

<http://researchcommons.waikato.ac.nz/>

## Research Commons at the University of Waikato

### Copyright Statement:

The digital copy of this thesis is protected by the Copyright Act 1994 (New Zealand).

The thesis may be consulted by you, provided you comply with the provisions of the Act and the following conditions of use:

- Any use you make of these documents or images must be for research or private study purposes only, and you may not make them available to any other person.
- Authors control the copyright of their thesis. You will recognise the author's right to be identified as the author of the thesis, and due acknowledgement will be made to the author where appropriate.
- You will obtain the author's permission before publishing any material from the thesis.

# **Co-browsing the Greenstone digital library collection**

A thesis submitted in partial fulfilment of requirements for the degree

of

**Master of Science in Computer Science**

at

**The University of Waikato**

by

**Saad Alzahrani**



THE UNIVERSITY OF  
**WAIKATO**  
*Te Whare Wānanga o Waikato*

2014

## Abstract

**Context:** Social interaction is an important aspect of a successful web page. Social network sites attract many people worldwide. The social interaction aspect is missing from digital libraries, including the Greenstone Digital Library.

**Objectives:** This study investigates how two distant users exchange information while in front of the computer and browsing the same Greenstone Digital library collection, in real time, and identifies the features that support their needs.

**Methods:** To answer the research questions, an observation methodology is applied to gain more insight into users' information-seeking behaviour for an online DL. Two recording elements were used to gather data from a sample of eight pairs of university students (n=16). The two elements were video camera (with audio) and screen capture. Further, a questionnaire was used to collect data about the workload during the session.

**Results:** The data obtained was analysed using conversation and content analysis methods. The findings of this user study related to the metadata presentation, referencing information and search box activities. A Co-browsing GDL system is proposed based on the requirements derived from findings from the user study and also the related works.

**Evaluation:** A usability test is used to evaluate the effectiveness, efficiency and satisfaction of the proposed system. Think aloud and questionnaire methods are used to gather the data of this usability test.

**Results:** The result of this study “debug” the proposed Co-browsing GDL system and explore issues related to communication and private works, with it having become apparent through the study that improvements can be made to some parts of the system presentation.

**Conclusions:** The findings of the thesis research have been used to provide recommendations for future work to develop and implement a Co-browsing Greenstone digital library (GDL) system.

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

"الْحَمْدُ لِلَّهِ الَّذِي لَهُ مَا فِي السَّمَاوَاتِ وَمَا فِي الْأَرْضِ وَلَهُ الْحَمْدُ فِي الْآخِرَةِ وَهُوَ الْحَكِيمُ الْخَبِيرُ" {1} (سُورَةُ سَبَأٍ)

In the name of Allah, the Beneficent, the Merciful

"All the praises and thanks be to Allah, to Whom belongs all that is in the heavens and all that is in the earth. His is all the praises and thanks in the Hereafter, and He is the All-Wise, the All-Aware" (Quran: Verse 34:1, Mohsin Khan Translation)

## Acknowledgments

*First and foremost, I thank Allah (God) for giving me the strength and ability to complete this study, and for giving me the power to believe in my passion and pursue my dreams. I could never have done this without the faith I have in you.*

*Especial thanks go to my mother, Fatimah, my father, Ghorom, and my grandfather, Saad, for their support, prayers and love during my study. I would like to thank my beloved wife, Dalal, for her love, understanding and support while she too was busy with her studies back in Saudi.*

*I am sincerely grateful to my supervisor, Dr Annika Hinze, for her support, wisdom, enthusiasm, guidance and advice throughout this study. Without her assistance it would have been impossible to write this thesis. Thanks also go to Nicholas Vanderschantz and Claire Timpany for their valuable assistance in designing the user study. Thanks to Hayat for providing all her dissertation materials to start my thesis, and thanks to her husband, Bader Alkolify, for his friendship and supportive words.*

*I would like to thank all of the people who participated in the user study and the usability test and appreciate their time, and all Bin-Asalah family members at home for their encouragement and motivation during the journey of completing my study.*

*I am grateful to the King Abdullah Bin Abdulaziz Programme for giving me the opportunity to continue my studies in such a peaceful and beautiful country, New Zealand.*

*Additionally, I would like to express my deepest appreciation to my friends Mohammed Alghamdi and Abdul Aziz Alshaer for their support and valuable discussion about my thesis study. I am grateful to my flatmate Abdul Mohsen Abdullah Mohammad Ali Alzahrani for creating a good atmosphere in which to complete my thesis study. Last, but not least, I would like to thank my friends in New Zealand, especially Mumrize, Mohammad, Amay and Mario, as well as those back in Saudi for supporting my best effort on my project.*

## Table of Contents

<b>Abstract.....</b>	<b>ii</b>
<b>Acknowledgments .....</b>	<b>iv</b>
<b>1.0 Introduction.....</b>	<b>1</b>
1.1 Research Questions .....	3
1.2 Importance of the Study .....	3
1.3 Terms and Definitions.....	5
1.4 Thesis Structure.....	6
<b>2.0 Related Works .....</b>	<b>7</b>
2.1 Social Interaction in a Physical Library.....	7
2.1.1 Communication.....	8
2.1.2 Awareness .....	9
2.1.3 Collaborative Navigation .....	9
Navigation Across Collections.....	10
Navigation Inside a Book.....	11
2.1.4 Group Assessment of Information .....	12
2.1.5 Summary .....	13
2.2 Collaborative Information in a Digital Environment .....	14
2.2.1 Collaborative Information Seeking.....	14
SearchTogether .....	14
CoSense .....	16
Coagmento .....	17
Distributed Tabletop .....	18
CoSearch.....	19
2.2.2 Collaborative Evaluation and Recommendation.....	21
Goodreads .....	21
LibraryThing.....	23
2.2.3 Collaborative Reading .....	24
BuddyBooks.....	24
Kindle .....	25
2.2.4 Digital Collection Management Tools.....	26
Mendeley .....	26
Greenstone .....	27
2.3 Summary and Discussion.....	29
<b>3.0 Methods and Design.....</b>	<b>32</b>

