.g. Science, Urdu, and Social studies. The researcher believes that there is a potential to study the transformation of teacher roles and the rationale of this transformation in a DGBL environment in future qualitative or mixed-methods studies and its impact on students' and teachers' empowerment.

Ethnographic studies to study the ripples effect on students' life outside schools

This study's findings also indicate that DGBL empowered the EG students by raising their confidence in using digital literacy and reading skills in the real world outside the school. As these unexpected findings emerged from the study, there is a potential to conduct ethnographic studies using ethnographic interviews with the study participants to study the ripple effect (Welborn et al., 2016) of students' DGBL on empowering their families.

Replication of the study in the contexts outside Pakistan

There is a potential to replicate the study in the New Zealand context to study the influence of DGBL on the reading skills of bilingual students. Such a study may also be insightful in exploring the impact of effective digital games on the reading skills of refugees arriving in New Zealand from different parts of the world. There is also potential to design an effective game in the Māori language and study its impact on developing reading skills in the Māori language. The study can also be replicated for other learning areas such as Maths, Science, and History, to name a few. The PEGS tool can be modified by replacing the English reading components with appropriate learning outcomes for a specific subject area. The adapted tool could help find effective digital games that could e used in future subject-specific DGBL studies.

9.7 Concluding Thoughts

The findings of this study have challenged the researcher's understanding of the role of teachers in a DGBL environment. The study findings revealed that pedagogically balanced digital games could be used as stand-alone to teach reading skills to students, independent of their teacher. However, the meta-analysis of the findings enabled the researcher to see the central value of the teacher in designing an environment that results in developing skills more than just reading skills. This implied that teachers are the visioners of their teaching and learning spaces. Appropriately trained and reflective teachers envision the outcomes and design the DGBL environments that empower students by acquiring the skills and attitudes to contribute to society.

The study findings revealed that although teachers struggled to detach from their beliefs of traditional-style teaching based on knowledge transmission, they were prepared to change their beliefs to experiment with the new ways of teaching using digital games. This suggests that teachers became reflective practitioners and were ready to accept new roles in the presence of pedagogically balanced digital games. The study has emphasised that using digital games could be more effective if teachers are empowered in their new roles to enact at different stages of the DGBL.

To implement the findings of this study in the real world, the researcher aims to design professional development sessions to train master trainers in their new roles at each layer of the DGBL environment and conduct action research to evaluate the effectiveness of these training on student learning outcomes and acquisition of 21st century skills. After the completion of the DGBL intervention, the researcher donated fifteen tablets to the main branch of OSC Schools. Now that the schools have the hardware resources, the next step will be to train master trainers who can set examples for others and further expand the training network to train in-service teachers on their campuses. After successful training of teachers and evaluation of the suggested DGBL environment, the training model will be expanded to other schools of similar status, catering to out-of-school children in other parts of the country, with an aim to improve access to quality education using low-cost mobile technologies and pedagogically balanced digital games.

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Appendix A

Email Invitations to Potential Participants (Phase 1)

Dear participant,

I intend to conduct a research project on investigating the impact of digital games in developing early reading skills in a developing country context. This research will contribute towards partial requirement of Ph.D. studies being conducted at University of Waikato, Hamilton, New Zealand.

As a language teacher you are in an ideal position to provide us valuable first-hand information from your own perspective by analysing three digital games on literacy learning against a given rubric.

The game playing and assessment process will take around 20-30 minutes of your time per game. You will also be involved into a collaborative paired assessment later in the study which will take no more than couple of hours on an agreed day and time.

Please see attached the **Participant Information Sheet** and the **Informed Consent.** Be advised to read the participant information clearly to understand the procedures, your role and rights, and commitment in relation to the study. Keep the copy of participant information with you whereas, sign the consent form and return a scanned copy via return email before dd/mm/2019.

Should you have any questions related to the intended study or your role in the intended study, please feel free to contact me through the contact details provided in the participant information sheet.

Looking forward to hearing from you soon.

Best Regards

Farzana Hayat Ahmad
PhD student
Faculty of Education
University of Waikato, Hamilton
New Zealand

Appendix B

PEGS - Game Evaluation Tool

Name of the game: ____

Instructions:

Rate each statement on the scale of 0 to 4, where 0 represents an attribute ‘not at all’ present in the game, and 4 represents an attribute present ‘to the highest degree/level’.

Reading Games Evaluation Tool based on PEGS Framework		
Pedagogical Aspects		Rate on the scale of 0 to 4
1. Learning Outcomes	Game activities are linked to the intended learning outcomes for language learning at the desired grade level.	
2. Learning content	Learning content is embedded in the story/fantasy/game challenge	
3. Prior Knowledge	The game provides opportunities to apply prior knowledge to the game activities.	
4. Assessment and feedback	The game embeds multiple types of assessments and provides opportunities to improve performance based on the feedback.	
5. Progression	a. The game contains the feature of tracking the individual performance of learners.	
	b. The game contains the feature of tracking the performance of the whole class.	
6. Active reading strategies	The game provides opportunities for becoming active participants in learning to read, e.g. learners are actively involved in the process of reading.	

7. Learning by exploring	The game provides opportunities for 'learning by exploring' that results from exploring the game-world, which can be supported by in-game activities that encourage players to observe and analyse the game world (e.g. by including hidden areas or secrets that players are encouraged to find but must use newly-acquired literacy skills to locate or uncover).	
8. Learning by being	The game design provides opportunities for 'learning by being' that results from the exploration of identity and self, such as taking roles in the gaming world.	
9. Learning by building	The game design provides opportunities for 'learning by building' that results from building objects, structures, or tools in the game environment, or by modifying the environment.	
10. Learning by collaborating	The game provides opportunities for 'learning by collaborating' resulting from working with peers to solve problems or accomplish goals.	
11. Learning by expressing	The game provides opportunities for 'learning by expressing' that result from presenting in-game activities or creations to an out-of-game audience (e.g. printing out certificates of achievements or summary of results to share with parents)	
	Sub Total A	
	English Reading Components	Rate on the scale of 0 to 4
12. Phonological awareness	a. Phoneme matching and isolating: The game provides opportunities to practice matching* and isolating** initial, final and medial phonemes in words. **matching sounds in a word (e.g., /k/ is the first sound in kitten, /k/ as first sound in cake, /k/ as first sound in , calendar."* ***Recognising individual sounds in a word (e.g., /p/ is the first sound in pan)*	
	b. Phoneme segmenting and blending: The game provides opportunities to practice segmenting* and blending** phonemes in words. **pausing between sounds (e.g." /f/i/sh/")* ***blending the word while saying it quickly (e.g. "/f/i/sh/, fish")*	
	c. Phoneme manipulating: The game provides opportunities to practice manipulating* phonemes in words. ** adding, deleting, and substituting sound in words (e.g. add /b/ to oat to make boat; delete /p/ in pat to make at; substitute /o/ for /a/ in pat to make pot)*	

13. Word coding/decoding	a. Letter-sound correspondence: The game provides opportunities to practice matching phonemes and digraphs* to letters. **A combination of two letters used to represent a single speech sound, such as gh in tough, ea in meat, ph in phone.*	
	b. Sight words: The game provides opportunities to practice reading high frequency or sight* words. * *commonly used words that young children are encouraged to memorise as a whole by sight, so that they can automatically recognise these words in print without having to use any strategies to decode(e.g. always, around, could, because, there, etc)*	
	c. Syllable patterns: The game provides opportunities to practice blending, segmenting, and identifying syllables in words.	
	d. Morpheme* structures: The game provides opportunities to practice forming compound words and identifying individual words in compound words**, identifying base words with inflections***, and blending base words with affixes and inflections. **The smallest recognised unit of grammar and syntax*. ** *a combination of two or more words that function as a single unit of meaning (e.g., airport, butterfly)* *** *the name for the extra letter or letters added to nouns, verbs and adjectives in their different grammatical forms. Nouns are inflected in the plural (adding /s/ or /es/ at the end), verbs are inflected in the various tenses (e.g. adding /d/ or /ed/, /ing/), and adjectives are inflected in the comparative/superlative (e.g. replacing /y/ in easy by /ily/ to become easily).*	
14. Reading Fluency	a. Letter-sound correspondence: The game provides opportunities to use timed* practices to recognise letter-sounds. **How many letter-sounds are recognised correctly in one minute*	
	b. Words and Phrases: The game provides opportunities to use timed practices* to read words and phrases. ***How many words and phrases are read correctly in one minute*	
	c. Chunked Text: The game provides opportunities to practice reading chunked* text with prosody**. **A decoding strategy for breaking words into manageable parts (e.g. yes/ter/day). It also refers to the process of dividing a sentence into smaller phrases where pauses might occur naturally.* ***Reading with expression using correct stresses, intonation, emphasis and pauses.*	

15 Vocabulary	a. Word knowledge: The game provides opportunities to practice identifying contractions*, synonyms, antonyms, homophones**, and homographs***. **A contraction is a word made by shortening and combining two words. Words like can't (can + not), don't (do + not), and I've (I + have) are all contractions* ***each of two or more words having the same pronunciation but different meanings, origins, or spelling (e.g. new and knew).* ****each of two or more words spelt the same but not necessarily pronounced the same and have different meanings and origins (e.g. bow and bow).*	
	b. word meaning: The game provides opportunities to practice identifying and producing the meaning of words.	
16 Comprehension	a. Narrative text structure: The game provides opportunities to identify story elements such as characters, setting, the sequence of events, problems, solution, plot, and theme.	
	b. Pre-reading strategies: The game provides opportunities to predict some words that might occur in a text by looking at picture/title.	
	c. Text analysis: The game provides opportunities to practice identifying and organising text, such as: • Locate specific factual information to answer short questions; • Predict what follows in the text using context and prior knowledge; • Use context to infer missing words.	
	Sub Total B	
Game Design Aspects		Rate on the scale of 0 to 4
17 Rules	The game rules and goals are clear and organised. It is easy for the player to figure out what to do.	
18 Rewards	The game provides rewards that come in varying forms and degrees of usefulness, such as new tools, increase in points, access to new game spaces or unlocking levels.	
19 Choice	The game provides several options and decisions a player has before, or while playing the game.	

20	Adaptability	The game can be started from any point or any level as needed	
21	Graphics	The graphics are aesthetically appealing for the desired audience and immerse the learners in the experience but do not distract from the learning process.	
22	Interactivity	The game provides the opportunity to interact with the game environment as well as non-player characters (NPC) that can be used to advance the storyline or provide feedback to the player.	
23	Fantasy	The game has an intriguing storyline that provides motivating and exciting gameplay, and cohesion for different levels.	
24	Levels/Flow	The game provides progression through multiple game levels, pitched at appropriate difficulty, and gradually increases in intensity as learners acquire more skills.	
25	Instructions	In-game instructions are provided using a range of media (e.g. audio, text. graphical cues).	
26	Self-Paced Learning	The game activities enable learners to manage their own learning.	
27	Immersion	The game provides an immersive experience to learners where they have to play a role and work with others to deliver mutual goals.	
28	Engagement and Motivation	The game is engaging and motivating and provides longer gameplay periods or repeat-play options with opportunities to achieve complex learning goals.	
29	Navigation	The game is well organised, user friendly and easy to navigate. Students can clearly understand where they are and where to go next.	
30	Developing country context	b. The game is available for a free download.	
		b. The game is available to download for multiple technologies, such as Android tablets/smartphones, iPads/iPhones, and laptops	
		c. The game is free of advertisements	
		d. The game hides any in-game purchase screens so these are not easily accessible to children but can be accessed by parents or teachers who would make a purchase decision	

	e. Free upgrades and technical assistance is provided to game users	
	Sub Total C	
Skills and Knowledge		Rate on the scale of 0 to 4
31 Cognitive skills The game provides opportunities to:	a. recall information that has been learned. (Remembering)	
	b. comprehend the meaning of the information. (Understanding)	
	c. use the information in a new situation. (Apply)	
	d. pull apart the information to examine the details. (Analyse)	
	e. evaluate the worth of the information. (Evaluate)	
	f. use the information to make something new. (Create)	
32 Affective skills The game enables learners to:	a. be open to learning about a new value/attitude/belief, e.g. listening to others with respect; following instructions carefully, etc. (Receive)	
	b. react to a new value/attitude/belief, e.g. reacting to a particular stimuli, learners are motivated, feeling happy or engaged in game activities or reading and responding to the instructions, etc. (Respond)	
	c. recognise that the new value/attitude/belief is worthwhile, e.g. demonstrating problem-solving skill; making informed selections, valuing rewards and motivated to collect more points, etc. (Value)	
	d. value diversity and shows the ability to solve problems, e.g. compare different languages and be able to apply skills acquired in one language to another. (Value)	
	e. relate the new value/attitude/belief to their current values/attitudes/beliefs, e.g. collaborating with others and showing responsible behaviour in collaborative activities, etc. (Organise)	

	f. acquire the new value/attitude/belief making part of their identity, e.g. showing self-reliance when working independently, displaying ethical practice, etc. (Internalise)	
33 Psychomotor skills The game enables learners to:	a. watch someone to perform a skill, e.g. detecting non-verbal communication cues, estimating the game strategies by watching a demonstration, etc. (Observe/Perception)	
	b. copy or imitate the performance of the skill, e.g. displaying readiness to perform the skill or follow the sequence of activities. (Model/set).	
	c. identify the standards that are acceptable in relation to the new skill, e.g. identifying navigation keys or sequences, game controls, or provide step-by-step instructions to follow in order to solve a problem. (Guided Response)	
	d. recognise when performance of the skill is different from the standard and correct the error, e.g. performing certain movements or skills with confidence and proficiency and recognising and correcting if these are not performed according to the game standards. (Recognise standards/Mechanism)	
	e. use the new skill in a new situation, e.g. displaying competence while playing a game, skilful performance of motor acts involving complex movement patterns, etc. (Apply/Complex overt response)	
	f. create new skills and support others to learn the new skill, e.g. creating new movement patterns or finding shortcuts to perform certain game actions transferring skills to others, peer learning, training others to acquire skills, etc. (Coach/Originate)	
	Sub Total D	
	Grand Total of sub-scales:	

Appendix C

Certificate of Appreciation

Technology, Environment, Mathematics, Science (TEMS)
EDUCATION RESEARCH CENTRE

The University of Waikato

Te Kura Toi Tangata Faculty of Education

CERTIFICATE OF PARTICIPATION

is presented to

____

for participating in data collection activities for the research titled:

IMPACT OF DIGITAL GAMES ON EARLY READING SKILLS IN A DEVELOPING COUNTRY CONTEXT

On

____

Farzana Ahmad
Researcher

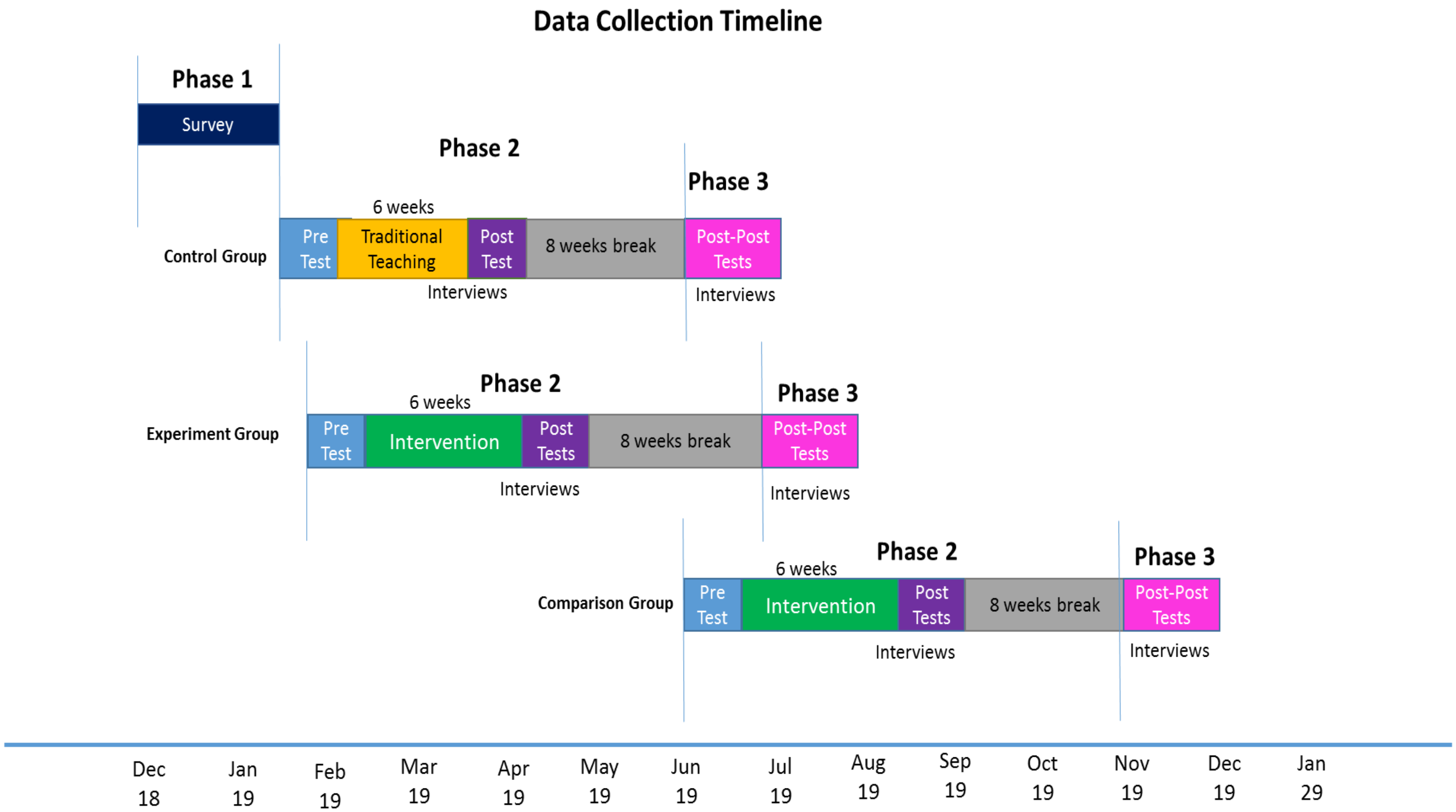
____

Associate Prof. Dr. Wendy Fox-Turnbull
Chief Supervisor

doi.

Appendix D

Data Collection Timeline



Phase 1

Seminar	27 Dec 2018
PEGS Scale	
Paired Review	

Phase 2

	Control Group	Experiment Group	Comparison Group
Pre Tests & Surveys	28 Jan – 12 Feb 2019	19 Feb – 26 Feb 2019	20 Jun – 5 Jul 2019
Pre Intervention testing and training		27 Feb – 1 Mar 2019	1 Jul – 3 Jul 2019
Intervention	Routine reading practice 12 Feb – 22 March (Six weeks)	Digital Game-based Learning 4 Mar – 19 Apr 2019 (Six weeks)	Digital Game-based Learning 8 Jul – 23 Aug 2019 (Six weeks)
Post-tests	25 Mar – 05 Apr 2019	22 Apr – 1 May 2019	26 Aug – 10 Sep
Group Interviews Individual Teacher Interview	01Apr – 05 Apr 2019	22 Apr- 1 May 2019	26 Aug – 10 Sep

Phase 3 (After 10 weeks of completing Phase 2 of the respective groups)

	Control Group	Experiment Group	Comparison Group
Post-Post-Tests	10 Jun – 21 Jun 2019	8 Jul – 19 Jul 2019	18 Nov – 29 Nov
Group Interviews Individual Teacher Interview		8 Jul - 19 Jul 2019	18 Nov – 29 Nov

Appendix E

CVs and Offer letters of Data Collectors

MAHWASH ASAD

H NO. 56/2-D, ST.37, F-6/1, ISLAMABAD
Cell No: [Type your phone number]
Email: [Type your e-mail]

OBJECTIVE:

An experienced, self-motivated and coordinated professional seeking to accept challenges, bring creativity, enthusiasm and support to an established and diverse organization.