<b>3.1 Users Study Design.....</b>	<b>32</b>
3.1.1 Sample Study .....	33
3.1.2 Demographic Questionnaire .....	34
3.1.3 Tasks .....	35
3.1.4 Digital Document Collection and Greenstone Website Interface .....	36
3.1.5 Environment.....	38
3.1.6 Medium of Communication.....	39
3.1.7 Recording Elements .....	39
3.1.8 Follow-up Questionnaire (self-report) .....	42
3.1.9 Procedure and Data Collection .....	42
3.1.10 Limitations .....	44
<b>3.2 Research Validity .....</b>	<b>45</b>
3.2.1 Internal Validity .....	45
3.2.2 External Validity .....	47
3.2.3 Data Analysis .....	47
<b>3.3 Result and Data Analysis.....</b>	<b>50</b>
3.3.1 Demographic Questionnaire Data.....	50
3.3.2 Recording Elements Data .....	54
Communication Channels.....	54
Time Spent on Tasks.....	55
Conversation Analysis .....	56
3.3.3 Follow-up Questionnaire Data .....	66
<b>3.4 Discussion.....</b>	<b>68</b>
<b>4.0 Proposed System .....</b>	<b>72</b>
<b>4.1 Prototype Overview.....</b>	<b>72</b>
4.1.1 Low-Fidelity Prototyping.....	72
4.1.2 Limitations .....	73
<b>4.2 Requirements for the Co-browsing GDL System.....</b>	<b>73</b>
<b>4.3 Co-browsing GDL Prototype .....</b>	<b>81</b>
<b>4.4 Scenarios .....</b>	<b>86</b>
4.4.1 Scenario: Separate Location, Separate Screen, Same Time .....	86
4.4.2 Scenario: Same Location, Separate Screen, Same Time.....	87
<b>4.5 Limitations .....</b>	<b>88</b>
<b>5.0 Usability Test.....</b>	<b>89</b>
<b>5.1 Usability Evaluation Methods .....</b>	<b>89</b>

5.1.1	Think Aloud Protocol .....	90
5.1.2	Follow-up Questionnaire .....	90
<b>5.2</b>	<b>Designing the Test .....</b>	<b>90</b>
5.2.1	Task Design .....	90
5.2.2	Follow-up Questionnaire Design .....	92
5.2.3	Participants.....	94
<b>5.3</b>	<b>Procedure .....</b>	<b>94</b>
<b>5.4</b>	<b>Result and Data Analysis.....</b>	<b>95</b>
5.4.1	Time Spent on Tasks.....	95
5.4.2	Task Observations.....	97
5.4.3	Follow-up Questionnaire Feedback on the Think Aloud Protocol .....	101
<b>5.5</b>	<b>Discussion.....</b>	<b>103</b>
5.5.1	Usability Assessment of Co-browsing GDL.....	103
	Effectiveness .....	103
	Efficiency .....	103
	Satisfaction.....	104
	Participants' suggestions to improve the Co-browsing GDL.....	104
5.5.2	Validity and Reliability of Results.....	105
	Credibility .....	105
	Transferability.....	106
	Dependability.....	106
	Conformability.....	106
<b>6.0</b>	<b>Conclusion, Recommendations, Scope of the Study and Limitations and Future Works .....</b>	<b>107</b>
6.1	Conclusion.....	107
6.2	Recommendations .....	108
6.3	Scope of the Study and Limitations .....	108
6.4	Future Works .....	109
<b>7.0</b>	<b>References .....</b>	<b>111</b>
<b>8.0</b>	<b>Appendixes.....</b>	<b>117</b>



## List of Figures

Figure 2-1: Interactions by focus and communication. Adapted from “Social Information Behaviour in Bookshops: Implications for Digital Libraries,” by Cunningham S.J., Vanderschantz N., Timpany C., Hinze A., & Buchanan G. 2013, <i>Research and Advanced Technology for Digital Libraries</i> , vol. 8092, pp. 84–95. Copyright 2013. Reprinted with permission. ....	9
Figure 2-2: Observed collaborative behaviours. Adapted from “Social Information Behaviour in Bookshops: Implications for Digital Libraries,” by Cunningham S.J., Vanderschantz N., Timpany C., Hinze A., & Buchanan G. 2013, <i>Research and Advanced Technology for Digital Libraries</i> , vol. 8092, pp. 84–95. Copyright 2013. Reprinted with permission. ....	10
Figure 2-3: The SearchTogether client. (a) integrating messaging, (b) query awareness, (c) current results, (d) recommendation queue, (e)(f)(g) search buttons, (h) page-specific metadata, (i) toolbar, (j) browser. Adapted from “SearchTogether: an interface for collaborative web search,” by S. Paul & M. Morris, Eric. Copyright 2007, <i>Proceedings of the 20th annual ACM symposium on User interface software and technology</i> , pp. 84–95. 2007. Reprinted with permission. ....	15
Figure 2-4: Coagmento interface .....	17
Figure 2-5: Mixed presence tabletop collaboration over digital artifacts using Distributed Tabletops. Adapted from “Distributed Tabletops: Supporting Remote and Mixed-Presence Tabletop Collaboration,” by P. Robinson and P. Tuddenham, Eric. 2007, <i>Second Annual IEEE International Workshop on Horizontal Interactive Human-Computer Systems (TABLETOP'07)</i> , pp. 19-26. Copyright 2007. Reprinted with permission. ....	19
Figure 2-6: CoSearchPC, with annotations identifying key UI features. Adapted from “CoSearch: a system for co-located collaborative web search,” by S. Amershi and M. Morris. 2008, <i>Proceedings of the SIGCHI Conference on Human Factors in Computing Systems</i> , pp. 1647–1656. Copyright 2008. Reprinted with permission. ....	20

Figure 2-7: CoSearchMobile (main menu). Adapted from “CoSearch: a system for co-located collaborative web search,” by S. Amershi and M. Morris. 2008, Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 1647–1656. Copyright 2008. Reprinted with permission.....	21
Figure 2-8: Goodreads user's profile .....	22
Figure 2-9: LibraryThing cover view .....	23
Figure 2-10: Screen shot from BuddyBooks. Adapted from “Co-reading: investigating collaborative group reading,” J. Pearson and T. Owen. 2012, Proceedings of the 12th ACM/IEEE-CS joint conference on Digital Libraries, pp. 325–334. Copyright 2012. Reprinted with permission.....	25
Figure 2-11: Mendeley interface .....	27
Figure 3-1: Librarian Interface (GLI) .....	37
Figure 3-2: eLearning Greenstone collection.....	38
Figure 3-4: Participants in two separate rooms.....	40
Figure 3-5: CamStudio Video Options .....	41
Figure 3-6: Procedure.....	43
Figure 3-7: Tools used for online group work, a participant may be mentioned twice .....	53
Figure 3-8: Social network service for education purposes, a participant may be mentioned twice .....	54
Figure 3-9: Medium of communication, only one option for each group.....	55
Figure 3-10: Average Task Completion Time (in seconds) .....	56
Figure 3-11: Frequency of search box activities .....	59
Figure 3-12: Referencing related activities .....	63
Figure 3-13: Count frequency of evaluation statements .....	65
Figure 3-14; Workload in different forms of communication .....	66
Figure 4-1: Interface of the start page of GDL system .....	81

Figure 4-2: Joint interface of the Co-browsing GDL.....	82
Figure 4-3: Login interface of the Co-browsing GDL.....	82
Figure 4-4:Co-browsing GDL interface.....	83
Figure 4-5:Co-browsing GDL information presentation .....	84
Figure 4-6: Co-browsing GDL reading a document view .....	85
Figure 5-1: Average Task Completion Timing.....	96
Figure 5-2: Effectiveness of Co-browsing GDL using Think Aloud Protocol Method .....	101
Figure 5-3: Efficiency of Co-browsing GDL using Think Aloud Protocol Method .....	102
Figure 5-4: Satisfaction of Co-browsing GDL using Think Aloud Protocol Method .....	102

## List of Tables

Table 2-1: Collaborative system comparisons .....	30
Table 3-1: Conversation Elements .....	48
Table 3-2: Demographic Questionnaire Data .....	52
Table 3-3: Time Spent by each Group (in seconds).....	55
Table 4-1: Telepointer.....	75
Table 4-2: Multi-user scrollbar pointer .....	76
Table 4-3: Approaches of pointing out more specific POI inside a document .....	77
Table 4-4: Icons for the Co-browsing GDL .....	79
Table 5-1 Tasks for Usability Tests .....	91
Table 5-2: Follow-up Questionnaire .....	92
Table 5-3: Question Division .....	94
Table 5-4: Task Timings (in seconds) in Think Aloud Protocol .....	96

# Chapter 1

## 1.0 Introduction

Shared browsing is a common activity among patrons in a physical library. A number of studies have investigated patrons' behaviour in a physical library when browsing and selecting objects, in association with the social aspect [1]–[6]. Physical libraries are considered as “third places” which are not home, “first place”, or work, “second place” [6], [7]. In these places people (friends and strangers) can collaborate; they can develop a relationship and a sense of community.

People enjoy working together in a group to carry out a common task faster and with less effort. The pleasure they find in discussing books can be seen in the book club phenomenon, a familiar and widespread activity in many countries. In addition, people enjoy browsing together for books or assisting each other to find an item [6]. Searching, browsing, sampling and reading are considered to be social activities.

In the past decade there has been considerable growth in social network websites. Facebook<sup>1</sup>, Twitter<sup>2</sup> and YouTube<sup>3</sup> are ranked as the most visited sites worldwide (Alexa: Top Sites<sup>4</sup>). People find it easy to share thoughts and opinions with others through these websites. They exchange information and have conversations about items (or products). Users are seen to be influenced by the opinions of their friends to make decisions in selecting items [8]–[10].

A known community that focuses on how people collaborate using technology is computer-supported cooperative work (CSCW) [11]. It addresses how several technologies can serve collaborative activities. A collaboration system may support one or more of the four CSCW matrixes based on location (remote or co-located), or on time (synchronous or asynchronous) [11].

---

<sup>1</sup> facebook.com

<sup>2</sup> twitter.com

<sup>3</sup> youtube.com

<sup>4</sup> www.alex.com

Synchronous interaction provides enjoyment and motivation among users [12]. The quick response in the real-time interaction makes another party more committed and motivated. A form of synchronous activity is “co-browsing”, which is a real-time sharing of navigation and pointing to content on the same webpage with one or more users [13]. Many studies focus on shared browsing of the whole internet rather than a specific page of content [13]. Allowing a group of users to share the same digital library collection is the focus of this study.

Current digital libraries (DLs), including the Greenstone digital library collection (GDL), do not support social interaction. Greenstone<sup>5</sup>, a popular open-source organizer tool for generating a digital library collection, is produced by the New Zealand Digital Library Project at the University of Waikato. The digital library web page that is generated by this tool is for a single-user only [14], rather than for multi-users. It does not support any social interaction or a collaboration platform between users.

A literature review shows that no study has investigated group information-seeking behaviour of remote computer users who are browsing the same digital articles collection. There is still a need to gain more insight into users’ information-seeking behaviour with respect to online DL. Consequently, this study will investigate a pair of non-located users interacting and collaborating, using computers for browsing the same Greenstone DL collection, and in doing so identify suitable features that support their needs.

This research applied an observation methodology to investigate how two distant users exchange information while in front of the computer. It combines two methods of recording the participants and their screen activities: video camera (with audio) and screen capture.

---

<sup>5</sup> greenstone.org

## 1.1 Research Questions

- What features are useful for users who are browsing together in the same digital library collection from separate locations?
- What type of communication channels are most users using to exchange information simultaneously?
- How can effort and time be reduced to allow users, who browse the same collection, to achieve their shared task?
- Which metadata presentation is suitable for a co-browsing system?
- How should the search function result presentation be in a Co-browsing GDL system?
- What is the best web navigation for the Co-browsing GDL system?

## 1.2 Importance of the Study

The web-based application makes it possible to contact users over distance to allow them to interact with each other and collaborate to achieve common tasks. Investigating the features to support a digital library has some advantages. Clearly, social interaction functionalities on a website attract many visitors to the site (e.g., Facebook, Twitter, YouTube and Google+<sup>6</sup> and LinkedIn<sup>7</sup>). Adding these functionalities to the Greenstone digital library could make it possible for visitors to browse the collection together with friends and increase its popularity. This could create enjoyment and motivation and a critical discussion about proper references and/or exchange experience. Further, connection with peers may increase the serendipity of discovering books while browsing.

Ackerman [15] outlines four ways in which providing social interaction in a digital library benefit and serve the information seeking process:

- One may need to communicate with the other person to “know what to know”, in other words, to assist in selecting material; or
- Seek informal information (e.g., technical fixes or organizational work-

---

<sup>6</sup> plus.google.com

<sup>7</sup> linkedin.com

arounds); or

- Look for assistance to understand highly specific information, and inquiries for this kind of information can be time-consuming, as “Information seekers often have highly specific interests and needs”.
- Physical libraries have a socializing function (e.g., study groups) that could be incorporated into a DL.

The outcomes of this study could also be useful for bookshop sites. The study provides a greater understanding of connected users’ activities and their needs when browsing together. Bookshop sites, therefore, can use such information (browsing and searching strategies) to improve their services to meet users’ needs, which could result in increasing the degree of satisfaction of current users and attracting more users to the site, and ultimately to greater profit.



### 1.3 Terms and Definitions

**Physical library** is a place that contains information material such as books, DVDs and maps. It can be an academic library, a bookstore, a public library or a private library.

**Digital library** is a way of storing digital information content either online or in a computer data storage system (e.g., CD).

**Online digital libraries** are sites for storing digital content on the Internet that can be accessed from any place where there is Internet access, and at any time.

**Co-browsing** refers to the shared browsing of the same web page content at the same time by two or more users.

**Third place** refers to places that have social surroundings (community building), since these places are not the two usual social environments: home and the workplace [7].

**Patron** refers to library customer.

**Observation technique** is entering the physical library (or place) in order to observe people's behaviour [6].

**Formal information** “is typically written and may be divided into data (numbers and other raw information) and processed information that is based on interpretation and analysis of the raw data.” [16].

**Informal information** “consists of information obtained through conversation and business transactions.” [16].

**Folksonomy** is a decentralised, social approach to creating and managing tags to categorize content.

**Synchronous communication** is a real time communication.

**Asynchronous communication** is a different time communication.

## 1.4 Thesis Structure

This section describes how the thesis is structured. The remainder of the thesis is divided into the following five sections:

**Chapter 2:** This chapter discusses related work in two main areas: first, social interaction in physical libraries; second, the collaborative system information in the digital environment including a description of existing collaborative systems for information seeking, evaluation and recommendation and reading; and then, the management systems that are related to this study. Finally, there will be a summary of the related systems, followed by a summary and discussion of the whole chapter.