EDUCATION:

Ongoing	Masters in Urdu, University of the Punjab
2005	Masters in Excellence of Women Studies, University of Karachi, Pakistan
1998 - 2000	Bachelor of Arts, Margalla College for Women, F-7/4, Islamabad *Major courses: Journalism, Sociology, Arabic*
1996 - 1998	Higher Secondary School Certificate, Margalla College for Women, F-7/4, Islamabad *Courses: Economics, Library & Information Science, Health Education*
1994 - 1996	Secondary School Certificate, Islamabad College for Girls, F-6/2 *Courses: Economics, Civics, Arabic*

PROFESSIONAL QULAIFICATION

2017	Certificate in Montessori Teaching, Pakistan Montessori Council (PMC)
2000 - 2002	B.Ed, Allama Iqbal Open University, Islamabad *Courses: English, Pak-Studies*
2001	Training for Data Entry, COMSATS, Islamabad

EXPERIENCE

Dec 2017 – Jan 2018	**Enumerator** Society for the Protection for the Rights of the Child Project: Learning is Fun • Conducted focus group discussions, with students and teachers

- Conducted in-depth interviews with teachers, head teachers, and other stakeholders
- Carried out classroom observations

Conducted data collation and data entry using Excel

Aug 2016 – Nov 2017 **Teacher Primary School**
F.G. Girls Primary School, Shahpur, Islamabad

- Teaching English, Math, Social Studies to Class 2 to Class 5.
- Preparing class activities using various teaching methods and monitoring students academic performance.
- Organizing parents teachers meetings, school fun fair, extra-curricular activity.
- Keeping the school record properly.
- Classroom management and maintaining discipline.
- Observe and evaluate students' performance, behavior, social development and physical health.

Feb 2016 – May 2016 **Monitoring & evaluation Assistant**
National University of Science and Technology (NUST), Pakistan
<u>Project: Investigating the impact of game based learning using tablets in learning mathematics for primary school students</u>

- Visiting schools and maintaining good communication between the stakeholders
- Facilitating students during learning with hand held devices
- Ensuring compliance with research procedures
- Data collection using survey forms
- Conducted Focus group discussions with students and teachers
- Carried out Classroom observations
- Data entry using Windows and tablets.

24June-10 October 2018
Women Economic and Social Well-Being Survey in Punjab 2017-2018
With collaboration of Three institutes Punjab Bureau of Statistics, Punjab Commission on the Status of Women and Apex Consulting.
Duration 24 June to 10 October 2018.
Strong Grip on Capi Device and Enumeration skill on house hold Interviews.

<u>REFERENCES:</u>

Available upon rest

Offer Letter to Data Collector 1

14 January 2019

Mahwash Ather
House no: 56/2-D
Street 37, F-6/1
Islamabad, Pakistan

Dear Ms. Mahwash Ather
I am pleased to offer you the full-time fixed term position of Research Assistant on the PhD research project titled: Impact of digital games on developing early reading skills in a developing country context conducted by Farzana Ahmad, a doctoral student at the University of Waikato, New Zealand.
The start date of your employment will be **Monday 4 February 2019**. The end date of employment will be **Friday 30 October 2019**. I believe your skills and experience are an excellent match for the project.
In this role, you will be required to conduct data collection using pre-approved data collection tools in the selected Out-of-School Children Schools in Islamabad. You will also be required to facilitate digital game-based learning sessions with students where your role will be to manage handing-over and taking-over of Android tablets and maintenance of tablets including daily charging routine. You will also be required to facilitate classroom observations for the researcher using video conferencing technologies, managing video recording equipment to record classroom observations as well as video interviews between the researcher and the research participants. As part of our duties, you will also be required to enter data in Excel sheets provided to you.
The salary for this role is **Rs. 15000 per month**. You will also be eligible to receive a travel allowance up to **Rs.2500 per month** to facilitate you with daily commute to the selected schools**.**
Your employment with the project will be on at-will basis, which means you and the project researcher are free to terminate the employment relationship at any given time for any reason. However, both the parties must give one-month written notice in advance to terminate the employment agreement.
Please confirm your acceptance of this offer by signing and returning this letter by **Friday, 25 January 2019.**
I will be looking forward to have you join our team. If you have any questions, please feel free to reach out at any time.
Sincerely,
Farzana Hayat Ahmad
Ph.D. Student
School of Education
University of Waikato, Hamilton 3240
New Zealand
Cell: +64 27 610 0675

Your letter of 14 January 2019 is acknowledged, relating to the following offer:

Position:	Research Assistant
Project:	Impact of digital games on developing early reading skills in a developing country context
Tenure	Full-time, Fixed-term
Start Date:	Monday, 4 February 2019
End Date	Friday, 30 October 2019
Hours	37.5 hours per week
Total Remuneration (Including travel allowance)	Rs. 157500 (PKR)

Response to the offer: *Please initial one*

I wish to accept this offer of appointment and the details and conditions contained in your letter. ☐

I decline the offer and /or I am now unavailable to take up this appointment ☐

Signed by: Mahwash Ather

Signed: ______________________________________

Date: ____

For and on behalf of the research project

Name: ____

Signed: _______________________________________

Date: ____

CV of Data Collector 2

MAHWISH SARWAR

FATHER NAME: MUHAMMAD SARWAR
DATE OF BIRTH: FEB 23 ,1990
N IC #: 61101-1856778-4
DOMICILE: FEDERAL (ICT)
MARITAL STATUS: SINGLE
NATIONALITY: PAKISTANI
RELIGION: ISLAM

House:377,street:27 ,sector g-14/4 islamabad.
mahchaudhry008@gmail.com

0321-5895334

Objective

Seeking a job in dynamic organization where I can boost up my professional skills and technical knowledge acquired during my educational experience and do

1. Experience

- **GSIS school h-8 islamabad.**

(oct 2017 – july 2018) Working experience as an art teacher ..

- **roots millenuim school d-18 echs iSB.**

  (April 2016 -Oct 2017)

  Working experience as an art teacher.

- DAWN MODEL SCHOOL I-10 MARKAZ ISB.

  (Feb 2012-March 2013)

  Working Experience of One year as a teacher.

- NIMBUS PUBLIC SCHOOL I-10/2 ISB.

  Working Experience of One year as a art teacher.

- PIZZA HUT F-7 MARKAZ ISB.

(June 2011 -July 2011)

Working experience for a week as an art instructor SUMMER CAMP

- OVEX TECHNOLOGIES,I-9/3 ,ISB

  (Feb 2014 – April 2015)

  Working as CRO (wi-tribe project)

- IBEX HOUSE ,I-9/3 ,ISB

  (May 2013 – Feb 2014)

  Working experience at TWENTY (4) SEVEN as CSR as best as I can do for the organization.

Skills

➢ Excellent in MS Word, Excel and PowerPoint.

➢ Good in ENGLISH and URDU.

2. Education

➢ **Sarhad University Peshawar (MA EDU) ,(2017- 2019)**

NATIONAL TEXTILE INSTITUTE ISLAMABAD.(SARHAD UNIVERSITY)

➢ **Sarhad University Peshawar (B.ED) ,(2016-2017)**
NATIONAL TEXTILE INSTITUTE ,ISLAMABAD .(SARHAD UNIVERSITY)

➢ **University Of The Punjab (B.A) ,(2013)**
PU,LAHORE. (F.G COLLEGE, F-7/2, ISB)

➢ **Higher Secondary School certificate (HSSC), (2007-2009)**
FBISE, ISLAMABAD. (F.G COLLEGE ,F-7/2, ISB

➢ **Secondary School certificate (SSC), (2005-2007)**
FBISE, ISLAMABAD. (I.M.C.G ,F-10/2 , ISB)

3. exTRA CURRICULAR ACTIVITIES

➢ Participant of 17 intra board science poster competition 2008

➢ Participant of poster painting competition, 2009 in the memory of Mohtarma Benazir Bhutto.

➢ Member of dramatics F. G College F-7/2, Islamabad.

➢ Participant in Twin City Inter University Challenge 2011

➢ Participant of painting competition held in Fatima Jinnah University, theme: “every mother counts”

➢ Member I.M.C.G college’s sports association.

➢ Participant of AIDS poster competition RWP Arts Council 2006-07

Offer Letter to Data Collector 2

14 January 2019

Mahwash Sarwar

House No: 377,
Street No: 27,
G-14/4
Islamabad, Pakistan

Dear Ms. Mahwash Sarwar

I am pleased to offer you the full-time fixed term position of Research Assistant on the PhD research project titled: Impact of digital games on developing early reading skills in a developing country context conducted by Farzana Ahmad, a doctoral student at the University of Waikato, New Zealand.

The start date of your employment will be **Monday 4 February 2019**. The end date of employment will be **Friday 30 October 2019**. I believe your skills and experience are an excellent match for the project.

In this role, you will be required to conduct data collection using pre-approved data collection tools in the selected Out-of-School Children Schools in Islamabad. You will also be required to facilitate digital game-based learning sessions with students where your role will be to manage handing-over and taking-over of Android tablets and maintenance of tablets including daily charging routine. You will also be required to facilitate classroom observations for the researcher using video conferencing technologies, managing video recording equipment to record classroom observations as well as video interviews between the researcher and the research participants. As part of our duties, you will also be required to enter data in Excel sheets provided to you.

The salary for this role is **Rs. 15000 per month**. You will also be eligible to receive a travel allowance up to **Rs.2500 per month** to facilitate you with daily commute to the selected schools**.**

Your employment with the project will be on at-will basis, which means you and the project researcher are free to terminate the employment relationship at any given time for any reason. However, both the parties must give one-month written notice in advance to terminate the employment agreement.

Please confirm your acceptance of this offer by signing and returning this letter by **Friday, 25 January 2019.**

I will be looking forward to have you join our team. If you have any questions, please feel free to reach out at any time.

Sincerely,
Farzana Hayat Ahmad
Ph.D. Student
School of Education
University of Waikato, Hamilton 3240
New Zealand
Cell: +64 27 610 0675

Your letter of 14 January 2019 is acknowledged, relating to the following offer:

Position:	Research Assistant

Project:	Impact of digital games on developing early reading skills in a developing country context
Tenure	Full-time, Fixed-term
Start Date:	Monday, 4 February 2019
End Date	Friday, 30 October 2019
Hours	37.5 hours per week
Total Remuneration (Including travel allowance)	Rs. 157500 (PKR)

Response to the offer: *Please initial one*

I wish to accept this offer of appointment and the details and conditions contained in your letter. ☐

I decline the offer and /or I am now unavailable to take up this appointment ☐

Signed by: Mahwish Sarwar

Signed: ______________________________________

Date: ____

For and on behalf of the research project

Name: ____

Signed: _______________________________________

Date: ____

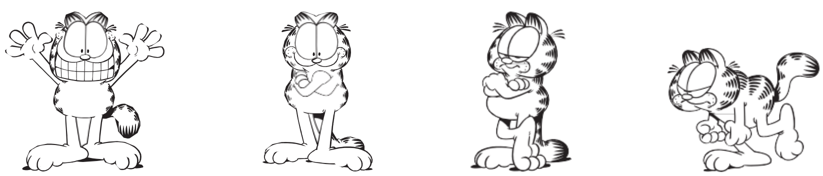
Appendix F

Elementary Reading Attitude Survey

School:___________________________Grade:______________Name: ______________________________

Directions: Please circle the picture that describes how you feel when you read a book.

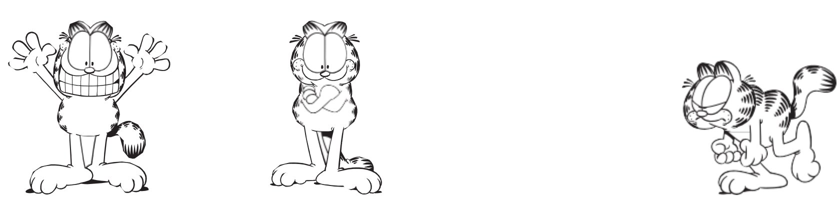
1. How do you feel when you read a book on a rainy Saturday?



2. How do you feel when you read a book in school during free time?

3. How do you feel about reading for fun at home?

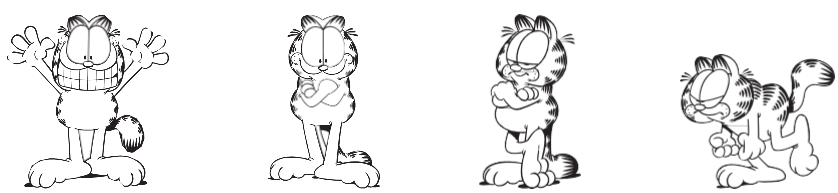
4. How do you feel about getting a book for a present?



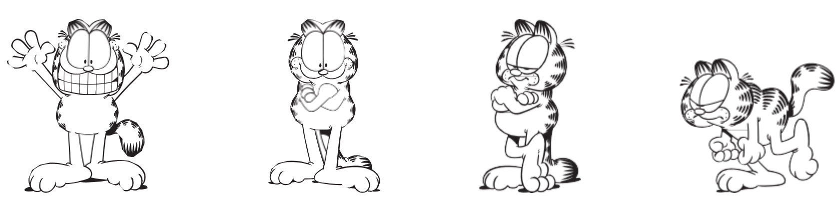
5. How do you feel about spending free time reading a book?

6. How do you feel about starting a new book?

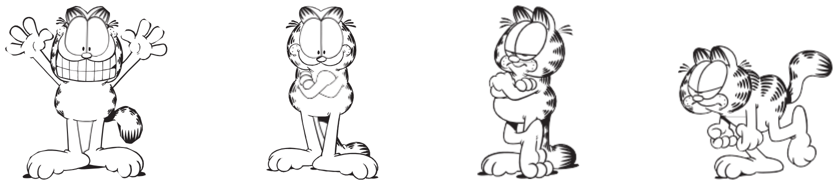
7. How do you feel about reading during summer vacation?



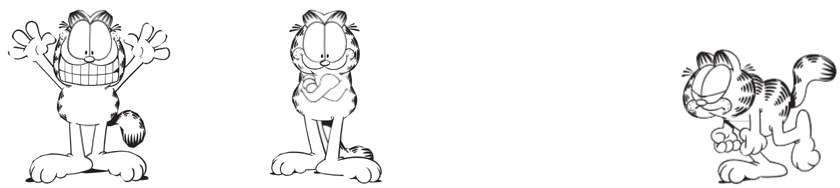
8. How do you feel about reading instead of playing?



9. How do you feel about going to a bookstore?



10. How do you feel about reading different kinds of books?



11. How do you feel when a teacher asks you questions about what you read?

12. How do you feel about reading workbook pages and worksheets?

13. How do you feel about reading in school?

14. How do you feel about reading your school books?

15. How do you feel about learning from a book?

16. How do you feel when it's time for reading in class?

17. How do you feel about stories you read in reading class?

18. How do you feel when you read out loud in class?

19. How do you feel about using a dictionary?

20. How do you feel about taking a reading test?

Urdu Translation of Elementary Reading Attitude Survey

Name: _______________________________ Grade:

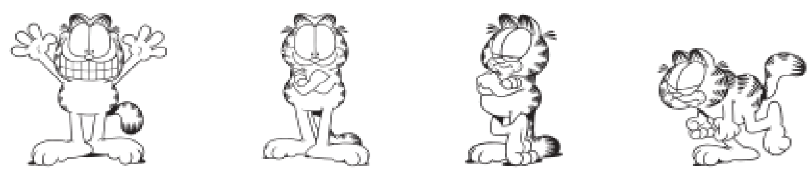
School: Date:

Group: Control / Experiment / Comparison

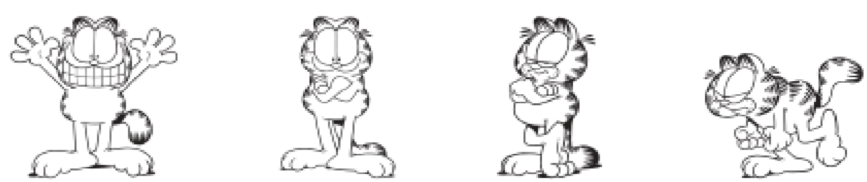
ہدایات:

برائے مہربانی اس تصویر پر دائرہ لگائیں جو کتاب پڑھتے وقت آپ کے احساسات کی صحیح عکاسی کرئے۔ ان سوالوں کا کوئ صحیح یا غلط جواب نہیں ہے۔ اس لیے اپنے احساسات کے مطابق جواب دیں۔

1. چھٹّی یا بارش والے دن آپ کو کتاب پڑھتے ہوئے کیسا لگتا ہے؟

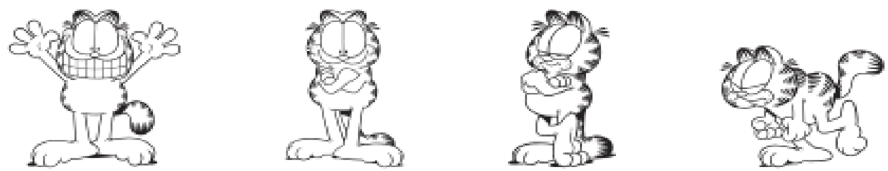


2. سکول میں فارغ اوقات میں آپکو کتاب پڑھنا کیسا لگتا ہے؟

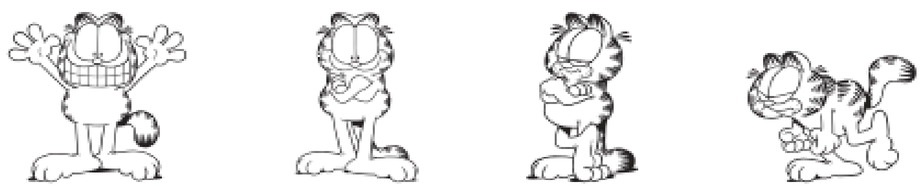


3. تفریح کے طور پر گھر میں پڑھنا آپکو کیسا لگتا ہے؟

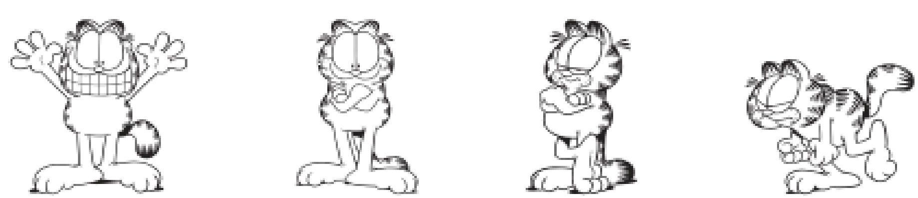
4. تحفہ میں کتاب ملنے پر آپ کیسا محسوس کرتے ہیں؟



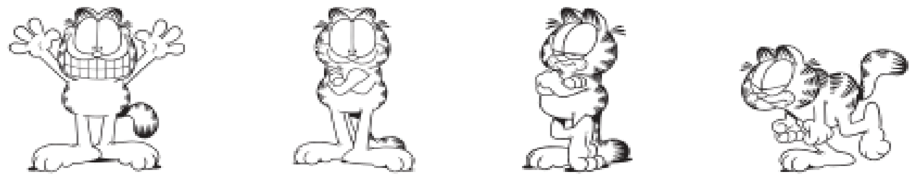
5. فارغ اوقات میں کتاب پڑھنے پر آپ کیسا محسوس کرتے ہیں؟



6. ایک نئی کتاب شروع کرنے کے بارے میں آپ کیسا محسوس کرتے ہیں؟

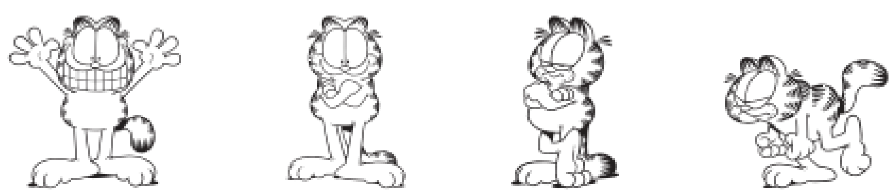


7. گرمیوں کی چھٹیوں کے دوران پڑھنا کیسا لگتا ہے؟

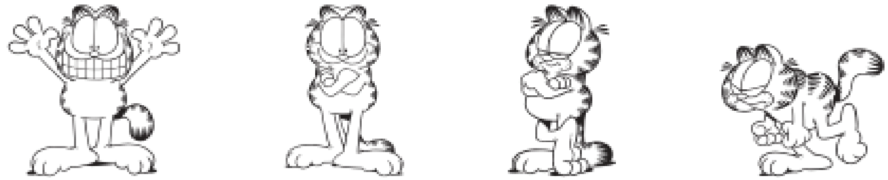


8. کھیلنے کے بجائے پڑھنے میں کیسا محسوس کرتے ہیں؟

9. کتابوں والی دوکان پر جانا کیسا لگتا ہے؟

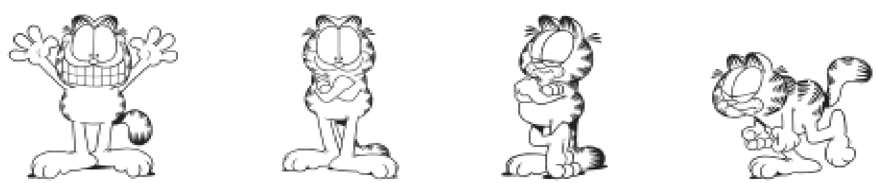


10. مختلف اقسام کی کتابیں پڑھنا کیسا لگتا یہ؟



11. جو آپ پڑھ رہے ہوں، اس کے بارے میں ٹیچر سوال کریں تو کیسا لگتا ہے؟

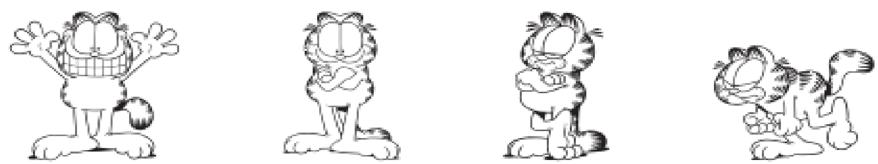
12. ورک بک پیجز یا ورک شیٹ پڑھنا کیسا لگتا ہے؟