**Chapter 3:** This chapter describes the observation methodology. It combines two methods: camera and screen recording to gain an insight into users' needs. Also, the results and data analysis are reported. The Co-browsing GDL's features are identified in this section.

**Chapter 4:** This chapter discusses the proposed design for a Co-browsing GDL system based on user study. It reviews some previous techniques related to the system and proposes suitable ones for the Co-browsing GDL system.

**Chapter 5:** This chapter presents the usability test for the proposed design. It discusses the usability test design and the methodology that has been used. Further, a result and discussion of this usability test is reported.

**Chapter 6:** Concludes this paper with recommendations, scope and limitations, of the study and a discussion of future work.

## Chapter 2

### 2.0 Related Works

This chapter identifies all possible related works associated with users' information behaviour. It will cover four main aspects of collaborative systems. These aspects are covered in both the physical and digital environments.

1. **Communication:** Refers to the process of exchanging information and knowledge between group members [13]. Communication is the core element in any collaboration or social environment (or system).
2. **Awareness:** Is the ability of group members to be aware of each other's action or activities, which involve verbal and non-verbal communication [13], [17]. Awareness is considered to be the fundamental feature of an effective collaborative information system.
3. **Collaborative navigation (or referencing):** Refers to the group activity of locating and tracking information. A collaborative system should have navigation features inside the document and within a collection to assist people to find the search object fast and with less effort.
4. **Group information assessment:** Refers to the way people share their opinions about and reviews of an object. Evaluation is an important feature that encourages people to have a discussion, or not, about an object, based on other people's reviews.

The chapter starts with the social interaction in a physical library followed by the collaborative system information in the digital environment, including a description of existing collaborative systems for information seeking, evaluation and recommendation and reading. Then, digital collection management systems are discussed. The chapter concludes with a summary and discussion of the related works discussed.

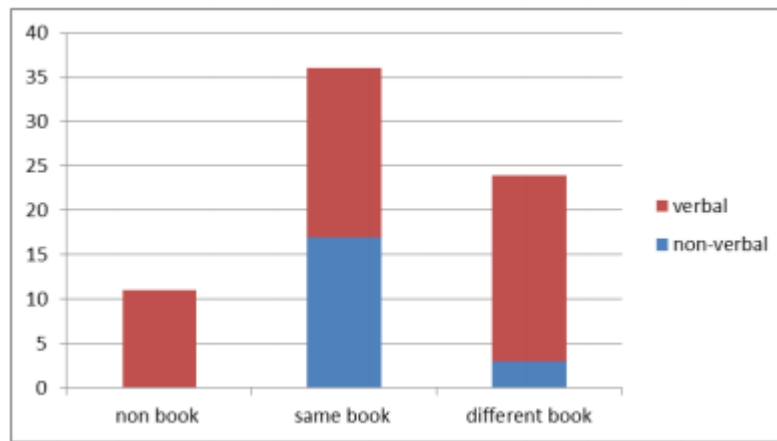
#### 2.1 Social Interaction in a Physical Library

This section mainly reviews two studies that applied observation methodology in physical places. The two studies focused on pairs or small groups of patrons who

entered such places. The first study involved observation conducted in an academic library, in this case the central library of the University of Waikato, New Zealand (10 of the 40 observed visitors) [5]. The second study was based on observations conducted in five bookshops, four in New Zealand and one in the USA (42 instances of groups: 94 bookstore visitors in total) [6]. The studies focused on groups of people browsing bookshelves and selecting books (in non-fiction areas). This section covers four aspects: communication, awareness, collaborative navigation and group information assessment.

### 2.1.1 Communication

Communication (interaction and collaboration) among patrons in a physical library is typically synchronous. Patrons communicate with each other face to face; therefore adjust their behaviour accordingly. Cunningham [6] identifies two types of communication (or behaviour): verbal (e.g. asking questions, chatting or reading aloud) and non-verbal (e.g. pointing to the book content or looking over a shoulder). The researchers observed that verbal communication occurred more often in bookstores (see Figure 2-1). It occurred frequently when a group had different books (e.g., making a comparison) or they had no books. While reading the same books, communication was mixed evenly between non-verbal and verbal communication.



*Figure 2-1: Interactions by focus and communication. Adapted from “Social Information Behaviour in Bookshops: Implications for Digital Libraries,” by Cunningham S.J., Vanderschantz N., Timpany C., Hinze A., & Buchanan G. 2013, Research and Advanced Technology for Digital Libraries, vol. 8092, pp. 84–95. Copyright 2013. Reprinted with permission.*

### 2.1.2 Awareness

As a result of the face-to-face communication in a physical library, pairs or groups of patrons are aware of each other’s movement since they share the space and in their eye zone. This co-located environment and visible activities assist them to understand each other’s mood and have a good engagement.

An important concept related to awareness in physical places is “social presence”. It is defined as the sense of “being together” that involves a sense of shared space, shared engagement and shared (inter) activity” [18]. Social presence cannot occur without the awareness of other person [19].

### 2.1.3 Collaborative Navigation

In relation to information material and when patrons arrive at the target bookshelf, navigation in a physical library can be divided into two types of navigation: navigation across the collection (e.g., pointing to shelved item), and navigation inside a document (e.g., pointing to book content) (see Figure 2-2). These kinds of behaviour are naturally supported by gesture.

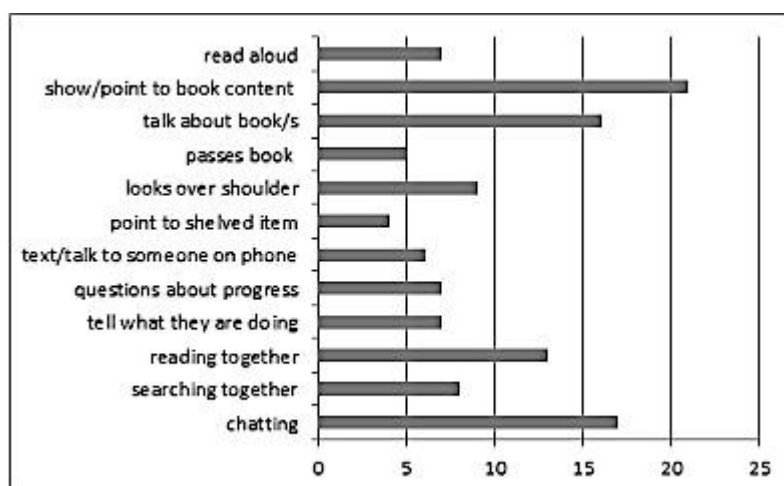


Figure 2-2: Observed collaborative behaviours. Adapted from “Social Information Behaviour in Bookshops: Implications for Digital Libraries,” by Cunningham S.J., Vanderschantz N., Timpany C., Hinze A., & Buchanan G. 2013, *Research and Advanced Technology for Digital Libraries*, vol. 8092, pp. 84–95. Copyright 2013. Reprinted with permission.

### *Navigation Across Collections*

Navigation across the bookshelves (or collection) refers to browsing the bookshelves to find a book or books particular to or related to a patron's interest(s). Typically, the bookshelves of physical libraries are organised and designed based on subjects [3]. This organised environment assists patrons to arrive at the target collection either by a direct reference (e.g. title of the subject area) or through the representative codes of the shelves, as in an academic library. Navigation across bookshelves involves sharing experiences and dividing the tasks among group members [5].

Those with prior knowledge of the location of the bookshelves can use their “mental map” to locate them [3]. Patrons share this knowledge in a pair or group to arrive at the target bookshelves. Typically, the physical collection position has been in its location for a long time. That means patrons can build a permanent mental map of bookshelf locations.

The presentation of a physical collection has an impact on a user making a decision to select a book [3]. Typically, bookshelves are classified by subject, which assists patrons in locating relevant books. Some pairs of patrons were observed consulting the library catalogue and then heading to the location of the

book, from which point they could find other related books on the same shelves [5].

However, the eye level of bookshelves has an impact on the serendipitous discovery of books [5], [20]. There are individual differences in the capabilities and experiences of patrons browsing the shelves. For instance, the tallest patrons browse the top shelves, whereas the shortest view the middle or kneel to browse the bottom shelves. Viewing above eye level occurs more frequently than viewing below eye level [2], [5]. Patrons in pairs withdraw a book, assess it, and start a discussion about the book that mostly ends with selecting the book [5].

### *Navigation Inside a Book*

Reading together the same book either from one copy or another copy involves navigation (pointing) for specific information inside the book. In a physical library (bookstore), researchers observed some form of behaviour that related to reading by two or more people either from the same book or from a different copy including “pointing to book content”, “looks over shoulder” and “reading together” (see Figure 2-2) [6].

The “pointing to book content” is the most frequent behaviour between the pair of patrons. When a pair or small group sit close to each other and read a book together, they point to a specific piece of information in the book, supported by natural hand gestures. This kind of navigation takes time and effort when patrons read together from two copies of the same book [21], particularly if the piece of information is not referenced by highlighting or a bookmark. Pairs of patrons in bookstores are observed to “look over shoulder” to read together from one book and engage with each other in chatting and use gesture communication [6]. Clearly, the number of people who read the same book is limited by the size of the book and the space.

In group “reading together” from individual and identical copies of the book, different approaches are used to navigate inside the book. The structure of some books assist readers to identify the text passage location [22]. The page number and chapter are used as a reference. Another approach is by using verse numbers as in religious texts (e.g., Quran and Bible) or use the references content (e.g.,

diagram, picture or table) [22]. This approach assists two or more readers to identify the location even if they have different editions or different pagination.

#### 2.1.4 Group Assessment of Information

Metadata is the core element in evaluating a source [3]. The presentation of metadata affects user choice. Accessing information can be divided into two parts: assessing the books on the shelves (no pull) and examining the pulled book more closely. Patrons are observed searching for books in three ways [20]:

- “Scanning a section” by walking along a number of shelves that has the same topic.
- “Sampling the shelves” often in order, book by book, looking from left to right and top to bottom.
- Standing closer to the shelf and examining at the “above”/“at”/“below” eye level.

The “spine” or “book cover” view of books in a physical library is limited with regard to the library space. Patrons' selection of books tends to be influenced by the book information presented, including the cover images or the spine size. For example, Hinze found that users tend to assess a document more often by looking at the spine first, then pulling and looking at the title [20]. They are more likely to interact with a book display showing cover images than with spine displays in bookshelves. However, Stelmaszewska found that the dimensions (thickness) of books also influence a patron's selection decisions [23]. It tells a reader something about the amount of information they are looking for, as members commented in the study [23]:

User E said: ‘If it is really thick, usually it's dealing with lots of things inside.’ Conversely, User M commented: ‘It doesn't have to be high level but it needs to be an introduction of HTML, so I'm looking for a thin book actually.’

This example illustrates the importance of presenting the object to allow patrons to identify what fits their needs before pulling up the book.

Sharing opinions or reviews about a pre-selected (pre-purchased) book is common behaviour in a physical library [5], [6]. When two patrons arrive at the



bookshelves and pull a book, together they start a process of sampling the book and evaluating its content before making a decision to select it. Sampling books or “talking about book/s” are common forms of behaviour among patrons [6], which are related to group assessment of information.

A physical library allows patrons to flick through a book, read it and examine the table of contents (TOC), which increases the chance of a book being selected [3]. Patrons may differentiate between two books to find the most useful one. As observed in [6], pairs of patrons may each hold a book to make a comparison between them based on the TOC information. The assessment of a book tends to be based on quality evaluation of the book rather than quantity.

#### 2.1.5 Summary

This section has reviewed related works regarding social interaction in a physical library. It covers communication, awareness, collaborative navigation within bookshelves and inside the book and group assessment of information. Having identified some related works regarding the physical world, the following section reviews related systems in a digital environment.

## 2.2 Collaborative Information in a Digital Environment

Based on the four main aspects of collaborative systems in the physical environment discussed above, this section begins by reviewing selective systems that are used for collaborative work in the digital environment (in Sections 2.2.1, 2.2.2 and 2.2.3). These systems use different approaches to support synchronous interaction. Then, in Section 2.2.4, two digital collection management tools are selected that are related to this study (Mendeley) and the core system of this study (Greenstone). Finally, there is a summary and discussion of both the physical library and related systems in Section 2.3.

### 2.2.1 Collaborative Information Seeking

A number of studies illustrate the value of collaborative information seeking. For example, Morris conducted a survey of 109 employees, that showed the majority of participants participated in collaborative web searching [24]. She found the common subjects or areas that motivate people to search collaboratively are planning travel, shopping, literature, technical information and social events [24]. Users typically exchange information-seeking tasks, queries, terms and links. They use the most common tools, including email, integrated messaging (IM), and phone calls. In response to the survey, Morris and her colleagues developed a number of collaborative web searching systems, such as SearchTogether [25], CoSearch [17] and CoSense [26].

#### *SearchTogether*

SearchTogether is a system that supports both synchronous and asynchronous interaction between separate locations [25]. It is designed for participants who know each other. Participants use their own devices to search the web together.

This system uses integrated messaging (IM) as a medium of communication (see Figure 2-3). Users can communicate through this channel in both synchronous and asynchronous modes, as the system supports storage of the IM conversation.

It supports awareness of other activities through several features, including (synchronize) pre-user query histories, page-specific metadata (associating

metadata), and availability status of member and sharing or recommending pages via IM.

The system does not support navigation within a certain page, as users are restricted to each other's points of interest (POI) through general comments. Nevertheless, members can navigate each other's search links through the IM or recommendation cue.