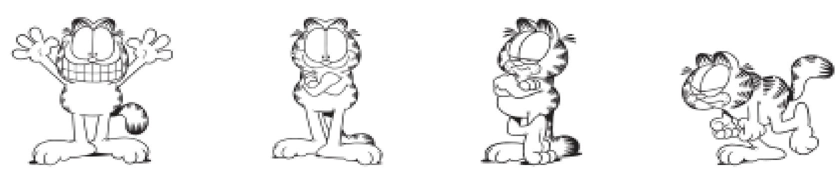
13. سکول میں ریڈنگ کرنا کیسا لگتا ہے؟

14. سکول کی کتابیں پڑھنا کیسا لگتا ہے؟

15. کتاب سے پڑھ کر کچھ سیکھنا کیسا لگتا ہے؟



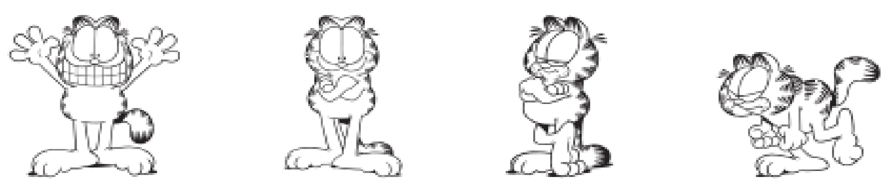
16. کلاس می ریڈنگ ٹائم میں کیا محسوس کرتے ہیں؟



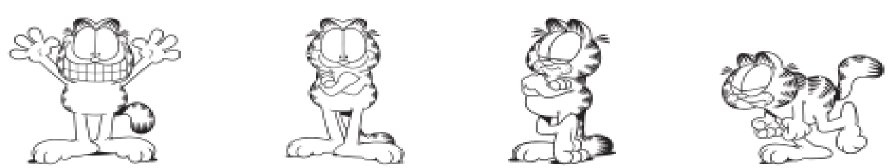
17. کلاس میں کہانیاں پڑھنا کیسا لگتا ہے؟

18. کلاس میں اونچی آواز میں سبق سناتے ہوئے کیسا محسوس کرتے ہیں؟

19. آپ ڈکشنری استعمال کرتے ہوئے کیسا محسوس کرتے ہیں؟



20. ریڈنگ ٹیسٹ کے دوران آپ کیسا محسوس کرتے ہیں؟



Elementary Reading Attitude Survey Scoring Sheet

Student's name: ______________________________

Teacher: ______________________________

Grade: ______________ Administration Date: ______________

Scoring Guide

4 points Happiest Garfield Slightly

3 points smiling Garfield Mildly

2 points upset Garfield

Recreational Reading		Academic Reading	
1.	________	1.	________
2.	________	2.	________
3.	________	3.	________
4.	________	4.	________
5.	________	5.	________
6.	________	6.	________
7.	________	7.	________
8.	________	8.	________
9.	________	9.	________
10.	________	10.	________
Raw Score:	________	Raw Score:	________

Full-Scale Raw Score .... (Recreational+ Academic): ________

Percentile Ranks: .... Recreational:

.... Academic:

.... Full Scale:

Appendix G

Early Grade Reading Assessment (EGRA) Tool English

General Instructions

It is important to establish a relaxed attitude through some simple initial conversation of interest to the child. The child should perceive the assessment more as a game than a formal assessment. After you have finished, thank the child and give him/her a pencil as a token of appreciation.

Verbal Consent

Read the text in the box to the child:

Read the text in the box to the child: **My name is _________. I'm working with the Department of Education.**

- We are trying to understand how children learn to read. You were picked by chance, like in a raffle or lottery.
- We would like your help in this. But, you do not have to take part if you don't want to.
- I'm going to ask you to sound out letters, and read words and a short story out loud, and then may ask you a few questions about the story you read.
- Using this stopwatch, I will see how long it takes you to do these things.
- This is NOT a test and it will not affect your grade at school.
- I will NOT write down your name so no one will know that these are your answers.
- Once again, you do not have to participate if you do not wish to. Also, once we begin, if you'd rather not answer a question, that's all right.
- Can we get started?

Tick box if verbal consent is obtained: ☐ ***YES***

(If verbal consent is not obtained, thank the child and move on to the next child)

A. Date of Assessment:		**B. Student's Gender**	**girl**	**boy**
C. Age		**D. School name**		
E. Assessor's name		**F. Assessor's contact number**		

1. **Letter Sound (LS)**
   Show the learner the chart of letters (Chart 1).

Here is a page full of letters. I would like you to sound as many letters as you can. You will start here and move across the page. (Point to the leftmost letter on the top row of the exercise, moving from left to right.) **When I say, 'Begin', you will sound the letters as best you can. Point to each letter as you sound it. If you don't know the sound of a letter, just skip it.**

Let's practice first. (Point to the first example letter, moving from left to right, to practice the instructions given above.)

Ok, now we're ready to begin. Put your finger on the first letter. Ready? Begin.

- **Start the timer when the child reads the first word.**
- Follow along with your pencil and clearly mark any incorrect words with a slash (/).
- Count self-corrections as correct.
- Stay quiet, except when providing answers as follows: if the child hesitates for 3 seconds, provide the word, point to the next word and say **"Please go on."** Mark the word you provide to the child as incorrect.
- **WHEN THE TIMER REACHES 0, SAY, "Stop." Mark the final word read with a bracket ( ]).** If the learner finished in less than 60 seconds, enter the remaining time.
- **Early stop rule:** If the child gives no correct answers on the first line, say **"Thank you!",** discontinue this exercise, draw the line through the words in the first row, check the box at the bottom of the page, and go on to the next exercise

LETTER SOUNDS, CHART 1

V	I	h	g	S	y	Z	W	L	N	/10
I	K	T	D	K	T	q	d	z	w	/20
h	w	z	m	U	r	j	G	X	u	/30
g	R	B	Q	I	f	ı	Z	s	r	/40
S	n	C	B	p	Y	F	c	a	E	/50

y	s	Q	P	M	v	O	t	n	P	/60
Z	A	e	x	f	F	h	u	A	t	/70
W	G	H	b	S	i	g	m	i	I	/80
L	L	o	o	X	N	E	Y	p	x	/90
N	k	c	D	d	y	b	j	R	v	/100
V	M	W	q	V	L	h	g	S	y	/110

Total number of words read correctly:	/110
If time remains on stopwatch at completion, record it here (# seconds):	
Tick this box if the exercise was discontinued:	

2. Nonsense Word Decoding (NWD)

Show the learner the chart of nonsense words (Chart 2)

Here are some made-up words. I would like you to read me as many made-up words as you can (do not spell the words, but read them). For example, this made-up word is: "ut".

1. Now you try: [point to the next word: "dif ' and say] please read this word
   [If correct]: "Very good: dif"
   [If incorrect]: This made-up word is "dif."
2. Now try another one: [point to the next word: mab and say] please read this word.
   [If correct]: "Very good: mab"
   [If incorrect]: This made-up word is "mab."

Do you understand what you are supposed to do? When I say "begin," read the words as best as you can. I will keep quiet and listen to you, unless you need help.

Ready? Begin.

- **Start the timer when the child reads the first word.**
- Follow along with your pencil and clearly mark any incorrect words with a slash (/).
- Count self-corrections as correct.
- Stay quiet, except when providing answers as follows: if the child hesitates for 3 seconds, provide the word, point to the next word and say **"Please go on."** Mark the word you provide to the child as incorrect.
- **WHEN THE TIMER REACHES 0, SAY, "Stop." Mark the final word read with a bracket ( ]).** If the learner finished in less than 60 seconds, enter the remaining time.
- **Early stop rule:** If the child gives no correct answers on the first line, say **"Thank you!",** discontinue this exercise, draw the line through the words in the first row, check the box at the bottom of the page, and go on to the next exercise.

Nonsense Words, Chart 2

loz	ep	yat	zam	tob	/5
zom	ras	mon	jaf	duz	/10
tam	af	ked	ig	el	/15
tig	pek	dop	zac	ik	/20
uf	ral	ep	bab	vif	/25
lut	sig	zop	zar	jaf	/30
ruz	huf	wab	ak	jep	/35
wub	dod	ik	vus	nux	/40
pek	zel	bef	wab	hiz	/45
wof	ib	dek	zek	vok	/50

Total number of words read correctly:	/50
If time remains on stopwatch at completion, record it here (# seconds):	
Tick this box if the exercise was discontinued:	

3. **Familiar Word Reading (WR)**

Show the learner the chart of words (Chart 3)

Here is a page full of words. I would like you to read aloud as many words as you can. You will start here and move across the page. (Point to the leftmost word on the top row of the exercise, moving from left to right.) **When I say, 'Begin', you will read the words as best you can. Point to each word as you read it. If you don't know a word, skip it.**

Let's practice first. (Point to the first example word to practice the instructions given above.)
Ok, now we're ready to begin. Put your finger on the first word. Ready? Begin.

- **Start the timer when the child reads the first word.**
- Follow along with your pencil and clearly mark any incorrect words with a slash (/).
- Count self-corrections as correct.
- Stay quiet, except when providing answers as follows: if the child hesitates for 3 seconds, provide the word, point to the next word and say **"Please go on."** Mark the word you provide to the child as incorrect.
- **WHEN THE TIMER REACHES 0, SAY, "Stop." Mark the final word read with a bracket ( ]).** If the learner finished in less than 60 seconds, enter the remaining time.
- **Early stop rule:** If the child gives no correct answers on the first line, say **"Thank you!",** discontinue this exercise, draw the line through the words in the first row, check the box at the bottom of the page, and go on to the next exercise.

Familiar Words, Chart 3

back	came	but	Look	Went	/5
what	did	be	got	Me	/10
eat	do	like	there	little	/15
with	had	are	your	make	/20
put	he	see	it	the	/25
all	here	no	from	tree	/30
out	an	come	will	time	/35
my	you	too	cat	she	/40
have	some	away	down	a	/45
them	we	in	that	they	/50

Total number of words read correctly:	/50
If time remains on stopwatch at completion, record it here (# seconds):	
Tick this box if the exercise was discontinued:	

4.

5. Passage Reading (PR)

Show the learner the passage chart (Chart 4).

Now I'm going to ask you to read this story out loud. If you get stuck, skip the word and keep on reading. When I say, 'Stop', stop reading the story. I will next ask you some questions about what you have just read – so try to remember the story you're reading. You will start here. (Point to the first word of the passage.)

Ready? Begin.

- **Start the timer when the child reads the first word.**
- Follow along with your pencil and clearly mark any incorrect words with a slash (/).
- Count self-corrections as correct.
- Stay quiet, except when providing answers as follows: if the child hesitates for 3 seconds, provide the word, point to the next word and say **"Please go on."** Mark the word you provide to the child as incorrect.
- **WHEN THE TIMER REACHES 0, SAY, "Stop." Mark the final word read with a bracket ( ]).** If the learner finished in less than 60 seconds, enter the remaining time.
- **Early stop rule:** If the child gives no correct answers on the first line, say **"Thank you!",** discontinue this exercise, draw the line through the words in the first row, check the box at the bottom of the page, and go on to the next exercise.

Passage Reading, Chart 4

Hamza had a dog. (Q1) The dog was fat and happy. (Q2)	/10
One day Hamza and the dog went out to play.	/20
The little dog ran away and got lost. Hamza was sad Q3 but after a while, the	/36
dog came back. Hamza took the dog home. When they got inside the house,	/50
Hamza gave the dog a bone. The little dog was tired, so he slept. Q4 When	/65
the dog woke up, Hamza took the dog outside to play. Q5	/76

Total number of words read correctly:	/ 76
If time remains on stopwatch at completion, record it here (# seconds):	
Tick this box if the exercise was discontinued:	

4**. Comprehension Questions**

Now I am going to ask you few questions about the story you have just read. Try to answer the questions as best as you can.

- If the child read only part of the story, only ask the questions related to the part that s/he has read. Enter a dash (--) in the boxes for questions not covered.
- Enter a ✓ for each question answered correctly.
- Leave a blank for each question answered incorrectly.
- If the learner corrects him/herself, accept the answer as correct.
- Count and record the number of questions that the learner answered correctly at the bottom of the exercise.

Questions	Answer	Correct
1. Who had a dog?	Hamza	
2. Was the dog thin or fat?	fat	
3. Why was Hamza sad?	The dog ran away/ the dog got lost	
4. What did the dog do after he got the bone?	He ate it; he slept	
5. Did the story have a happy ending? Why?	Yes: the dog came back; they went home together; the dog got a bone; he slept; they played again	
	Total number of questions answered correctly:	/5

End of assessment. Make sure you have properly recorded all information on each page of the assessment before letting the child go. Once everything is properly recorded and complete, thank the child and give him/her a pencil as a token of appreciation.

Appendix H

Early Grade Reading Assessment (EGRA) Urdu

General Instructions

It is important to establish a relaxed attitude through some simple initial conversation of interest to the child. The child should perceive the assessment more as a game than a formal assessment. After you have finished, thank the child and give him/her a pencil as a token of appreciation.

Verbal Consent

Read the text in the box to the child:

Read the text in the box to the child: **My name is _________. I'm working with the Department of Education.**

- We are trying to understand how children learn to read. You were picked by chance, like in a raffle or lottery.
- We would like your help in this. But, you do not have to take part if you don't want to.
- I'm going to ask you to sound out letters, and read words and a short story out loud, and then may ask you a few questions about the story you read.
- Using this stopwatch, I will see how long it takes you to do these things.
- This is NOT a test and it will not affect your grade at school.
- I will NOT write down your name so no one will know that these are your answers.
- Once again, you do not have to participate if you do not wish to. Also, once we begin, if you'd rather not answer a question, that's all right.
- Can we get started?

Tick box if verbal consent is obtained: ☐ ***YES***

(If verbal consent is not obtained, thank the child and move on to the next child)

A. Date of Assessment:		**B. Student's Gender**	**girl**	**boy**
C. Age		**D. School name**		
E. Assessor's name		**F. Assessor's contact number**		

1. Letter Sound (LS)

Show the learner the chart of letters (Chart 1).

LETTER SOUNDS, CHART 1

Examples: د ف

ب	د	ج	چ	ت	ش	ث	خ	ا	ٹ	/10
ص	ط	ف	ب	ک	ن	ل	م	و	ہ	/20
ح	ج	ل	د	ڈ	ر	ڑ	ز	ڈ	ل	/30
و	ف	ق	ز	د	ض	غ	س	ص	ٹ	/40
پ	چ	ہ	ز	ط	د	ل	م	ن	ا	/50
ت	ز	ژ	ص	ن	ہ	و	ی	ڑ	ج	/60
د	ذ	س	ن	ش	ب	ث	ل	م	ر	/70
ب	ج	خ	ف	ن	ل	ر	ڑ	ژ	د	/80
ج	ذ	ڈ	ا	آ	ب	ص	ش	و	ق	/90
م	ن	ٹ	ث	ت	و	ح	خ	ج	س	/100

Total number of words read correctly:	/100
If time remains on stopwatch at completion, record it here (# seconds):	
Tick this box if the exercise was discontinued:	

2. Nonsense Word Decoding (NWD)

Show the learner the chart of nonsense words (Chart 2)

Here are some made-up words. I would like you to read me as many made-up words as you can (do not spell the words, but read them). For example, this made-up word is: "ut".

1. Now you try: [point to the next word: "dif ' and say] please read this word
   [If correct]: "Very good: dif"
   [If incorrect]: This made-up word is "dif."
2. Now try another one: [point to the next word: mab and say] please read this word.
   [If correct]: "Very good: mab"
   [If incorrect]: This made-up word is "mab."

Do you understand what you are supposed to do? When I say "begin," read the words as best as you can. I will keep quiet and listen to you, unless you need help.

Ready? Begin.

- **Start the timer when the child reads the first word.**
- Follow along with your pencil and clearly mark any incorrect words with a slash (/).
- Count self-corrections as correct.
- Stay quiet, except when providing answers as follows: if the child hesitates for 3 seconds, provide the word, point to the next word and say **"Please go on."** Mark the word you provide to the child as incorrect.
- **WHEN THE TIMER REACHES 0, SAY, "Stop." Mark the final word read with a bracket ( ]).** If the learner finished in less than 60 seconds, enter the remaining time.
- **Early stop rule:** If the child gives no correct answers on the first line, say **"Thank you!",** discontinue this exercise, draw the line through the words in the first row, check the box at the bottom of the page, and go on to the next exercise.

Nonsense Words, Chart 2

ات	را	جا	چا	ڈ	/5
جت	پت	اخ	طر	نل	/10
ٹرم	جر	سی	شی	ٹا	/15
جلم	گلم	سنل	لر	مش	/20
فطر	بوم	جر	لوش	نژ	/25
چٹ	مخ	قل	پچ	فج	/30
بن	پاڑ	خات	جاڑ	رال	/35
طرم	غام	لاط	نار	شوب	/40
چالا	جوفا	لالی	سارم	پارا	/45
بھاسی	پھالا	چھور	ٹونا	موچا	/50

Total number of words read correctly:	/50
If time remains on stopwatch at completion, record it here (# seconds):	
Tick this box if the exercise was discontinued:	

3. Familiar Word Reading (WR)

Show the learner the chart of words (Chart 3)

Here is a page full of words. I would like you to read aloud as many words as you can. You will start here and move across the page. (Point to the leftmost word on the top row of the exercise, moving from left to right.) **When I say, 'Begin', you will read the words as best you can. Point to each word as you read it. If you don't know a word, skip it.**

Let's practice first. (Point to the first example word to practice the instructions given above.)
Ok, now we're ready to begin. Put your finger on the first word. Ready? Begin.

- **Start the timer when the child reads the first word.**
- Follow along with your pencil and clearly mark any incorrect words with a slash (/).
- Count self-corrections as correct.
- Stay quiet, except when providing answers as follows: if the child hesitates for 3 seconds, provide the word, point to the next word and say **"Please go on."** Mark the word you provide to the child as incorrect.
- **WHEN THE TIMER REACHES 0, SAY, "Stop." Mark the final word read with a bracket ( ]).** If the learner finished in less than 60 seconds, enter the remaining time.
- **Early stop rule:** If the child gives no correct answers on the first line, say **"Thank you!",** discontinue this exercise, draw the line through the words in the first row, check the box at the bottom of the page, and go on to the next exercise.

Familiar Words, Chart 3

Examples: pot bell

جوان	سلوک	سیدھی	ستارہ	سہارا	/5
مقام	پیام	صادق	مشکلوں	نظام	/10
امین	یتیم	موقع	منظور	قرارداد	/15
امتحان	انتقال	پگھلتی	خوامخواہ	پریشان	/20
کیچڑ	مکالمہ	خوشامد	باریک	اندھیرا	/25
کلہاڑی	پیغمبر	نقصان	حفاظت	طبیعت	/30
مخلوق	نصیحت	اخلاق	مصیبت	بہترین	/35
تفریح	جھاڑیاں	کوہسار	ہونہار	دوکاندار	/40
صحیح	سحر	صبح	دانت	درخت	/45
پودا	پڑھتی	حقیقت	تکلیف	عورت	/50

Total number of words read correctly:	/50
If time remains on stopwatch at completion, record it here (# seconds):	
Tick this box if the exercise was discontinued:	

4. Passage Reading (PR)

Show the learner the passage chart (Chart 4).

Now I'm going to ask you to read this story out loud. If you get stuck, skip the word and keep on reading. When I say, 'Stop', stop reading the story. I will next ask you some questions about what you have just read – so try to remember the story you're reading. You will start here. (Point to the first word of the passage.)

Ready? Begin.

- **Start the timer when the child reads the first word.**
- Follow along with your pencil and clearly mark any incorrect words with a slash (/).
- Count self-corrections as correct.
- Stay quiet, except when providing answers as follows: if the child hesitates for 3 seconds, provide the word, point to the next word and say **"Please go on."** Mark the word you provide to the child as incorrect.
- **WHEN THE TIMER REACHES 0, SAY, "Stop." Mark the final word read with a bracket ( ]).** If the learner finished in less than 60 seconds, enter the remaining time.
- **Early stop rule:** If the child gives no correct answers on the first line, say **"Thank you!",** discontinue this exercise, draw the line through the words in the first row, check the box at the bottom of the page, and go on to the next exercise.