SearchTogether does not support features that allow users to evaluate the web pages (subject), such as by ratings, comments and favourites. Users can add their critical evaluation through the comment or IM when they are on the same page.



Figure 2-3: The SearchTogether client. (a) integrating messaging, (b) query awareness, (c) current results, (d) recommendation queue, (e)(f)(g) search buttons, (h) page-specific metadata, (i) toolbar, (j) browser. Adapted from "SearchTogether: an interface for collaborative web search," by S. Paul & M. Morris, Eric. Copyright 2007, *Proceedings of the 20th annual ACM symposium on User interface software and technology*, pp. 84–95. 2007. Reprinted with permission.

SearchTogether stores all session information and generates a shared summary of the work group's results. The system stores all group members' details, which reduces time and effort wasted in query repetition.

### *CoSense*

CoSense is a collaborative web search tool that supports synchronous and asynchronous collaborative interaction [26]. The main aim of this tool is to enhance "sensemaking" by generating visualization and contextualization from group members' search activities. The tool uses the databases of SearchTogether [25] and CoSense to extract and generate a representation of group activities. CoSense has four interactive views to support collaborative web search, and which support our selected features (in a more visual way):

**The search strategies view:** shows the keywords of each participant in separate boxes and with a unique colour. All group keywords are integrated under one colour. This view uses "folksonomy" presentation of the user activities. It increases the font size of keywords based on frequency of use. Search strategies viewed present two types of graphs: total enquiries and total URLs visited.

**Timeline view:** is divided into two regions. The left region presents all members' activities, including queries, web pages visited, comments, and chat. Activities are colour-coded to identify who issued them. This region is interactive so that users can click on the enquiries, which will open the result in a new tab. The right region "preview" is a report of a web page that shows rating, comment, visitors' information and chat associated with that web page.

**Chat-centric view:** is also divided into two regions. The chat region shows the transcript of the group's IM conversation. Each user has a colour code that identifies her or him. The webpage view region displays the webpage visited by the member.

**Workspace view:** is divided into two regions. The share web page information region associates URLs, comments, rating, tags, and who visited that webpage. Users can add comments, rate web pages and tag them from this region. The right region has two form-free areas to add notes, "scratch pad", and "to do". It also allows members to add external files that can be shared with group members.

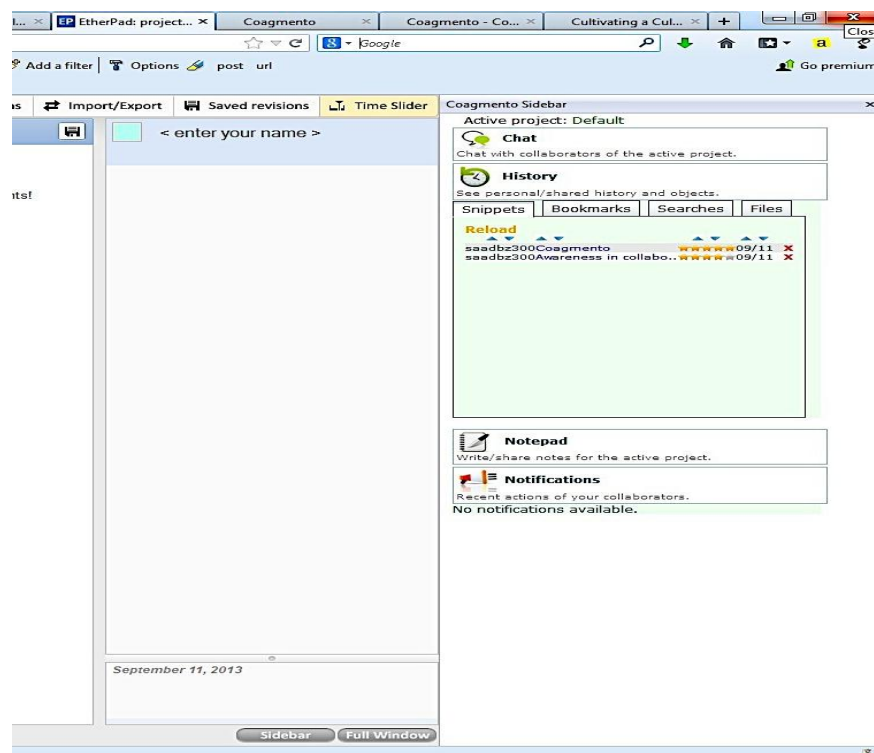
Overall, these views help members to be aware of each other's activities and therefore divide and refine the task accordingly. A member can jump between viewing and retrieving all group members' activities. Group members can communicate by integrating messages (IM), therefore maintaining awareness of

each other. Moreover, CoSense supports two types of awareness: action (in search strategies and Workspace View) and context awareness (in Timeline and Chat-Centric View). The use of colour and tags appears to (the size of websites and keywords) help users quickly navigate the desired information. The communication through comments and chatting feature assist users to assess a website. It was observed that the more often people interact through comment and chatting in a website, the more helpful the evaluation of that website.

### *Coagmento*

Coagmento <sup>8</sup> is a Firefox plug-in that supports both synchronous and asynchronous information-seeking collaboration. The following points describe the system's features (see Figure 2-4):

**Chat:** This feature is a text-based communication that allows online members to exchange information and enhance a discussion while browsing the Internet.



*Figure 2-4: Coagmento interface*

<sup>8</sup> [www.coagmento.org](http://www.coagmento.org)

**History:** This feature stores users' activities that can then be seen by any group member. It assists awareness of each other through the "history" region that stores activity with a colour code. It includes four sub-features and each feature can have an evaluation (from one to five stars):

- Snippets: users can select and add some optional comment to the selected passages from the web page.
- Bookmarks: users can view what group members have found. It assists them to navigate the web pages faster.
- Searches: all participants' queries can be viewed in this area.
- Files: users can upload (or attach) any additional files from their computers.

**Notepad:** includes personal and public notes.

**Notifications:** In this area, group members can be notified of each other's contribution. This increases the degree of group awareness, as members cannot miss the other member's contributions.

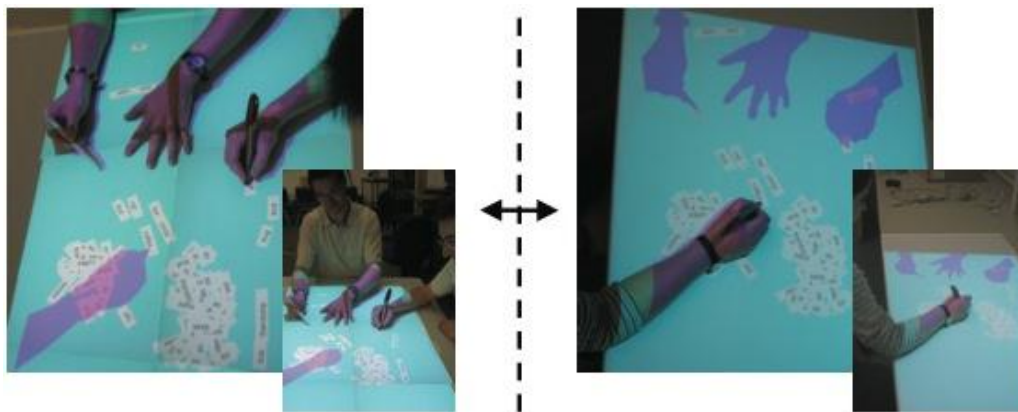
**Recommend:** This feature assists users to share a recommended page via email.

### *Distributed Tabletop*

The Mixed-Presence Tabletops interface is a tool that supports co-located and remote collaboration over digital artifacts [27]. Group members sit around a horizontal multi-touch display to work together with digital content. Participants can collaborate to string words together, organize lists or solve puzzles.

In remote conditions, Distributed Tabletops allows participants to communicate and talk with each other (audio communication). They can see each other's gestures through the shadow of their arms and torsos; therefore maintain awareness of the other participants' action (e.g., artifact moved by participants) (see Figure 2-5).

There is no scroll in the system since there is a big multi-touch screen, which indicates the ease of navigating objects as it shows a big picture of the workplace. This design assists users to quickly navigate the artifact.



*Figure 2-5: Mixed presence tabletop collaboration over digital artifacts using Distributed Tabletops. Adapted from “Distributed Tabletops: Supporting Remote and Mixed-Presence Tabletop Collaboration,” by P. Robinson and P. Tuddenham, Eric. 2007, Second Annual IEEE International Workshop on Horizontal Interactive Human-Computer Systems (TABLETOP’07), pp. 19-26. Copyright 2007. Reprinted with permission.*

### *CoSearch*

CoSearch is a collaborative information-seeking system designed for small co-located groups [17]. This system uses support devices such as mobile phones and computer input mouse. By using mobile phones, the system can be divided into two applications: CoSearchPC application on a computer and CoSearchMobile application on phones with the same functionalities. These functionalities, to some extent, meet the four-selected aspect. The following describes the system features and their value in both applications.

First, the CoSearchPC interface is divided into six regions (see Figure 2-6):

1. **Page Queue:** This is colour coded for users to maintain awareness of each activity. Users sharing of webpages can be shown or updated in this area.
2. **Query Queue:** In this area all group members contribute queries, either by computer (drivers) or through text messaging (observers). Queries are coloured-coded to identify who adds them.
3. **Result Pane:** Drivers can click on any keywords from "Query Queue" to extract a result on this page. Group members can see a result and build a discussion around it.
4. **Identify region:** In this region a member is identified by colour and nickname.

**5.Summary region:** The drivers can upload the summary of the results so that observers can download them on their mobile phones.

**6.Note region:** This feature allows users to add notes about the current web page. The notes are linked to the summary region.

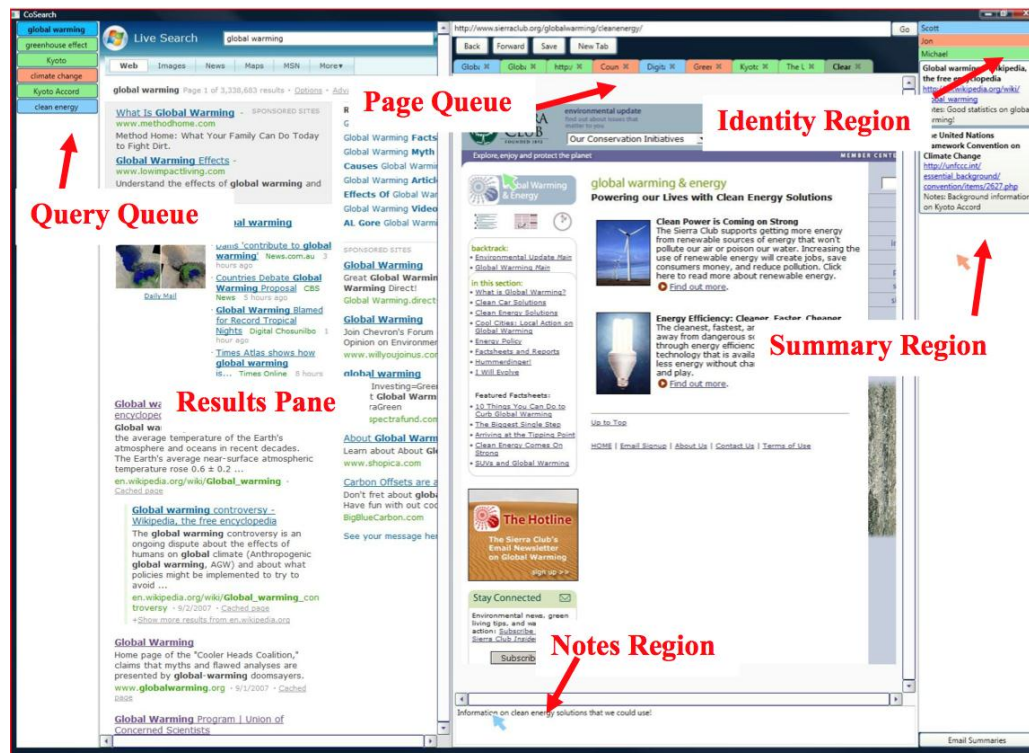


Figure 2-6: CoSearchPC, with annotations identifying key UI features. Adapted from “CoSearch: a system for co-located collaborative web search,” by S. Amershi and M. Morris. 2008, *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, pp. 1647–1656. Copyright 2008. Reprinted with permission.

Second, CoSearchMobile interface has four main options (see Figure 2-7):

- 1.**Send Query:** Participants (observers) can enter keywords via the phone's keypad and send them to CoSearchPC (drivers).
- 2.**Get search result:** From here, users can download the results that are uploaded by the drivers in the CoSearchPC's Results Pane (see Figure 2-6).
- 3.**Get Tabs:** Another option to download the list of tab titles from the Page Queue.
- 4.**Get summary:** Observers can download the contents that have been uploaded in the summary region of CoSearchPC (see Figure 2-6).





*Figure 2-7: CoSearchMobile (main menu). Adapted from “CoSearch: a system for co-located collaborative web search,” by S. Amershi and M. Morris. 2008, Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 1647–1656. Copyright 2008. Reprinted with permission.*

### 2.2.2 Collaborative Evaluation and Recommendation

In recent decades book-based social network websites have emerged. These websites serve book clubs through book reviews or recommendations. Users can post a critical review of books they have read (books are post-purchase or post-loan) through comments and ratings. The system does not provide for sampling the content of books because of copyright restrictions.

People decide to read a book influenced by a number of factors, including the author, book's representation, advertising, and, above all, their friends' recommendations. Users prefer recommendations from those whom they know (e.g., friends and family members) [8]–[10] and trust over online recommender systems. The following two book-based social networking systems focus on post-loan or post-purchase activities [6].