Passage Reading, Chart 4

Q1	مکڑا: اے مکھّی! تمہارا کیا حال ہے؟	/7
Q2	مکھّی: " ٹھیک ہوں"۔	10
	مکڑا: تم روز یہاں سے گزرتی ہو لیکن میرے گھر کبھی نہیں آئی۔	23
Q3	اگر میرے گھر آؤ گی تو یہ میرے لیے عزت کی بات ہو گی۔	/37
	مکھّی: سنا ہے تمہارے گھر جو بھی گیا پھر واپس نہیں آیا۔	/49
	میں تو نہیں آؤں گی۔ مکڑا: نہیں، ایسی بات نہیں۔	/59
Q5	میں تو مہمانوں کی بہت عزت کرتا ہوں۔	/67

Total number of words read correctly:	/ 67
If time remains on stopwatch at completion, record it here (# seconds):	

Tick this box if the exercise was discontinued:

4**. Comprehension Questions**

Now I am going to ask you few questions about the story you have just read. Try to answer the questions as best as you can.

- If the child read only part of the story, only ask the questions related to the part that s/he has read. Enter a dash (--) in the boxes for questions not covered.
- Enter a for each question answered correctly.
- Leave a blank for each question answered incorrectly.
- If the learner corrects him/herself, accept the answer as correct.
- Count and record the number of questions that the learner answered correctly at the bottom of the exercise.

جواب	**سوال**	**Correct**
مکّھی کا	سوال ۱ ۔ مکڑا کس کا حال پوچھ رہا تھا؟	
ٹھیک ہوں	سوال ۲- مکّی نے حال پوچھنے پر کیا کہا؟	
عزت کی	مکڑی کے لیے مکّھی کا اسکے گھر -سوال ۳ آنا کیسی بات تھی؟	
جو گیا وہ واپس نہ آیا	مکّی نے مکھڑی کے گھر آنے سے کیا -سوال ۴ کہ کر منع کیا؟	
مہمانوں کی	سوال ۵- مکڑا کس کی عزت کرتا ہے؟	
	Total number of questions answered correctly:	/5

End of assessment. Make sure you have properly recorded all information on each page of the assessment before letting the child go. Once everything is properly recorded and complete, thank the child and give him/her a pencil as a token of appreciation.

Appendix I

Interview Schedule Phase 2 (Teachers)

Name of the Teacher: _________________________ Role: __________________________

School: __________ Contact no: ____________________________ Date: _____________

Part A: Training

1. How many years of teaching experience you have
2. How long have you been working in OSCS schools?
3. What is your highest Qualification?
4. Have you attended any pre-service teacher training? Yes No
5. If yes, then list the name of trainings received:
6. Have you received any in-service training? Yes No

If yes, then list the name of trainings received:

Part B: Pedagogical practices for reading development

Purpose: The aim is to gather data about current pedagogies adopted for reading development.

1. How do you teach reading skills to students?
   Prompts: What activities do you involve students in reading?
2. Are you familiar with essential components of reading?
   Prompts: Have you received any training in teaching reading skills? How do you know which techniques work best for developing reading skills?
3. How often you involve students in reading activities during a week?
4. What type of reading materials do you provide students to read?
5. What is your target to achieve in reading?
6. How do you know that you have /have not achieved your target?

Part C: Learning through Games

Purpose: The focus of this section is to get insights into the use of digital games for developing reading skills. Also to find teachers' perception on using DGBL as a teaching and learning tool.

1. For past six weeks, your students were involved in digital game-based learning where they were playing a game to improve reading skills. How do you describe t his experience for students and for yourself as a teacher?
2. What benefits students have gained through DGBL?
3. What benefits have you seen for yourself as a teacher from them playing digital games?
4. What were the drawbacks of DGBL?
5. How these drawbacks could be addressed/improved?
6. Do you play digital games? Or do you have interest in playing digital games?
   Prompts: What type of games do you play? How much time in a week do you spend in playing games?
7. Do you think digital games can be used as a tool for teaching to improve reading skills? Please, explain with examples.

8. In your opinion, what are the most desirable characteristics of digital games that makes them a good tool for teaching and learning?
9. Do think students can learn a second language, such as English, through digital games? Please explain your response with examples.
10. What should be the desirable characteristics of a digital game to learn a second language?
11. In your opinion, do you thinks students have improved their reading skills?
    Please explain with examples.
    Prompts: What areas of reading components have they improved, e.g. phonological awareness, decoding or vocabulary, oral reading fluency, comprehension, etc.
12. After playing digital games, do you think students are now able to apply skills to read other languages such as Urdu or Arabic? Please, explain with examples.
13. Is it possible to teach Urdu or Arabic through digital games? Please elaborate your answer.
14. Can you teach Urdu using the similar techniques as English? How?/ Please elaborate your response with examples.

Part D: Desirable characters of games

Concept Building through Games

1. What are the most desirable characteristics in games that make them useful as a teaching and learning tool?
   Prompts: videos, animations, instructions, rewards, interactive activities, feedback, etc.
2. Do you think learning through games help building the concepts of students about the topic under study? Yes No
   Prompts: If yes, please explain which elements in the game helped concept building (such as videos, animations, narration, Instructions, etc)
3. What is your opinion on using bilingual instructions on improving students understanding? Do you think using bilingual instructions would help improving students' English language vocabulary?

Part E: Attitude

1. What is the impact of digital games on students' attitude?
   Prompt: Are they more regular in attending to school now? Do they feel more motivated in learning? Have they become more responsible individuals, etc.
2. Have you noticed a change in students' attitude once they have finished playing games and are attending routine taught sessions?

Part F: Self-Paced learning

1. Do you think learning through digital games enable students to manage their own learning process? Please elaborate your answer.
2. How do you see the role of a teacher if students are learning through games?
   Prompt: Do you think teacher's presence or facilitation is still required if students are learning through games. Why, explain?
3. What is the possibility of using digital games as a practice tool at home? Can students play games as homework?
4. What is your opinion on using such games for fast track learning, that you offer at OSC Schools?

Part G: Perceptions (to be asked from teachers)

1. If game based learning is to be implemented in your schools, what difficulties do you foresee through technology integrated teaching and learning? What can be done to overcome these difficulties?
2. What type of training would you require if you were to carry out such programs on your own?
3. Do you think students studying with technology integration can perform better than those studying without it?
4. List three strengths of game based learning as you may have observed during the intervention period in schools:
5. List three limitations that you think need improvement:

Part G: Perceptions (to be asked from head teachers)

1. If game based learning is to be implemented in your schools, what difficulties do you foresee through technology integrated teaching and learning? What can be done to overcome these difficulties?
2. If your school is given the tablets, what facilities do you have to handle tablets? *Prompts: How would you ensure they are fully charged before given to students? Who will create student logins on these devices? Who will install the updates? Who will provide the technical assistance for maintenance of these devices?*
3. What type of training would teachers need if they have implement DGBL?
4. List three strengths of game based learning as you may have observed during the intervention period in schools:
5. List three limitations that you think need improvement:

Appendix J

Informed Consent from participants

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

I have read the Participant Information Sheet for this study and have had the details of the study explained to me. My questions about the study have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I also understand that I am free to withdraw from the study not later than two weeks after reviewing the interview transcripts, or to decline to answer any particular questions in the study. I understand I can withdraw any information I have provided up until the researcher has commenced analysis on my data by 1 October 2019. I agree to provide information to the researchers under the conditions of confidentiality set out on the Participant Information Sheet.

I agree to participate in this study under the conditions set out in the Participant Information Sheet.

Name____ Signed: _______________________________________

Date: ____

Additional Consent

I agree / do not agree to my responses to be audio recorded.

I agree/do not agree to my responses to be video recorded.

I agree / do not agree to my photographs being used

Signed: ____

Name: ____

Date: ____

Appendix J1: Participant Information Sheet-Teachers

[redacted]

Purpose

You are invited to participate in a research study stated above which is being conducted by Farzana Hayat Ahmad under the supervision of Associate Professor Dr. Wendy Fox-Turnbull and Professor Dr. Claire McLachlan, as partial requirement for PhD studies at the University of Waikato, Hamilton, New Zealand. This research project requires the researcher to involve children in digital game based learning for building reading skills. Data will be gathered through pre-post-tests, survey questionnaires, in-depth interviews and focus group discussions.

What is this research project about?

This research is about investigating the role of digital games on early reading skills development in a developing country context such as Pakistan. It is well recognized that Pakistan has not yet achieved the literacy skills targets as set out in the Millennium Development Goals (MDGs) by UN from 2000 – 2015. Also, thus far, Pakistan is lagging behind in achieving Sustainable Development Goals that replaced MDGs in 2015 and are due to be achieved by 2030. The purpose of this research is to explore if literacy, especially, reading skills could be taught through pedagogically sound digital games delivered through mobile devices such as tablets or smart phones. Moreover, this research also intends to investigate if the skills acquired through digital games could be transferred to learning other languages.

What will you have to do and how long will it take?

This is a multi-phase project that will be completed in three phases. In Phase 1, the researcher will want to either interview you or have you complete a survey questionnaire (or, in some cases, both). This should take no longer than 45 minutes. In Phase 2, the researcher will involve your students in playing digital games related to literacy learning during usual school time. You will either be facilitating the students or teaching them as per the lesson plans provided to you. You will also be asked to participate in interview sessions, classroom observations, focus group discussion and completing a survey questionnaire that will take no more than 30 – 40 minutes respectively on a usual school day. In Phase 3, whilst your students will be involved in literacy skills assessments, you will be interviewed during the usual school day. The interviews and classroom observations may be audio/video recorded. You will also have the opportunity to verify the accuracy of what has been transcribed from the interviews and document analysis. A consent will be sought from you prior to data collection.

What will happen to the information collected?

You will be assigned a pseudonym of your choice will be used for data coding and reporting of the study findings. No participant will be named in the publications and every effort will be made to disguise your identity. The data collected will be used for the doctoral thesis, publications and conference presentations. Only the researcher and the supervisory panel will be privy to the notes, documents, recordings and the paper written. All data will be kept confidential and will be destroyed after five years of the completion of the study. Afterwards, notes, documents will be destroyed and recordings erased. The researcher will keep transcriptions of the recordings and a copy of the paper but will treat them with the strictest confidentiality.

Declaration to participants

If you take part in the study, you have the right to:

- refuse to answer any particular question, and to withdraw from the study not later than two weeks after reviewing the interview transcripts.
- withdraw any information you have provided up until the researcher has commenced analysis on data by 1 Oct 2019.
- ask any further questions about the study that occurs to you during your participation.
- be given access to a summary of findings from the study when it is concluded.

Who's responsible?

If you have any questions or concerns about the project, either now or in the future, please feel free to contact the research team.

Name: Farzana Hayat Ahmad	Name: Dr. Wendy Fox-Turnbull
Phone: +92 3205429392	Phone: +64 78384466 ex 7880
Email: fha7@students.waikato.ac.nz	Email: wendy.fox-turnbull@waikato.ac.nz
Position: Researcher	Position: Supervisor

Complaints about this research

This project has been approved by the University's Human Research Ethics Committee, Approval No. *xxxxxxxxxx. Should you have concerns about your rights as a participant in this research, or you have a complaint about the manner in which the research is conducted, it may be given to the researcher, or, if an independent person is preferred, to* WMS Research Manager, Amanda Sircombe, email amandas@waikato.ac.nz, phone +64 (07) 838 4376

Impact of Digital Games on Early Reading Skills in a Developing Country Context

Your child is invited to participate in a research study stated above which is being conducted by Farzana Hayat Ahmad under the supervision of Associate Professor. Wendy Fox-Turnbull and Professor Claire McLachlan, as partial requirement for PhD studies at University of Waikato, Hamilton, New Zealand. This research project requires the researcher to involve children in digital game based learning for building reading skills. Data will be gathered through pre and post-tests, survey questionnaires, in-depth interviews and focus group discussions.

This research is about investigating the role of digital games on early reading skills development in Pakistan. The purpose of this research is to explore the teaching of reading skills through interaction with digital games delivered through mobile devices such as tablets or smart phones. The research also intends to investigate if the skills acquired through digital games can be transferred to learning other languages.

This project will be completed in three phases in which your child will be required to complete English and Urdu reading assessments. These should take no more than ten minutes per assessment. During normal school hours, your child will be involved in playing digital games on tablets related to reading skills. He/she will also be asked to participate in interview sessions, a focus group discussion, and a survey that should take no more than 30-40 minutes on a usual school day. All interviews and any classroom observations may be audio/video recorded. Photographs may be taken for study dissemination purposes.

The information collected will be used by the researcher to write a research report for her PhD thesis. It is possible that articles and presentations may be the outcome of the research. Only the supervisors, Dr. Wendy Fox-Turnbull and Dr. Claire McLachlan and the researcher will have access to the data. Published papers may be in the public domain. Afterwards, all data and notes will be destroyed. The researcher must keep data including transcriptions of the recordings in the strictest confidence for a period of five years after which they will be destroyed. No participants, nor schools will be named in any publication and every effort will be made to disguise their identity.

If your child takes part in the study, he/she and you have the right to:

- refuse to answer any particular question, and to withdraw from the study no later than two weeks of reviewing interview transcripts or before the analysis has commenced on the data by 1 October, 2019.
- ask any further questions about the study during his/her participation.
- be given access to a summary of findings from the study when it is concluded

If you have any questions or concerns about the project, either now or in the future, please feel free to contact the research team.

Name: Farzana Hayat Ahmad Phone: +92 3205429392 Email: fha7@students.waikato.ac.nz Position: Researcher	Name: Dr. Wendy Fox-Turnbull Phone: +64 78384466 ex 7880 Email: wendy.fox-turnbull@waikato.ac.nz Position: Supervisor

This project has been approved by the University's Human Research Ethics Committee, Approval No. *xxxxxxxxxx.* Should you have concerns about your child's rights as a participant in this research, or you have a complaint about the manner in which the research is conducted, it may be given to the researcher, or, if an independent person is preferred, to WMS Research Manager, Amanda Sircombe, email amandas@waikato.ac.nz, phone +64 (07) 838 4376

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

Impact of Digital Games on Early Reading Skills in a Developing Country Context

Consent Form for Participants and their Parents

I have read the Participant Information Sheet for this study and have had the details of the study explained to me. My questions about the study have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I also understand that my child is free to withdraw from the study before the analysis begins on 1 October, 2019 or to decline to answer any particular questions in the study. I also understand that that if my child is involved in an interview, he/she is free to withdraw not later than two weeks after reviewing the interview transcripts. I agree to provide information to the researchers under the conditions of confidentiality set out on the Participant Information Sheet.

I agree to let my child participate in this study under the conditions set out in the Participant Information Sheet.

______________________________	______________________________
Name of the child	Age of the child
______________________________	______________________________
Name of Parent/Legal Guardian	Signature
______________________________	______________________________
Relationship to Minor Child	Date of Signature
______________________________	______________________________
Email Address	Telephone Number

Additional Consent

I agree / do not agree to my child's responses to be audio recorded.

I agree/do not agree to my child's responses to be video recorded.

I agree / do not agree to my child's photographs being used

Signed: ____

Name: ____

Date: ____________________________________

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THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

Student Participant Information

Part A

Title of the Project: Impact of Digital Games on Early Reading Skills in a Developing Country Context

Principal Investigator: Farzana Hayat Ahmad

Greetings

You are being invited to take part in a research study related to digital game-based learning to improve reading skills. Before you decide whether or not to take part, it is important for you to understand why this research will be conducted and what it will involve.

Why I have been invited to participate?

Pakistan is performing much below on literacy standards as compared to other countries in the world. In order to improve the economic outlook of Pakistan, it is important to improve literacy standards across the whole country. Also, it is seen that usual teaching methods do not involve creativity and fun in learning. Existing methods do not allow you to express your creativity and mostly require you to memorise from the textbooks and reproduce in exams.

The purpose of our research is to introduce fun oriented methods to improve reading skills and allow you to be more creative and expressive. As reading forms the basis of literacy learning, therefore, we will focus our research in improving reading skills through digital games based learning within your normal classroom practices.

Your parents/caregivers has already given permission for you to participate in this research.

Do I have to take part?

Taking part in this research is entirely voluntary. Just because your parents/caregivers have given you permission to participate doesn't mean that you have to take part.

It is up to you to decide whether or not to take part. If you decide to take part, you are still free to withdraw and without giving a reason before the commencement of data analysis on 1 October 2019. However, if you are invited for an interview, then you can withdraw from the study, should you want to, no later than two weeks after reviewing your interview transcripts. In case of withdrawal, your data will be destroyed. Rest assure that by choosing to either take part or not to take part in the study will have no impact on your marks, assessments or future studies.

What will happen to me if I take part?

If you decide to take part in the study, you will be asked to complete a simple reading assessment not more than ten minutes in the beginning of the study, one for English and one for Urdu reading.

Next, you will be divided into two groups. One group will play digital games on the tablets with the teacher facilitation. We call this group as comparison group. The other group will play same digital games on tablets without teacher's facilitation. We call this as experiment group. The experiment group teacher will be present in the class to advise you on any technical issues, however, she will not teach you the reading skills.

Prior to playing games on the tablets, you will be provided one day training on using and handling tablets so you don't experience any technical issues during the sessions.

Game-based sessions will happen every day for 40 minutes during your routine school day. The total duration of this intervention will be around four weeks.

After four weeks, you will be asked to complete another set of similar reading assessments as earlier, one for English and one for Urdu.

Some of you will be asked to give individual in-depth interviews on the experience of digital game based learning, whereas a few of you will be invited in groups to give insights on the learning attained through digital games.

We may audio or video record classroom observations and your interviews to transcribe them later.

Upon successful completion of data, all of you will receive colourful bookmarks with QR codes (scanable links) to digital learning resources, which you can access from home through your smart phones or tablets.

Who will see what I say or do?

The information collected from your assessments, interviews or discussions will not be shared with your parents/caregivers, teachers or any other individual. It will only be available to the researchers (myself, and my supervisor). You will be assigned an ID number which will be used in data coding and reporting findings. Every effort will be made to protect your identity in the research process.

We will keep all the information securely under lockable drawers. Any audio or video recordings will be held in a password protected computer to prevent unauthorised access.

The data will be securely kept for five years, after which it will be destroyed.

What should I do if I want to take part?

Do you understand what you will be asked to do? Yes / no

Do you have any questions about what will happen or why? Yes / no

Do you want to stay and do the activities I have described? Yes / no

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Mathematics and Science
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Te Whare Wānanga o Waikato

Please complete and return Part B of this form.

Impact of Digital Games on Early Reading Skills in a Developing Country Context

Student Consent Form (Part B)

TO BE FILLED BY STUDENTS

I agree to take part in the study titled "Impact of digital games on early reading skills in a developing country context" and would like to take part in research activities as explained to me in Part A (participant information leaflet)

I declare that I have read and understood the accompanying information leaflet (Part A). I know what the study is about and the activities that I will be involved in. I know my participation is on volunteer basis and I can withdraw from the study without any effects on my grades, assessments or future studies.

Name ____

Age ______________________ School: ___________________________________

Signature: ______________________________ Date: _________________________

Additional Consent

I agree to my responses to be audio recorded. Yes /No

I agree to my responses to be video recorded. Yes /No

I agree to my photographs being used Yes /No

Signed: ____

Name: ____

Date: ____

Appendix K

Student Group Interview Schedule (Phase 2)

Impact of Digital Games on Early Literacy Skills in a Developing Country Context

School: ________________Date: _____________ No. of students participating: ____________

Pre-interview discussion

Hi, my name is Farzana Ahmad. I am doing PhD in Education from University of Waikato in New Zealand. My research project is about finding the effectiveness of digital games in improving reading skills. I'd like to invite you to participate in a conversation on reading through digital games. This conversation would last for an hour or so. It is important to understand that there are no right or wrong answers. Also, you do not have to participate if you don't want to. Once we begin, if you don't want to answer a question, that's all right.

This conversation is to share your reading experiences through digital games so that we can improve our teaching of reading and may introduce new tools or techniques in reading.
So, shall we get started?

Prompts were used when clarification was required.

Part A: Experience of reading

Purpose: To find out students' interest in reading, what and where they read and self-assessed strengths, needs, and goal.

1. Can you remember anything you did when you first started to learn to read?
   Prompts: What was it like? How did you learn to read?

2. What kind of things do you read?
   Prompts: Text books, magazine, story books, TV listings, junk mail, text messages on phone, newspaper (which sections), Quran, advertising/sign boards and packaging, etc.

3. When do you read?
   Prompts: at home, at school, out shopping, every day, every few days etc.

4. What do you enjoy about reading?

5. What you don't enjoy about reading?

6. What do you find difficult about reading?

7. What kind of things would you like or need to read?

Part B: Reading Behaviours

Purpose: To find out the range of strategies that students use at word, sentence and whole text level. These include understanding of text and vocabulary.

1. What do you do if what you read doesn't make sense to you?
2. What do you do if you come to a word you don't know or can't read?
3. What do you do if you can read a word but can't understand it?
4. What do you do that helps you to understand what you are reading?

   Prompt: before reading, during reading, after reading.
5. What else do you do that helps you when you read?

Part C: Reading through traditional style

Purpose: To find out students' experience of traditional style teaching of reading and how do they perceive its benefits or drawbacks.

1. How do you learn to read through routine traditional style teaching?
   Prompts: When and where do you practice reading? Who do you ask for help if you are stuck on something while reading?

2. What benefits do you see in learning to read through traditional style teaching?
   Prompts: Tell me three things that you like best about reading through conventional methods in normal classroom setting.

3. What drawback do you see in learning to read through traditional style?
   Prompts: What are the three things that you don't like about reading through conventional methods.

4. Are you able to apply the skills of reading you acquire in reading classes to read on other subjects, such as Islamic studies, Urdu, social studies, etc.

Part D: Reading through digital games

Purpose: To find out students' experience of learning to read through digital games played on tablets and how they can apply these skills to reading across other subjects at school.

1. How did you like reading games you played on tablets? Rate on the scale of 1 – 5, with 1 being lowest and 5 being highest, as how much you liked learning through games.

2. Tell me three things that you liked best in the games and why?

3. What were the three things that you did not like in the games?
   Prompt: language of instruction, storyline, rewards, collecting points, feedback, game interface, interactivity etc.

4. What was your favourite activity in the game? Why?

5. Do you think games have helped you improve your reading skills?
   Prompt: Explain with examples as why do you think games have helped improving your reading skills.

6. What were the benefits of learning to read through digital games?

7. What were the drawbacks in learning to read through digital games?

8. In your opinion, which activity helped you best in developing reading skills? *Prompt: Can you please elaborate with examples?*

9. In your opinion, what can be done to make games even better?
   Prompt: What should be improved in the games? Were you able to listen to the instructions clearly? Were you able to understand instructions clearly?

10. If you have a smart phone or tablet at home, what type of games would you like to play?
    Prompt: Would you play the same game or other reading development games at home?

11. During digital game-based learning sessions, did you need help in playing games?
    Prompt: When you were stuck on something, who did you get the help from?

12. Can you use the same techniques that you learned in games to read Urdu language?
    Prompt: Can you please elaborate with examples?

Part E: Self-Paced Learning

Purpose: To find out if students have developed an autonomy to manage their own learning through digital games and applying those concepts to reading of other languages.

1. Do you think teachers' presence is necessary when you are learning to read through digital games?
   Prompt: Can you *please elaborate your answer with examples?*

2. Do you think teachers' presence is necessary when you are learning to read through conventional methods in normal classroom setting?
   Prompt: Is teacher support required in your normal classroom reading? Please elaborate why would you need support in normal classroom setting while learning to read.

3. Do you think playing such games would enable you to learn on your own without the need of a teacher?
   Prompt: Can you please elaborate?

4. What happens if you make a mistake whilst reading?
   Prompt: What is the teachers' response when you make a mistake in reading? What do you do to avoid making mistakes?

5. How much do you think digital games have helped improving your reading skills? Rate on the scale of 1 – 5, with 1 being least, 5 means highest.

6. Do you think, you can apply concepts learnt through the games to your routine school reading?
   Prompt: Can you please elaborate?

7. Do you think you can apply the skills you acquire through digital games to read Urdu, Arabic, or any other language?
   Prompt: Can you elaborate with examples please?

8. Can you describe your feelings when you were playing digital games at school?

9. How do you feel when you are doing reading during normal classroom session?
   Prompt: What is more helpful in developing your reading skills? Reading through digital games or reading using traditional techniques in normal classroom sessions?

10. What was your biggest motivation in playing digital games?

Part F: Self-assessment

Purpose: To find out how confident participants feel about reading and what they feel they need to improve.

1. How confident do you feel now about reading?

2. What kind of things are you confident reading?

3. What kind of things are you not confident reading?

4. What do you think you need to do to help your reading?

Part G: Following up

Purpose: To identify how participants feel their reading has changed through digital game-based learning.

1. How has your reading changed over the course of DGBL?

2. What new things do you do now when you are reading that you didn't do before?

3. What makes reading easier or better for you now?

Appendix L

Student Group Interview Schedule Phase 3

1. Can you tell me what type of reading materials did you read during school holidays?
    a. Prompts: how did you w=feel about reading? Why did you choose those materials?

2. What reading strategies did you apply for reading?
    a. Prompts: What do you do if you struggle on reading a word
3. How many hours a day did you read during school holidays?

4. How did you get access to the reading materials?

5. Describe your feelings when you read for school and when you read for fun (like storybooks).

6. Do you play digital games? What types of game you play?

7. Describe what you still remember about the games you played at school sometime ago.

8. Explain how do you apply knowledge from the game in reading books (English, Urdu or any other subject). What types of techniques you apply to read in different languages?

9. What different have you noticed in your behaviour after playing games?
    a. Describe the behaviour.

10. What do you do when someone in your class is struggling in reading or doing their work?

    a. Prompts: What type of support do you provide to them?
11. Explain how games overall helped you developing reading skills? And what skills do you still remember and use?

Appendix M

Coding Schemes for Qualitative Data

Codes for Classroom Observation

Observations	**Date (2019)**	**Time PST**	**Group**	**Video recording**	**Code**
1	13 Mar	10:00-10:40	Experiment group 1	O.01	O1.EX1
2	14 Mar	10:00-10:40	Experiment group 2	O.02	O2.EX2
3	19 Mar	10:00-10:40	Experiment group 1	O.03	O3.EX1
4	20 Mar	10:00-10:40	Experiment group 2	O.04	O4.EX2
5	25 Mar	10:00-10:40	Experiment group 1	O.05	O5.EX1
6	26 Mar	10:00-10:40	Experiment group 2	O.06	O6.EX2
7	10 Jul	9:50- 10:30	Comparison group 1	O.07	O7.CP1
8	10 Jul	10:30 -11:10	Comparison group 2	O.08	O8.CP2
9	15 Jul	9:50- 10:30	Comparison group 1	O.09	O9.CP1
10	16 Jul	10:30 -11:10	Comparison group 2	O.10	O10.CP2
11	22 Jul	9:50- 10:30	Comparison group 1	O.11	O11.CP1
12	2 Aug	10:30 -11:10	Comparison group 2	O.12	O12.CP2
13	7 May	12:40- 13:20	Control group	O.13	O13.CN
14	15 May	12:40- 13:20	Control group	O.14	O14.CN
15	21 May	12:40- 13:20	Control group	O.15	O15.CN

Note. For example, O3.EX1.3:20 refers to a citation obtained from the third classroom observation of the experiment group and retrieved from the video recording at 3 minutes 20 seconds.

Codes for Teacher Interviews

Interview	Phase	Group	pseudonym	Code
1	Phase 2	Comparison Group	Comparison Group Teacher 1	TI.CP1
2	Phase 2	Comparison group	Comparison Group Teacher 2	TI.CP2
3	Phase 3	Comparison group	Comparison Group Teacher 3	TI.CP3
4	Phase 2	Experiment group	Experiment Group Teacher 1	TI.EX1
5	Phase 2	Control Group	Control Group Teacher 1	TI.CN1

Note. For example, TI.CP1:30 refers to a citation from Teacher 1 interview from the comparison group, and appears on page 30 of the transcript.

Codes for Student Group Interviews

Interview	Phase	Group	Code
1	Phase 2	Comparison Group Interview 1	SGI.CP1
2	Phase 2	Comparison Group Interview 2	SGI.CP2
3	Phase 3	Comparison Group Interview 3	SGI.CP3
4	Phase 2	Experiment Group Interview 1	SGI.EX1
5	Phase 2	Experiment Group Interview 2	SGI.EX2
6	Phase 3	Experiment Group Interview 3	SGI.EX3
7	Phase 2	Control group interview 1	SGI.CN1

Note. For example, SGI.CP2.27 refers to a citation from the student group interview of comparison group 2, and appearing on page 27 of the transcript.

Appendix N

Coding Scheme for Quantitative Data Analysis

Table N1

Coding scheme for EGRA (English and Urdu)

Variable 1	ID	ID - Identification assigned to each student. Syntax: School prefix_001 (e.g. G14_001); data type = nominal
Variable 2	Gender	Gender; 1= Male, 2 = Female; data type = nominal
Variable 3	Age	Age – age of each student; 10 = 10 years, 11= 11 years; data type = nominal
Variable 4	Class	Class – The class/grade students belong to, 1 = Class 1, 2 = Class 2, 3 = Class 3, 4 = Class 4, 5 = Class 5; Data Type = nominal
Variable 5	School	School – The campus students belong to, 1 = G14 campus, 2 = G-8 campus, 3 = I-10 campus, 4 = F-12 campus, 5 = I-8 campus; data type = nominal
Variable 6	Test	Pre/post Test – type of test; 0 = Pre-Test; 1 = Post-Test
Variable 7	Group	Group: 1=Control Group; 2= Experiment Group; 3=Comparison group
Variable 8	LS	Letter Sound score – total score letters sounded correctly in 1 minute, 0 to 110, data type = scale (continuous)
Variable 9	LS remaining time	Letter Sound Remaining Time – Total number of seconds remaining on stop watch if letter sound reading is completed within 1 minute; 3 = 31 to 40 sec remaining, 2 = 21 to 30 sec remaining, 1 = 0 to 20 sec remaining. Data type = nominal
Variable 10	LS discontinued	Letter Sound Discontinued – If letter sound reading is discontinued; 0 = not discontinued; 1 = discontinued; data type: nominal
Variable 11	NWR	Non-sense word reading – Total score of non-sense words read correctly in 1 minute, 0 to 50; data type = scale (continuous)
Variable 12	NWR Remaining time	Non-sense words remaining time – Total number of seconds remaining on stop watch if non-sense word reading is completed within 1 minute; 3 = 31 to 40 sec remaining, 2 = 21 to 30 sec remaining, 1 = 0 to 20 sec remaining. Data type nominal
Variable 13	NWR discontinued	Non-sense words reading discontinued - If non-sense word reading is discontinued; 0 = not discontinued; 1 = discontinued
Variable 14	FWR	Familiar word reading – Total score of familiar words read correctly in 1 minute, 0 to 50
Variable 15	FWR remaining time	Familiar words remaining time – Total number of seconds remaining on stop watch if familiar word reading is completed

		within 1 minute; 3 = 31 to 40 sec remaining, 2 = 21 to 30 sec remaining, 1 = 0 to 20 sec remaining. Data type = nominal
Variable 16	FWR discontinued	Familiar words reading discontinued - If familiar word reading is discontinued; 0 = not discontinued; 1 = discontinued
Variable 17	PR	Passage reading – Total score of passage reading in 1 minute, 0 to 76
Variable 18	PR remaining time	Passage reading remaining time – Total number of seconds remaining on stop watch if passage reading is completed within 1 minute; 3 = 31 to 40 sec remaining, 2 = 21 to 30 sec remaining, 1 = 0 to 20 sec remaining. Data type = nominal
Variable 19	PR discontinued	Passage reading discontinued – If familiar word reading is discontinued; 0 = not discontinued; 1 = discontinued
Variable 20	CR	Comprehension questions – Total score of comprehension questions answered correctly – 0 to 5
Variable 21	Total EGRA Score	Total EGRA Score – total score by adding all scores of letter sound (LS), non-sense word reading (NWR), Familiar word reading (FWR), Passage reading (PR), and Comprehension questions (CQ), 0 to 975

Table N2

Coding Scheme for ERAS

Variables	Labels	Coding
Variable 1	ID	ID - Identification assigned to each student. Syntax: School prefix_001 (e.g. G14_001); data type = nominal
Variable 2	Grade	Grade level of students; 1 = Grade 1, 2 = Grade 2, 3 = Grade 3, 4 = Grade 4, 5 = Grade 5; Data Type = nominal
Variable 3	School	School – The campus students belong to, 1 = G14 campus, 2 = G-8 campus, 3 = I-10 campus, 4 = F-12 campus, 5 = I-8 campus; data type = nominal
Variable 4 - 13	Q1 to Q10	Questions related to recreational reading; 4 = happiest, 3 = slightly smiling, 2 = mildly upset, 1 = very upset; Data type = ordinal
Variable 14-23	Q11 to Q20	Questions related to academic reading, 4 = happiest, 3 = slightly smiling, 2 = mildly upset, 1 = very upset; Data type = ordinal
Variable 24	Recreational Reading Score	Total score of recreational reading 10 to 40 ; Data type = Interval
Variable 25	Academic Reading score	Total score of academic reading 10 to 40 ; Data type = Interval
Variable 26	Total score	Total score of recreational and academic reading, 20 – 80; Data type = interval

Appendix O

Participant Information Sheet- Phase 1

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Hamilton, New Zealand

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E-mail:
fha7@students.waikato.ac.nz

Participant Information Sheet- Phase 1

Title of the Project: Impact of Digital Games on Early Reading Skills in a Developing Country Context

Principal Investigator: Farzana Hayat Ahmad

Background

You are invited to participate in a research study stated above which is being conducted by Farzana Hayat Ahmad under the supervision of Associate Professor Dr. Wendy Fox-Turnbull and Professor Dr. Sashi Sharma, as partial requirement for PhD studies at the University of Waikato, Hamilton, New Zealand.
This research is about investigating the role of digital games on early reading skills development in a developing country context such as Pakistan. It is well recognized that Pakistan has not yet achieved the literacy skills targets as set out in the Millennium Development Goals (MDGs) by UN from 2000 – 2015. Also, thus far, Pakistan is lagging behind in achieving Sustainable Development Goals that replaced MDGs in 2015 and are due to be achieved by 2030. The purpose of this research is to explore if literacy, especially, reading skills could be taught through pedagogically sound digital games delivered through mobile devices such as tablets or smart phones. Moreover, this research also intends to investigate if the skills acquired through digital games could be transferred to learning other languages.

Procedures
This is a multi-phase project to be completed in three phases. Your participation will mainly be required during the **first phase** of the project starting from December 2018.
Once you agree to participate, you will be invited to attend a seminar followed by data collection activities, mainly comprising of two rounds.
In round one, you will be involved in the evaluation of two literacy learning digital games against the given instrument. Each game evaluation should take no more than 30 to 40 minutes of your time.
In the second round, you will be paired up with another participant to jointly review the responses and discuss any variance in the responses. This activity will not take more than an hour of your time.

Risks and Harms
There will be no risks or harms associated with the study.

Benefits
This project may contribute towards your Continued Professional Development by analysing the characteristics of the digital games that would benefit students' reading skills. In future, you may also be able to integrate digital game-based learning within your own pedagogy while teaching language lessons. You will also receive a certificate of participation from Faculty of Education, University of Waikato, Hamilton, New Zealand, as a token to recognize your cooperation to conduct the study.

Costs/Payments
We are unable to offer any monetary compensation. No travel allowance or Internet data will be provided for this study.

Anonymity

You will be assigned a pseudonym of your choice will be used for data coding and reporting of the study findings. No participant will be named in the publications and every effort will be made to disguise your identity. The data collected will be used for the doctoral thesis, publications and conference presentations. Only the researcher and the supervisory panel will be privy to the notes, documents, recordings and the paper written. All data will be kept anonymous and confidential, and will be destroyed after five years of the completion of the study. Afterwards, notes, documents will be destroyed and recordings erased. The researcher will keep transcriptions of the recordings and a copy of the paper but will treat them with the strictest confidentiality.

Voluntary Participation

Participation in the research is voluntary. If you would like to volunteer, please email: fha7@students.waikato.ac.nz. Given that data collection needs to commence by end of December, 2018, please express your interest as soon as possible. We hope that you will volunteer to be one of a small group of 10 to 12 participants with whom we can work closely to gather deep and valuable information. However, if the number of volunteers exceeds our target number of participants, we will need to select a range of volunteers who represent the diversity of experience in using or designing literacy learning games for primary school children. We aim to notify all volunteers with the outcome of the sampling process by Friday 21st December, 2018. If you are selected, you will be invited to attend a seminar, followed by data collection activities. Participation consent will be sought prior to the data collection process. You will be asked to read and sign the Consent and return to the researcher on the day of the seminar.

You are under no obligation to accept this invitation. If you decide to participate, you have the right to withdraw from the study at any point before the analysis of the Phase 1 begins by 15th January 2019; ask any questions about the study at any time during participation; decline to answer any particular question; provide information on the understanding that your name will not be used unless you give permission to the research team. When the project is concluded, you will receive an Executive Summary of our final report and will be given access to the full report upon request. In addition, you will receive the game evaluation tool to evaluate reading development games.

Contacts

If you have any questions or concerns about the project, either now or in the future, please feel free to contact the research team or the postgraduate office.

Name: Farzana Hayat Ahmad
Phone: +92 3205429392
Email: fha7@students.waikato.ac.nz
Position: Researcher

Name: Dr. Wendy Fox-Turnbull
Phone: +64 78384466 ex 7880
Email: wendy.fox-turnbull@waikato.ac.nz
Position: Supervisor

Complaints about this research

This project has been approved by the University's Human Research Ethics Committee, Approval No. FEDU056/18. Should you have concerns about your rights as a participant in this research, or you have a complaint about the manner in which the research is conducted, it may be given to the researcher, or,the supervisor available on the aforementioned email addresses.

Impact of Digital Games on Early Reading Skills in a Developing Country Context

Consent Form for Participants

I have read the Participant Information Sheet for this study and have understood the details of the study. I understand that I may ask further questions at any time.

I also understand that I am free to withdraw from the study before the Phase 2 begins in May 2019 or to decline to answer any particular questions in the study. I understand I can withdraw any information I have provided up until the researcher has commenced analysis on my data. I agree to provide information to the researchers under the conditions of confidentiality set out on the Participant Information Sheet.

I agree to participate in this study under the conditions set out in the Participant Information Sheet.

Signed: ____

Name: ____

Date: ____

Additional Consent

I agree / do not agree to my responses to be audio recorded.

I agree/do not agree to my responses to be video recorded.

I agree / do not agree to my photographs being used

Signed: ____

Name: ____

Date: ____

Appendix P

Seeking Approval to Conduct Research

Technology, Environmental, Mathematics and Science Education Research Centre
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The University of Waikato
Private Bag 3105
Hamilton, New Zealand

Tele 64-7-838 446
E-mail:
fha7@students.waikato.ac.nz

[Date]

Dr. XXXXXXXXXXX

The Principal,

Out-of-School Children (OSC) School,

F-10/2 Islamabad. Pakistan

Subject: **Research project on investigating the impact of digital games on early reading skills in a developing country context.**

Dear Dr. XXXXXXXXX,

I would like enquire about conducting some research in your school in the next academic year. My name is Farzana Hayat Ahmad and I am a doctoral research student at University of Waikato, Hamilton, New Zealand, supervised by Associate Professor. Wendy Fox-Turnbull. In my research project titled: 'Impact of Digital Games on early Reading Skills in a Developing Country Context', I seek to explore the development of reading skills in second language throb ugh the use of digital games and subsequent impacts on the first language.

I am hoping that the research will take place with 300 Grade 2 and 3 students enrolled in various branches of OSC schools. A multi-phase embedded mixed method research design will be adopted for the project for which we require a control group that would follow the usual literacy learning, a comparison group that will experience digital game based learning along with their teacher, and an experiment group which will be exposed to the digital game based learning without the teacher support. Data will be gathered through pre and post-tests, survey questionnaires, in-depth interviews and focus group discussions. The total duration of the research activities will span from six to eight weeks during normal school hours.

By participating in the research, your schools would be contributing to a project that will deepen our understanding of literacy learning for students with low prior attainment, and so contribute towards developing ways of improving attainment for similar students in the future.

The commitment from the school would be to allow me to conduct interventions using tablet based literacy learning digital games over four weeks, beginning from the beginning of summer term (June 2019). This is a multiphase research project spanning over three phases. In Phase 1, teachers will be required to assess number of preselected digital games against a provided rubric to evaluate the effectiveness of the literacy learning digital games. In Phase 2, pre-tests will be undertaken by the research team including the researcher and trained enumerators from all the selected students prior to the intervention to gauge existing literacy skills of the students. I will also observe, take notes and interview teachers and students about their experience of digital games in classroom sessions. Post-tests will be conducted after the intervention to evaluate the impact of digital games on literacy learning. Finally, Phase 3 will occur after six weeks of the intervention and will comprise of post-tests, interviews and focus group discussions with students and in-depth interviews with teachers and head teachers. The total duration of the research activities will span around eight weeks during normal school hours.

University of Waikato has strict ethical procedures on conducting ethical research with teachers and young people in compliance with Ethical Conduct in Human Research and Related Activities Regulations 2008. Before beginning the research, I would inform teachers, parents and guardians about the research and offer them the opportunity to refuse to participate. Throughout the research particpants will be able to refuse to participate at any time. Similarly, parents and guardians may withdraw their children from the study at any time. There will be no penalty or negative implications for students who withdraw from or who are withdrawn from the project before completion.

All participants, including students, teachers and the school in the study, will remain anonymous in all research reports. The data collected would be kept strictly confidential in my password protected computer, available only to my supervisor and myself. The data will not be used for anything other than that which is specified without the further consent of all involved being obtained. All recordings would be destroyed at the end of the research period, and kept in locked conditions until then. I have enclosed copies of the leaflets (participant information) for parents and students with this letter.

If you feel you would like to take part in the study, or need more information about what is involved, please contact me or my supervisor.

Name: Farzana Hayat Ahmad	Name: Dr. Wendy Fox-Turnbull
Phone: +92 3205429392	Phone: +64 78384466 ex 7880
Email: fha7@students.waikato.ac.nz	Email: wendy.fox-turnbull@waikato.ac.nz
Position: Researcher	Position: Supervisor

Whether or not you feel it would be appropriate for your school to participate, I would be grateful if you would complete the pro-forma below, and return it to me in the stamped addressed envelope enclosed in this letter.

Thank you for your time and attention. I look forward to hearing from you.

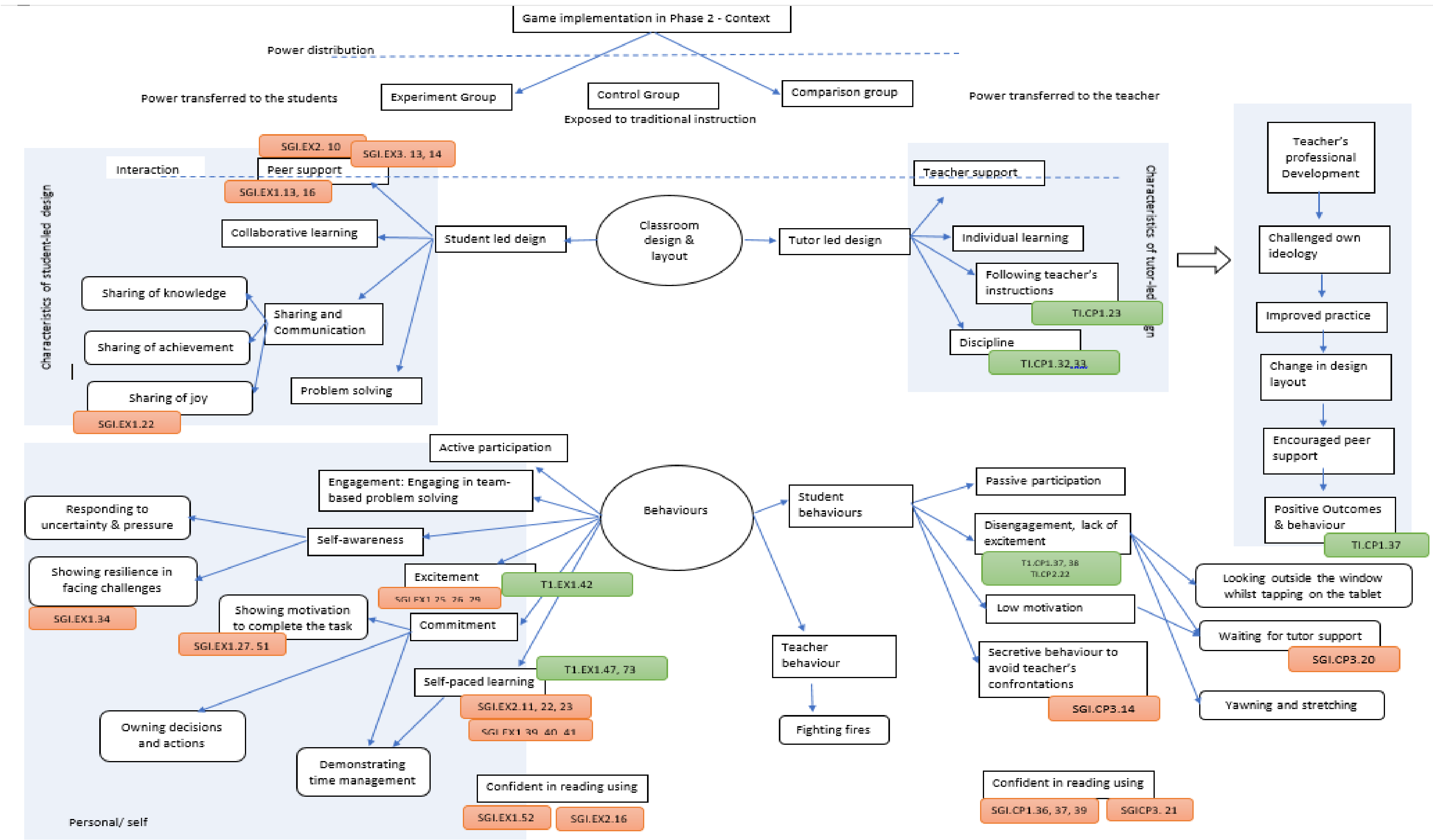
Yours sincerely,

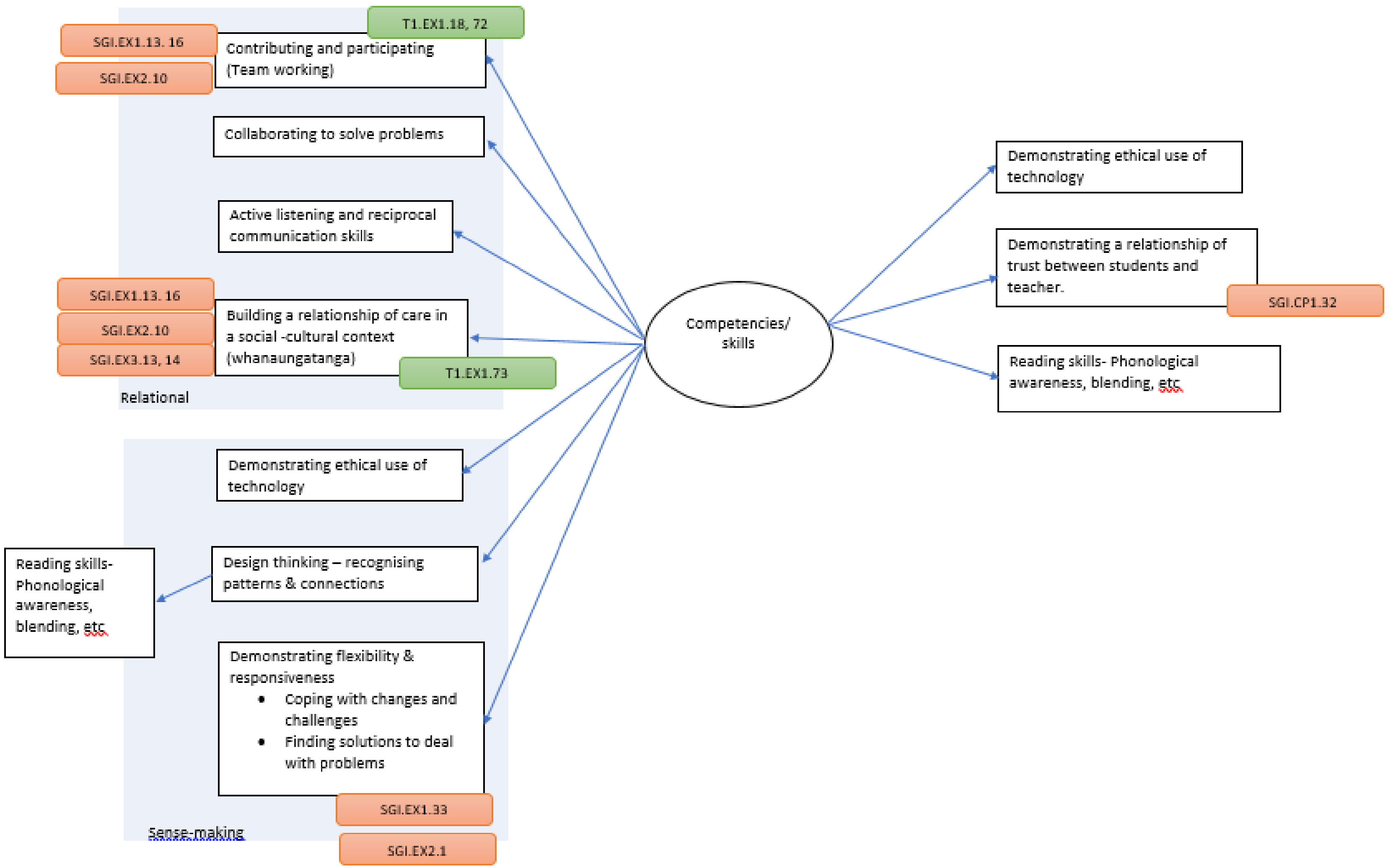
Farzana Hayat Ahmad

PhD Student
Faculty of Education
University of Waikato
Hamilton, New Zealand

Appendix Q

Key Themes Generated from Qualitative Data




T1.EX1.18, 72
SGI.EX1.13. 16
SGI.EX2.10
Contributing and participating (Team working)
Collaborating to solve problems
Active listening and reciprocal communication skills
SGI.EX1.13. 16
SGI.EX2.10
SGI.EX3.13, 14
Building a relationship of care in a social -cultural context (whanaungatanga)
T1.EX1.73
Relational
Competencies/ skills
Demonstrating ethical use of technology
Demonstrating a relationship of trust between students and teacher.
SGI.CP1.32
Reading skills- Phonological awareness, blending, etc
Demonstrating ethical use of technology
Reading skills- Phonological awareness, blending, etc
Design thinking – recognising patterns & connections
Demonstrating flexibility & responsiveness
Coping with changes and challenges
Finding solutions to deal with problems
SGI.EX1.33
SGI.EX2.1
Sense-making

Appendix R

Comparison of TYMTR and GGUK on Game Aspects

Figure R1

Comparison of Pedagogical aspects between the two games

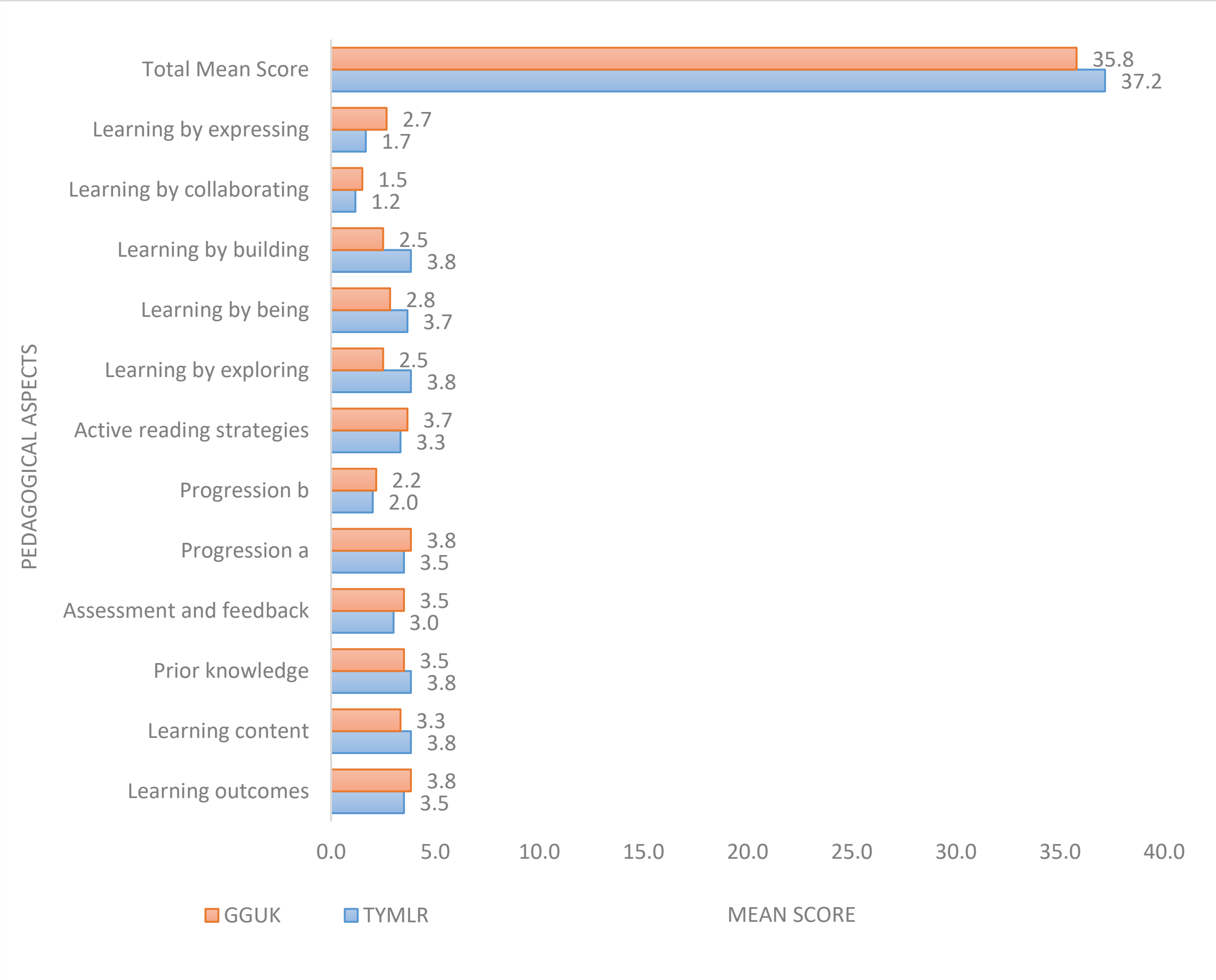


Figure R2

Comparison of educational components between the two games

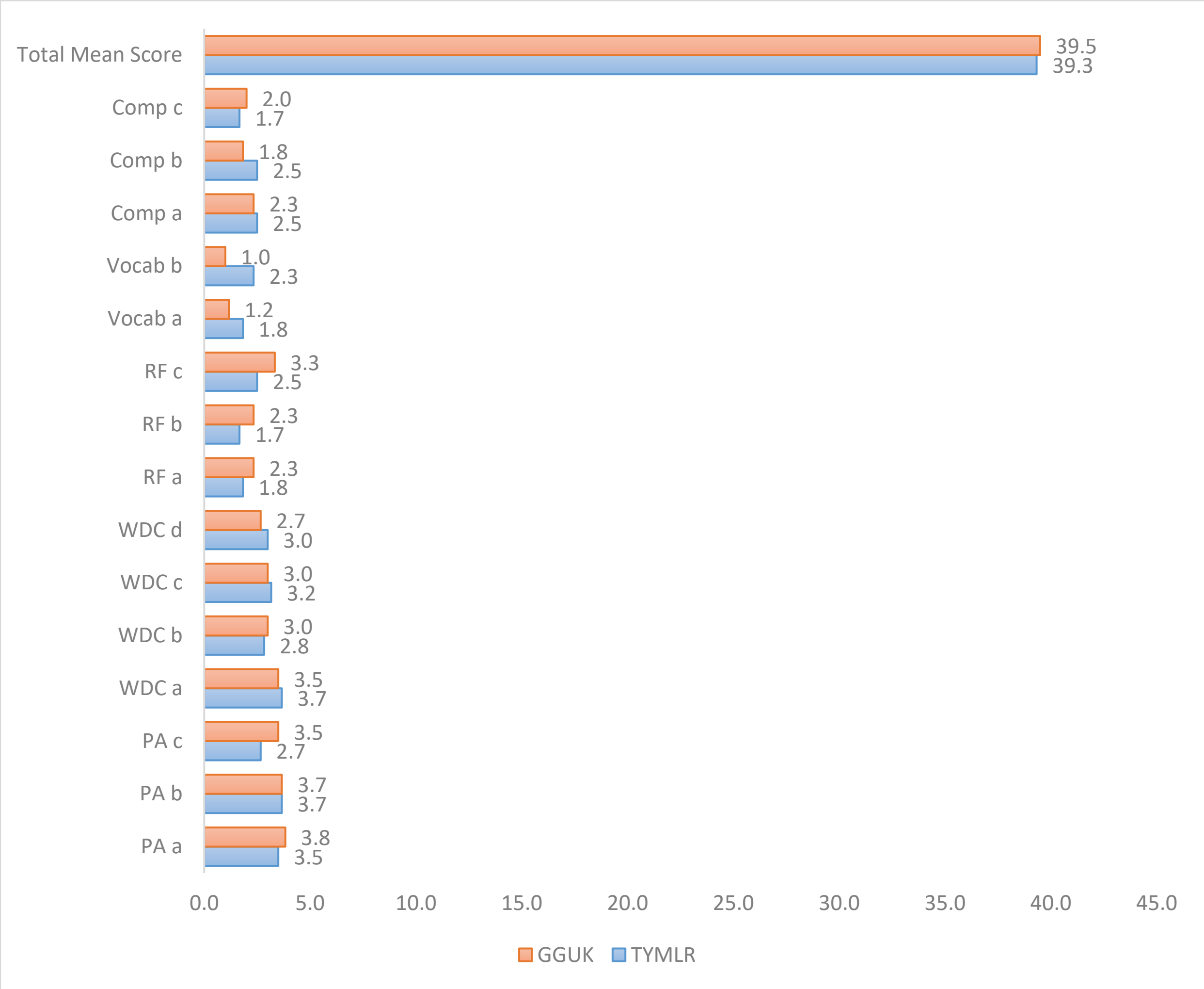


Figure R3

Comparison of game design aspects between the two games

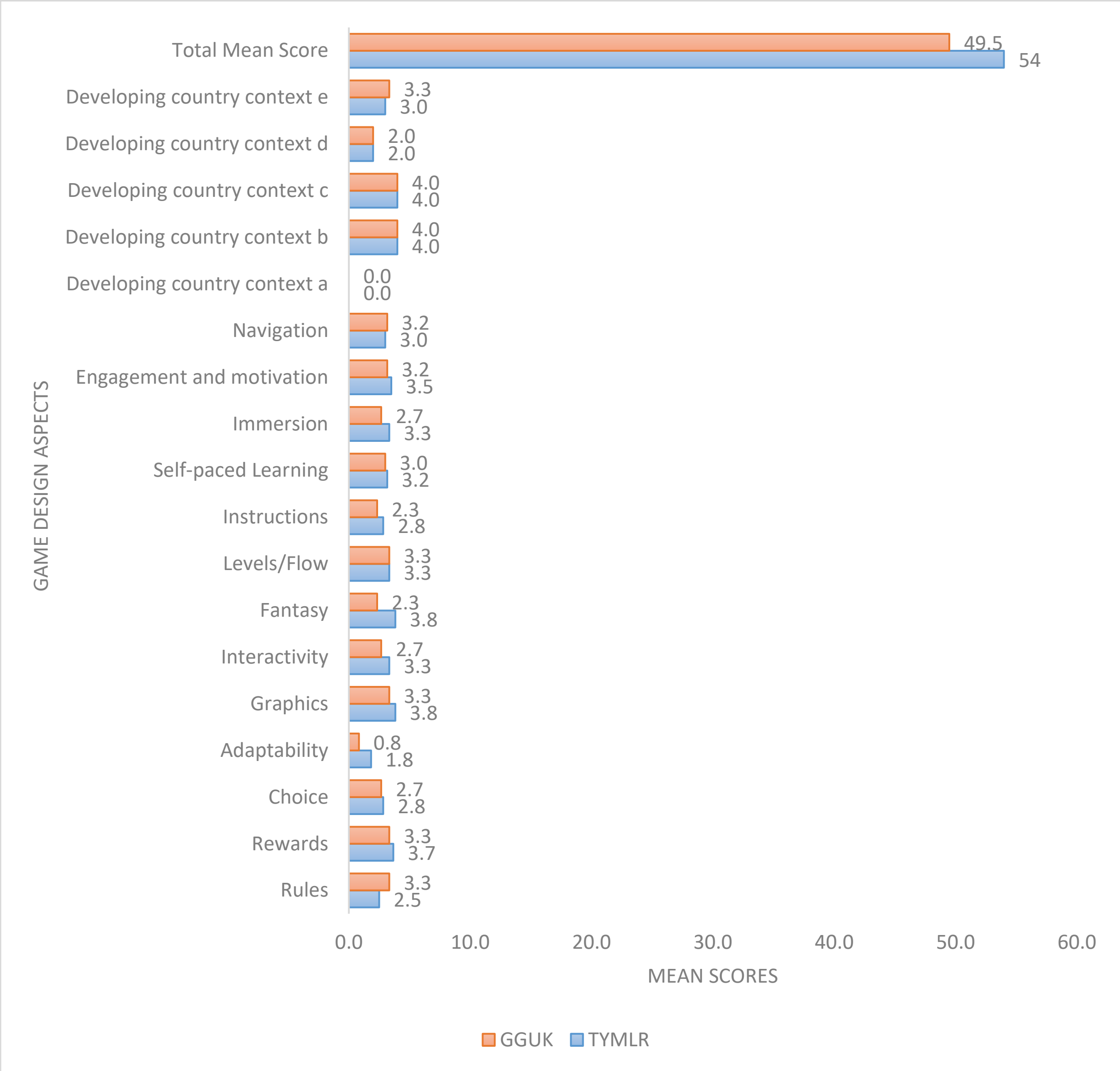
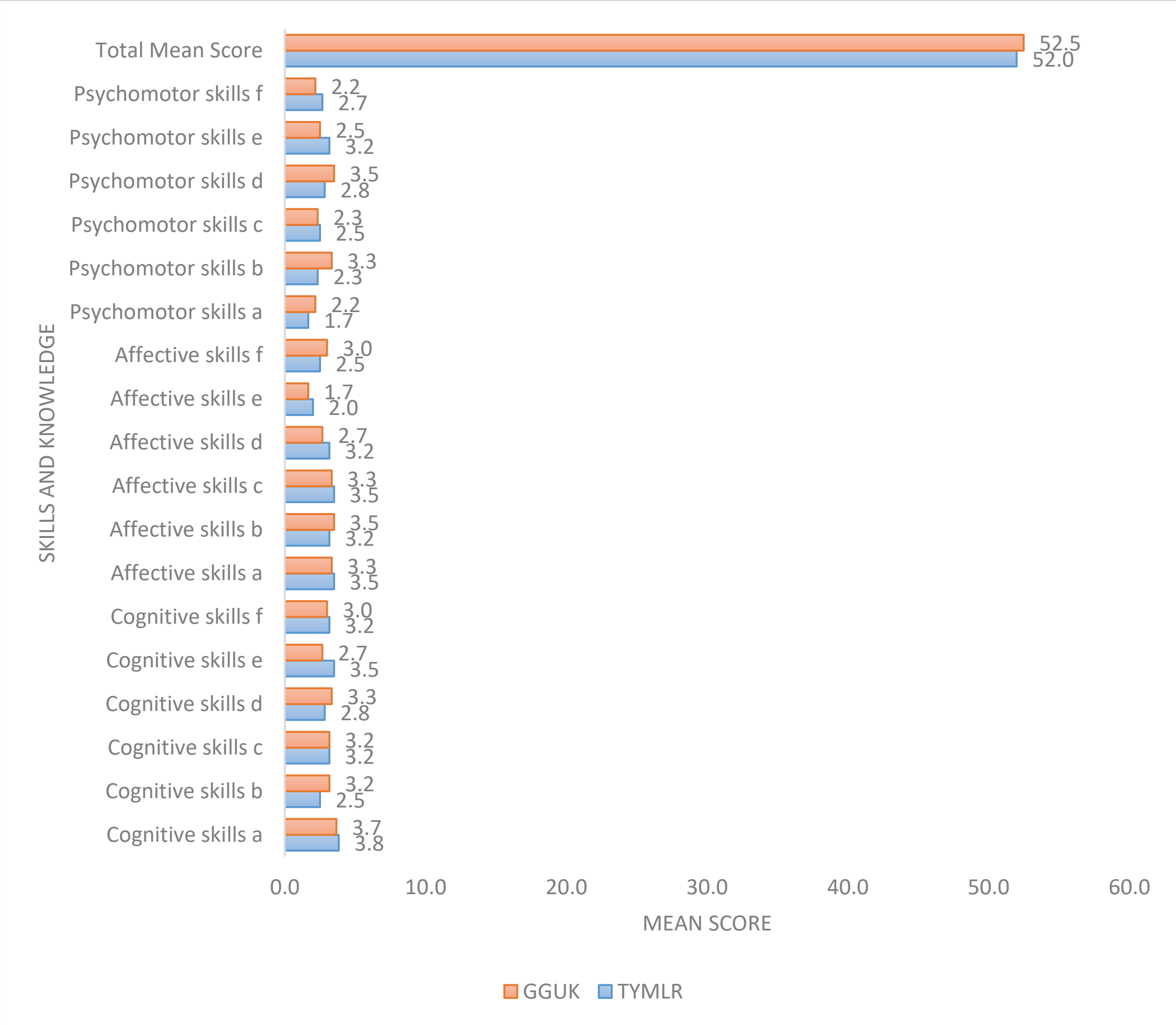


Figure R4

Comparison of aspects of skills and knowledge between the two games



Appendix T

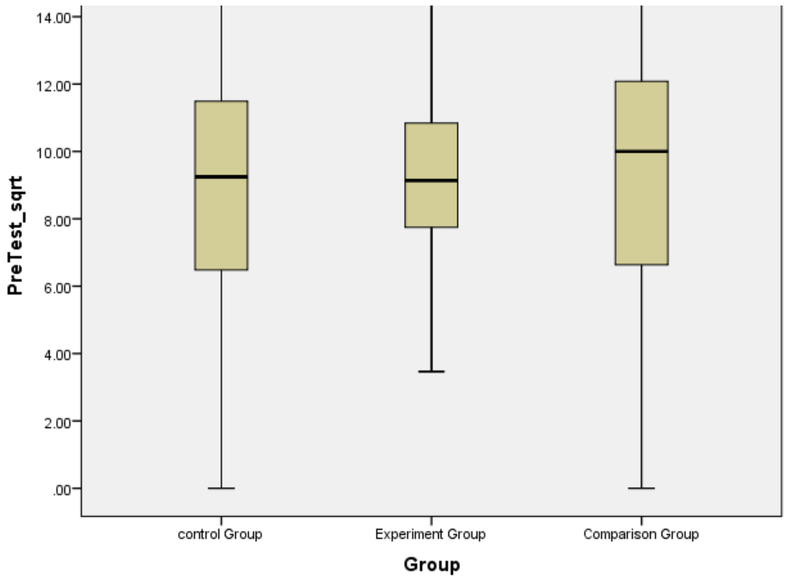
One-way ANOVA Assumptions for the Baseline English Reading

Assumption 1: No significant outliers

Outliers were detected using SPSS by creating box plots as shown in Figure 5.1, depicting three box plots, one for each group, with a range of values (pre-test EGRA scores) lying between upper and lower whiskers. Most of the values lie in the box, between the lower quartile (25th percentile), and upper quartile (75th percentile) and no value lies outside 1.5 box-lengths from the edge of the box. Hence, the assumption was met as no outliers were found in the dataset.

Figure T1

Box plot for pre-test EGRA English Scores showing no outliers

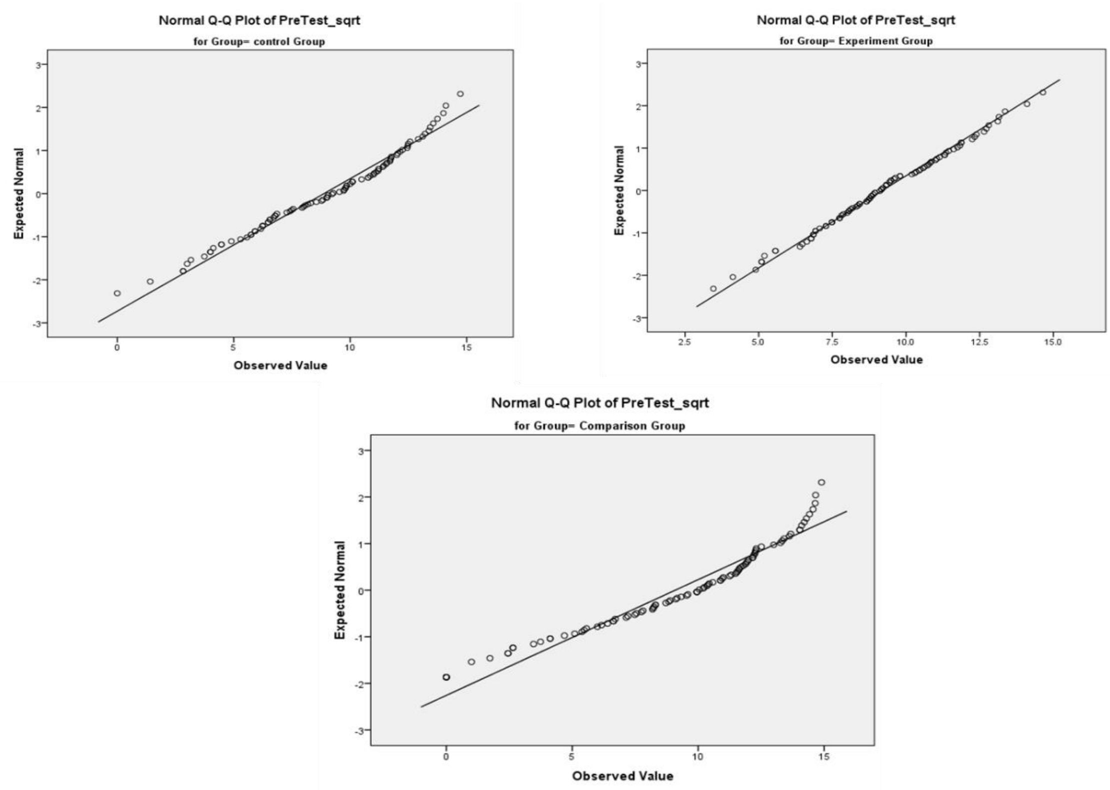


Assumption 2: Normal distribution of the dependent variable

To minimise Type I error, dependent variables need to be approximately normally distributed. The present study assessed the normality of dependent variables (pre-test scores) using normal Q-Q plots. Figure 5.2 shows that data points are mapped close to the diagonal line; hence, it was assumed that the dependent variable (pre-test scores) was approximately normally distributed across the three groups.

Figure T2:

Normal; Q-Q plot to test normality of pre-test scores in control, experiment, and comparison groups



Assumption 3: Homogeneity of variance

The third assumption refers to the homogeneity of variances across groups. Essentially, this means that population variances should be equally distributed in each group. Levene's test using SPSS was conducted to determine homogeneity of variance. Table 5.1 shows that Levene's test was statistically significant, $F(2, 285) = 14.9$, $p < 0.001$, which implies heterogeneity of variance. Therefore, the assumption of homogeneity of variances was violated, and pre-test scores were not equally distributed around means of control, experiment and comparison groups.

Table T1

Test of homogeneity of variance for pre-test English data

Levene Statistic	df1	df2	Sig.
14.944	2	285	.000

Appendix U

Assumptions for One-Way ANCOVA (Phase 2, EGRA English)

Assumptions:

a) Linearity of the relationship between covariate and output variable at each level of the independent variable

The assumption of the linear relationship between covariate (pre-test scores) and dependent variable (post-test scores) for each level of the independent group was assessed using correlations. Table 1 indicates a statistically significant relationship between covariate and dependent variable (r = 0.640, N = 288, p = .0001). Hence, the covariate pre-test met the assumption of linearity for running ANCOVA.

Table T2

Correlations between pre-test scores (covariate) and post-test scores (dependent variable) for EGRA English

		Pre-Test English Score	Post-Test English Score
Pre-Test English Score	Pearson Correlation	1	.640**
	Sig. (2-tailed)		.000
	N	288	288

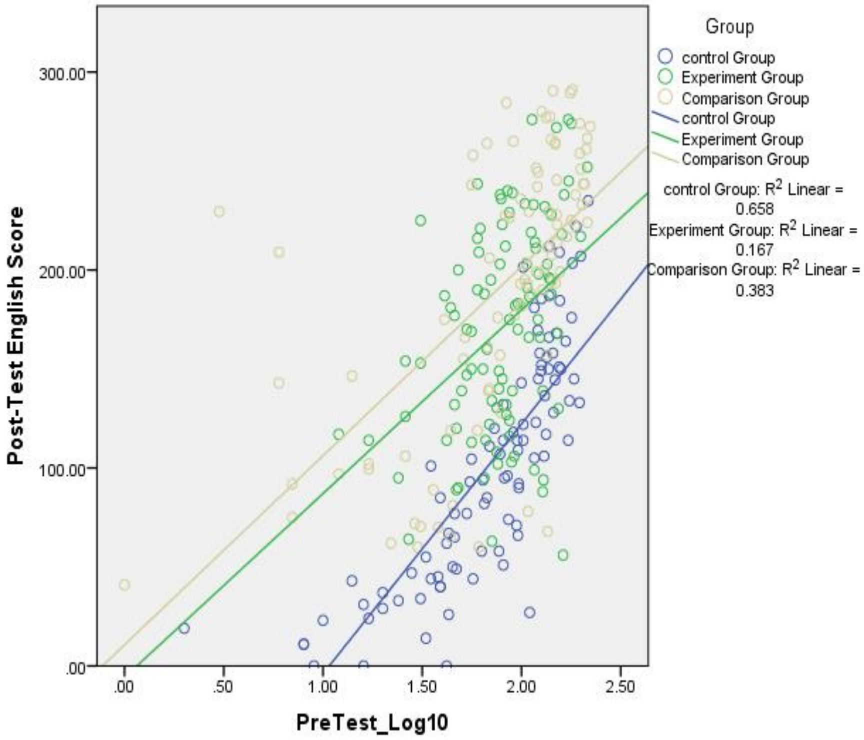
**. Correlation is significant at the 0.01 level (2-tailed).

b) Homogeneity of regression slope

This assumption checks if there is an interaction between the covariate (pre-test scores) and the independent variables. Scatterplots were created using SPSS to assess the interaction between the covariate and the independent variables. The regression slopes interacted with each other, which means that the assumption of homogeneity of regression was violated. In order to correct this violation, log10 transformation was applied to the covariate. Further analysis of homogeneity of regression slopes with transformed covariate returned positive results; hence, the assumption was met. Figure 1 indicates parallel regression lines on the scatterplot.

Figure T3

Scatter plot showing homogeneity of regression slopes between transformed covariate and post-test English scores



This assumption was also statistically assessed by determining if there is a statistically significant interaction term, Group*preTest_Log10. Table 2 confirms that there was no statistically significant interaction between the transformed covariate and the independent groups. Hence, there was homogeneity of regression slopes as the interaction term was not statistically significant, $F(2, 276) = 1.92$, $p = 0.149$.

Table T3

Test of interaction between covariates and dependent variable for English reading in Phase 2

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	833196.742[a]	5	166639.348	75.254	.000
Intercept	13651.751	1	13651.751	6.165	.014
Group	45589.334	2	22794.667	10.294	.000
PreTest_Log10	313159.602	1	313159.602	141.421	.000
Group * PreTest_Log10	8481.071	2	4240.535	1.915	.149
Error	611166.531	276	2214.371		
Total	8086462.000	282			
Corrected Total	1444363.273	281			

Dependent Variable: Post-Test English Score

a. R Squared = .577 (Adjusted R Squared = .569)

c) Normal distribution of the dependent variable for each independent variable

In one-way ANCOVA, the assumption of normality is not to be assessed on actual observed values but on the standardised residuals, which were created whilst fitting a model in ANCOVA procedure. Shapiro-Wilk test was performed to assess the normality of standardised residuals. Table 3 indicates that standardised residuals for dependent variable were normally distributed across three independent groups (W = 0.979, p = 0.126; W = 0.983, p = 0.257; W = 0.978, p= 0.123). Since p-values for each group is greater than 0.05, hence it was assumed that the dependent variable was normally distributed.

Table T4

Shapiro-Wilk test of testing normality of standardised residuals for post-test English scores (Phase 2)

	Groups	Statistic	Statistic	df	Sig.
Standardized Residual for Post-Test English	Control Group	.061	.979	95	.126*
	Experiment Group	.074	.983	96	.257*
	Comparison Group	.104	.978	91	.123*

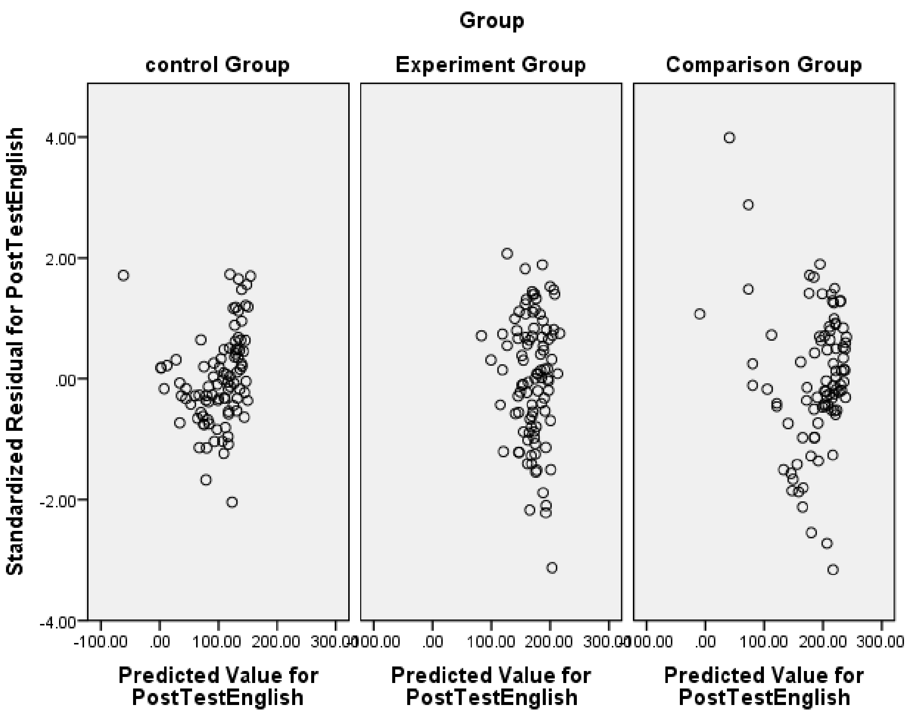
*. Significance at the level of 0.05.

d) Homoscedasticity

An important assumption for one-way ANCOVA refers to the homoscedasticity of error variance within each group. To verify this assumption, plots of standardised residuals were inspected against the predicted values whilst fitting the model for one-way ANCOVA. Figure 2 indicates no specific pattern (e.g. increasing funnel, decreasing funnel, or fan-shaped); hence, the assumption of homoscedasticity was fulfilled.

Figure T4

Scatterplot of control, experiment, and comparison group showing homoscedasticity



e) Homogeneity of variance

To minimise Type I error, one-way ANCOVA assumes that the variance of residuals is equal for all independent groups. This assumption was tested using Levene's test of equality of variances using SPSS. Table 4 indicates that there was homogeneity of variance, as assessed by Levene's test of homogeneity of variance , p = 0.085 (p> 0.05).

Table T5

Levene's test of homogenity of variance for English reading in Phase 2

Dependent Variable: PostTest_Log10

F	df1	df2	p
2.491	2	276	.085

F= F-statistic; *df* = degree of freedom, *p* = significance at 0.05

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

f) No significant outliers

For one-way ANCOVA, outliers are any standardised residuals with $\pm$ 3 standard deviations. The data were inspected for standards deviations of 3 or more. Few outliers were detected and removed from the data set.

Appendix V

Retention of English Reading Skills

Retention of English reading skills in the control group

Table V1

Retention of English reading components of the control group in Phase 3

		M	n	SD	SE
Pair 1	Phase 3 Letter Sound Reading	29.7	96	30.1	3.1
	Phase 2 Letter Sound Reading	24.6	96	18.3	1.9
Pair 2	Phase 3 Non-Word Reading	19.8	96	14.8	1.5
	Phase 2 Non-Word Reading	15.2	96	10.7	1.1
Pair 3	Phase 3 Familiar Word Reading	25.3	96	18.4	1.9
	Phase 2 Familiar Word Reading	23.4	96	17.2	1.8
Pair 4	Phase 3 Passage Reading	38.5	96	26.4	2.7
	Phase 2 Passage Reading	35.9	96	22.3	2.3
Pair 5	Phase 3 Comprehension Reading	1.9	96	1.3	0.1
	Phase 2 Comprehension Reading	1.6	96	1.0	0.1
	Phase 3 Total EGRA English Score	115.3	96	79.9	8.2
Pair 6	Phase 3 Total EGRA English Score	115.3	96	79.9	8.2
	Phase 2 Total EGRA English Score	100.6	96	59.7	6.1

Note: *M* = Mean; *n* = group sample size; *SD* = Standard deviation; *SE* = Standard error mean

Retention of English reading in the experiment group

Table V2

Retention on English reading components of experiment group in Phase 3

		M	n	SD	SE
Pair 1	Phase 3 Letter Sound Reading	57.1	96	26.5	2.7
	Phase 2 Letter Sound Reading	60.4	96	21.9	2.2
Pair 2	Phase 3 Non-Word Reading	28.5	96	12.5	1.3
	Phase 2 Non-Word Reading	26.9	96	10.7	1.1
Pair 3	Phase 3 Familiar Word Reading	30.2	96	14.7	1.5
	Phase 2 Familiar Word Reading	32.6	96	13.8	1.4
Pair 4	Phase 3 Passage Reading	44.3	96	22.8	2.3
	Phase 2 Passage Reading	48.1	96	19.1	1.9
Pair 5	Phase 3 Comprehension Reading	2.1	96	1.2	0.1
	Phase 2 Comprehension Reading	2.3	96	0.9	.01
Pair 6	Phase 3 Total EGRA English Score	162.2	96	62.3	6.4
	Phase 2 Total EGRA English Score	170.4	96	53.8	5.5

Note: *M* = Mean; *n* = group sample size; *SD* = Standard deviation; *SE* = Standard error mean

Retention of English reading in the comparison group

Table V3

Retention of English reading components of the comparison group in Phase 3

		M	n	SD	SE
Pair 1	Phase 3 Letter Sound Reading	54.6	96	19.7	2.0
	Phase 2 Letter Sound Reading	60.6	96	26.1	2.7
Pair 2	Phase 3 Non-Word Reading	26.7	96	12.7	1.3
	Phase 2 Non-Word Reading	30.9	96	14.7	1.5
Pair 3	Phase 3 Familiar Word Reading	31.9	96	15.2	1.6
	Phase 2 Familiar Word Reading	34.4	96	16.3	1.7
Pair 4	Phase 3 Passage Reading	48.6	96	22.7	2.3
	Phase 2 Passage Reading	53.4	96	23.4	2.4
Pair 6	Phase 3 Comprehension Reading	2.8	96	1.1	0.1
	Phase 2 Comprehension Reading	3.0	96	1.1	0.1
Pair 6	Phase 3 Total EGRA English Score	164.7	96	63.0	6.4
	Phase 2 Total EGRA English Score	182.3	96	74.9	7.7

Note: *M* = Mean; *n* = group sample size; *SD* = Standard deviation; *SE* = Standard error mean

Appendix X

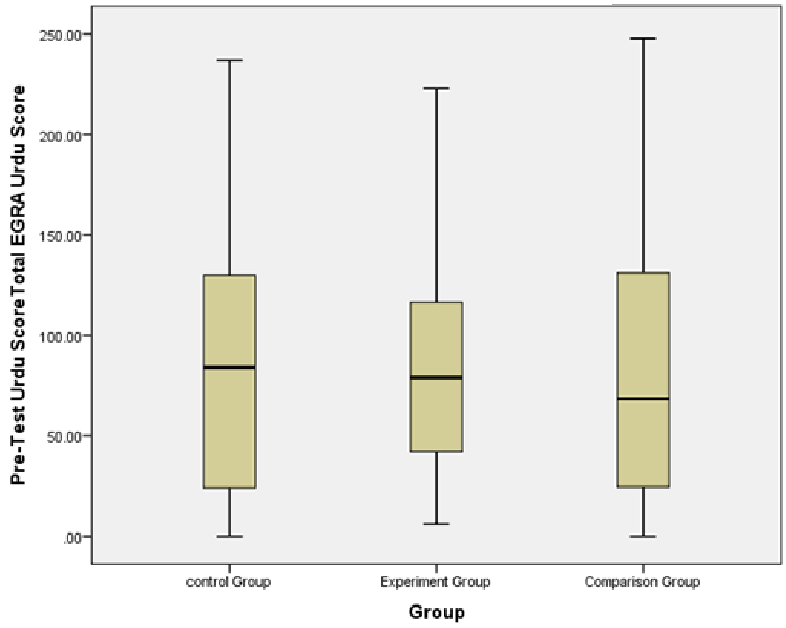
Assumptions for One-Way ANOVA for Urdu Reading

Assumption 1: No significant outliers

No outliers were detected in the data set as evident by boxplots (Figure 5.16)

Figure X1

Boxplots showing no outliers for EGRA Urdu pre-tests



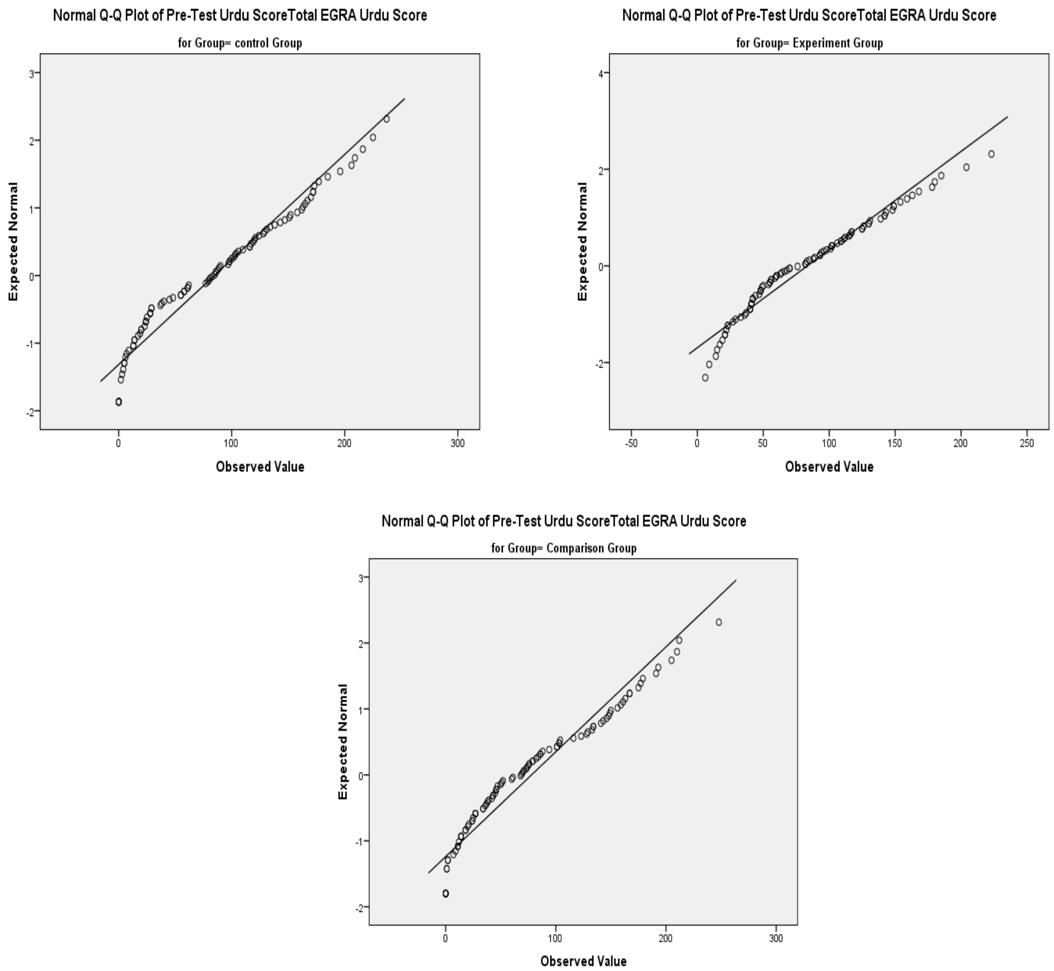
Assumption 2: Normal distribution of the dependent variable

The dependent variable (pre-test Urdu scores) was approximately normally distributed as assessed by Normal Q-Q plots (Figure 5.17),

Figure X2

Normal Q-Q plots showing normality of pre-test EGRA Urdu scores for control, experiment and

.



Assumption 3: Homogeneity of variance

The assumption of homogeneity of variance was not met, as assessed by Levene's test (p = 0.007) a shown in Table a(5.4)

Table X1

Test of homogeneity of variance for pre-test EGRA Urdu

		Levene's Statistic	df1	df2	Sig.
Pre-Test Total EGRA Urdu Score	Based on Mean	5.082	2	285	.007

84.7, *SD* =64.4) to experiment group (*M* = 83.4, *SD* = 49.2) to comparison group (*M* = 77.9, *SD* = 62.9). However, the differences between the pre-test Urdu scores was not statistically significant (Table 5.29), one-way Welch's $F(2, 186.9)$ = 0.320, p = 0.727 ($p > 0.05$). Therefore, we fail to reject the null hypothesis i.e., there is no difference between Urdu reading skills of students belonging to control, experiment, and comparison groups. Table 5.28 presents pre-test EFRA Urdu scores in order of achievement from control group (*M* =

Appendix Y

Assumptions for one-way ANCOVA (Phase 2, EGRA Urdu)

Linear relationship between covariate and dependent variable:

Assumption of linearity between covariate and post-test EGRA Urdu scores was assessed using correlations. Table 5.5a shows a statistically significant correlation between pre-test EGRA Urdu (covariate) and post-test EGRA Urdu scores (dependent variable), $r = 0.654$, $N = 288$, $p < 0.001$. Hence, the assumption of linearity between covariate and dependent variable was met.

Table Y1

Correlations between pre-test scores (covariate) and post-test scores (dependent variable) for EGRA Urdu

		Pre- EGRA Urdu	Post-Test Urdu
Pre-Test EGRA Urdu	Pearson Correlation	1	.654**
	Sig. (2-tailed)		.000
	N	288	288

**. Correlation is significant at the 0.01 level (2-tailed).

Homogeneity of regression slopes

This assumption checks if there is an interaction between the covariate (pre-test scores) and the independent variables. Scatterplots were created using SPSS to assess the interaction between covariate and the independent variables. The regression slopes interacted with each other which means that the assumption of homogeneity of regression was violated. To correct this violation, log10 transformation was applied on the covariate. This assumption was also statistically assessed by determining if there is a statistically significant interaction term, Group*preTestUrdu_Log10. Table 5.5b confirms that there was no statistically significant interaction between transformed covariate and the independent groups. Hence, the assumption of homogeneity of regression slopes was fulfilled as the interaction term was not statistically significant, $F(2, 271) = 1.17$, $p = 0.312$.

Table Y2

Test of interaction between covariates and dependent variable for Urdu reading skills in Phase 2

Tests of Between-Subjects Effects

Dependent Variable: Post-Test Urdu Score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	817799.9[a]	5	163559.9	73.4	.000
Intercept	14123.2	1	14123.2	6.3	.012
Group	37448.9	2	18724.5	8.4	.000
PreTestUrdu_log10	422345.4	1	422345.4	189.5	.000
Group * PreTestUrdu_log10	5209.4	2	2604.7	1.17	.312
Error	604134.3	271	2229.3		
Total	6762737.0	277			
Corrected Total	1421934.2	276			

a. R Squared = .575 (Adjusted R Squared = .567); df = degrees of freedom; *F* = F-statistic

Approximate normal distribution of standardised residuals of dependent variable

Shapiro-Wilk test was performed to assess the normality of standardized residuals. Table 5.5c indicates that standardised residuals for dependent variable were normally distributed across three independent groups (W = 0.973, p = 0.053; W = 0.993, p = 0.915; W = 0.971, p= 0.051). Since p-values for each group is greater than 0.05, hence it was assumed that dependent variable was normally distributed.

Table Y3

Shapiro-Wilk test of normality for Standardised Residual for Post-Test EGRA Urdu (Phase 2)

	Group	Statistic	df	Sig.
Standardized Residual for Post-Test EGRA Urdu	Control Group	.973	91	.053*
	Experiment Group	.993	96	.915*
	Comparison Group	.971	90	.051*

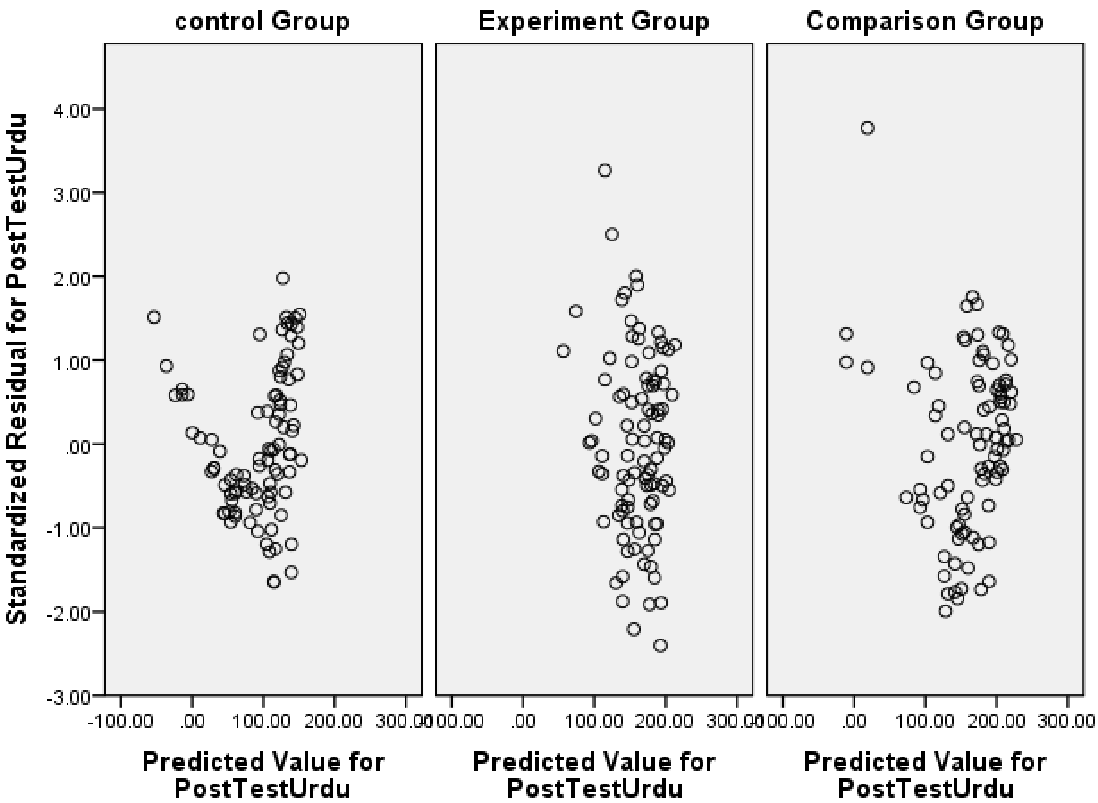
*. Significance at the level of 0.05.

Homoscedasticity

To verify the assumption of homoscedasticity, standardised residuals were plotted against the predicted values whilst fitting the model for one-way ANCOVA using SPSS. Figure 5.19 indicates no specific pattern, hence, the assumption of homoscedasticity was approximately fulfilled.

Figure Y1

Scatterplot of control, experiment, and comparison group showing homoscedasticity



Homogeneity of variance

Homogeneity of variance for standardised residuals was calculated using Levene's test. Table 5.33 indicates that residuals violated the assumption of homogeneity of variance, $F(2, 274) = 3.72$, $p = 0.025$ ($p < 0.05$). However, F-statistic for one-way ANCOVA is generally robust to the violations of homogeneity of variance as long as group sizes are equal. Since, the present study is designed with equal group sizes, therefore, violation of this assumption did not affect the analysis of one-way ANCOVA.

Table Y4

Levene's test of homogenity of variance for Urdu reading in Phase 2

F	df1	df2	Sig.
3.72	2	274	.025

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

No significant outliers

Inspection of boxplots created for standardised residuals of dependent variable (post-test EGRA Urdu) revealed two outliers, however, no outlier lied outside 1.5 box-lengths from the edge of the box, therefore, the outliers were not removed.

Appendix Z

Retention of Urdu reading skills

Retention of Urdu reading skills in the control group

Table Z1

Retention of Urdu reading components of the control group in Phase 3

		M	n	SD	SE
Pair 1	Phase 3 Letter Sound	46.6	96	31.9	3.3
	Phase 2 Letter Sound	34.5	96	22.6	2.3
Pair 2	Phase 3 Non-Word Reading	20.4	96	16.2	1.7
	Phase 2 Non-Word Reading	16.5	96	13.6	1.4
Pair 3	Phase 3 Familiar Word Reading	11.7	96	15.6	1.6
	Phase 2 Familiar Word Reading	9.1	96	11.2	1.1
Pair 4	Phase 3 Passage Reading	31.3	96	28.9	2.9
	Phase 2 Passage Reading	27.2	96	27.3	2.8
Pair 5	Phase 3 Comprehension Reading	1.8	96	1.8	0.2
	Phase 2 Comprehension Reading	1.1	96	1.4	0.1
Pair 6	Phase 3 Total EGRA-Urdu	111.8	96	83.4	8.5
	Phase 2 Total EGRA-Urdu	88.4	96	67.2	6.9

Note: *M* = Mean; *n* = group sample size; *SD* = Standard deviation; *SE* = Standard error mean

Retention of Urdu reading skills in the experiment group

Table Z2

Retention of Urdu reading components of experiment group in Phase 3

		M	n	SD	SE
Pair 1	Phase 2 Letter Sound	69.2	96	20.5	2.1
	Phase 3 Letter Sound	67.0	96	21.6	2.2
Pair 2	Phase 2 Non-Word Reading	30.7	96	12.3	1.3
	Phase 3 Non-Word Reading	26.9	96	12.3	1.3
Pair 3	Phase 2 Familiar Word Reading	18.0	96	12.9	1.3
	Phase 3 Familiar Word Reading	15.2	96	14.3	1.5
Pair 4	Phase 2 Passage Reading	40.8	96	21.3	2.2
	Phase 3 Passage Reading	36.1	96	27.2	2.8
Pair 5	Phase 2 Comprehension Reading	2.5	96	1.5	0.2
	Phase 3 Comprehension Reading	2.3	96	1.6	0.2
Pair 6	Phase 2 Total EGRA-Urdu	161.2	96	57.2	5.8
	Phase 3 Total EGRA-Urdu	147.5	96	62.2	6.3

Note: *M* = Mean; *n* = group sample size; *SD* = Standard deviation; *SE* = Standard error mean

Retention of Urdu reading skills in the comparison group

Table Z3

Retention of Urdu reading components of the comparison group in Phase 3

		M	n	SD	SE
Pair 1	Phase 2 Letter Sound	61.7	96	25.6	2.6
	Phase 3 Letter Sound	51.1	96	21.3	2.2
Pair 2	Phase 2 Non-Word Reading	28.8	96	15.4	1.6
	Phase 3 Non-Word Reading	25.2	96	13.6	1.4
Pair 3	Phase 2 Familiar Word Reading	20.2	96	14.5	1.5
	Phase 3 Familiar Word Reading	16.3	96	11.6	1.2
Pair 4	Phase 2 Passage Reading	40.6	96	23.9	2.4
	Phase 3 Passage Reading	37.5	96	22.6	2.3
Pair 5	Phase 2 Comprehension Reading	2.9	96	1.4	0.1
	Phase 3 Comprehension Reading	2.8	96	1.2	0.1
Pair 6	Phase 2 Total EGRA-Urdu	154.3	96	73.3	7.5
	Phase 3 Total EGRA-Urdu	132.8	96	64.1	6.5

Note: *M* = Mean; *n* = group sample size; *SD* = Standard deviation; *SE* = Standard error mean

Appendix AA

Ethics Approval

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THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato

MEMORANDUM

To:	**Farzana Ahmad**
cc:	AProf Wendy Fox-Turnbull
From:	**Dr Nicola Daly** Co-chair Faculty of Education Research Ethics Committee
Date:	20/8/18

Request for Extension to Research Ethics Approval – Student (FEDU056/18)

Thank you for your request for an extension to ethics approval for the project:

Impact of digital games on early reading skills in a developing country context

It is noted that you wish to add non-participatory observations of four randomly selected sessions (two from experiment group and two from comparison group) during which the researcher will take the observation notes.

Thank you for the amended information and consent forms which will be held on file.

I am pleased to advise that the extension has received approval.

Please note that researchers are asked to consult with the Faculty's Research Ethics Committee in the first instance if any further changes to the approved research design are proposed.

The Committee wishes you all the best with your research.

Nicola Daly

Dr Nicola Daly
Co-chair Faculty of Education Research Ethics Committee

Appendix BB

Resources Acquired for the Research

Table BB

List and Purpose of Resources Acquired for the Study

Resource	Quantity	Purpose
Android Tablets	30	To conduct DGBL intervention in EG and CMG
Digital game: Teach Your Monster	1 x game with the license to install on multiple devices	Game used for developing reading skills in EG and CMG
Digital camera and tripod stand	1	For recording DGBL sessions and interviews
iPad	1	For observations, interviews and group interviews using video conferencing through Whtasapp and Facetime app.
Data collectors	2	for data collection and establishing direct contact with the researcher
Print material	Phase 1 13 copies of the game evaluation tool 6 Copies of Paired game evaluation tool. Phase 2 288 copies of Pre EGRA test 288 copies of Post EGRA tests 288 copies of ERAS survey Phase 3 288 copies of post-post EGRA test 300 copies of post-post EGRA test	Printed materials used in data collection during different phases of the research