#### *Goodreads*

Goodreads<sup>9</sup> is one of the most popular network websites specified for books. Users can create an account either by email and choosing IDs and passwords, or by connecting through Facebook, Twitter, Google or Amazon accounts.

---

<sup>9</sup> [www.goodreads.com](http://www.goodreads.com)

The screenshot shows the Goodreads profile of a user named 'Dylan'. The profile includes a search bar at the top with the text 'Title / Author / ISBN'. The navigation menu includes 'Home', 'My Books', 'Friends', 'Recommendations', and 'Explore'. The profile section shows a silhouette icon, the name 'Dylan', and details: 'Male, New Zealand', 'Joined in September 2010, last active this month', and a URL 'https://www.goodreads.com/dylanchambers'. Below this, it says 'Dylan (dylan.other@g...com) is your friend' and provides links to 'send message', 'recommend book', 'compare books', 'write a story', and 'suggest friends'. The profile also shows '78 ratings (3.85 avg)' and '0 reviews'. A section titled 'Dylan's favorite books' displays a row of book covers including 'The Hobbit', 'The Lord of the Rings', 'The Girl on the Train', 'The Daylight Marriage', 'The Girl on the Train', 'The Daylight Marriage', 'The Girl on the Train', 'The Daylight Marriage', 'The Girl on the Train', and 'The Daylight Marriage'. Below this is a section titled 'Dylan's Bookshelves' with tabs for 'read (76)', 'currently-reading (0)', and 'to-read (109)'. A 'Stats | More...' link is also present. The 'Dylan's Recent Updates' section shows a post from 'Dylan' stating 'Dylan is now friends with Madeleine Majenburg' with a timestamp of '12 hours, 24 min ago' and links to 'like' and 'comment'. Below this, a post titled 'Dylan wants to read' features the book 'The Luminaries' by Eleanor Catton, with a 'Want to Read' button and a 'Rate this book' section showing five stars. The post is dated 'Oct 18, 2013 05:33PM' and includes 'like' and 'comment' links. On the right side, a section titled 'Dylan's Friends (31)' lists several friends with their book counts and friend counts, including 'Miriam Williams' (277 books, 47 friends), 'Lance' (157 books, 44 friends), 'Madeleine Majenburg' (45 books, 8 friends), 'Danielle' (59 books, 15 friends), 'Malin Ida' (0 books, 11 friends), 'Maria' (56 books, 42 friends), 'Frida' (109 books, 19 friends), and 'Brian Kristensen' (50 books, 8 friends). A 'More friends...' link is also present. At the bottom right, a section titled 'People Dylan is Following' shows a small profile picture.

Figure 2-8: Goodreads user's profile

Goodreads supports awareness of friends' activities (see Figure 2-8). Through social network connectivity, friends who use the Goodreads system can view and recommend books to each other. As Goodreads is connected to Facebook and Twitter it is easy to recognize friends' activities. It allows users to distribute (or post) their recent activities through the social networks. Users can share their favourite books through the sharing or "like" buttons of Facebook, Twitter, Google Plus and Pinterest<sup>10</sup>. Further, users can show the state of these books as either "read" or "currently reading" or "to be read". Also, they can add liked books to a favourite folder.

The system supports friends' evaluation of books. It provides quality evaluation through comment and quantity evaluation through rating books from one to five stars. Goodreads shows additional statistical information about activities related to a book in the form of the number of users who review and rate a book.

<sup>10</sup> www.pinterest.com

### LibraryThing

LibraryThing <sup>11</sup> is a web-based service for cataloguing books. Similar to Goodreads, it allows users to connect their account with social network sites, including Facebook and Twitter. Users can view their friends' collections. They can also create groups and start sharing recommendations and evaluations of books.

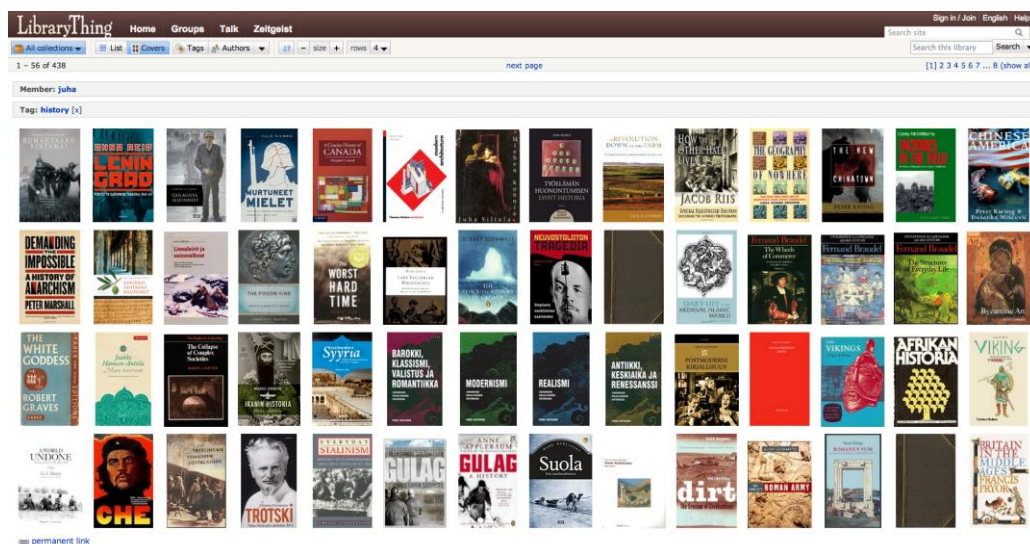


Figure 2-9: LibraryThing cover view

LibraryThing uses tags when adding books. This helps to navigate faster to the related books of that tag. Users can click on the tag to retrieve all matched books that the collection owner adds under that tag. LibraryThing presents the collection either in list (show all metadata and user activities in table view) or in cover images (if the added document does not have a cover image the system will automatically generate a default cover with a title and another name) that give visitors the opportunity to browse the collection in “Grid View” and thus increase the serendipity of discovering books (see Figure 2-9). LibraryThing also, provides quality (commenting) and quantity (rating) critical evaluation of the read books.

<sup>11</sup> [www.librarything.com](http://www.librarything.com)

### 2.2.3 Collaborative Reading

Collaborative reading is a common process of in-group reading such as group book-club reading and group study [22]. Group reading activities are frequently associated with annotation or references (navigating information inside a document). In terms of referencing inside a document, readers refer to their discovery of information by either page number, annotation, reference content or bookmark [28]. The following two systems are designed to support group readers.

#### *BuddyBooks*

BuddyBooks is an iPad application that mainly supports group readers who sit together and read the same documents [22]. The main aim of this system is to provide a means of mutual navigation for readers. To achieve this aim, the application uses coloured highlighted text to identify the point of interest (POI) that has been established by users. As a result, with this tool there is a high degree of awareness of other readers' activities, as each member is identified by a unique colour and nickname (see Figure 2-10). The colour is a marker for a member's activities, including annotation and bookmaking. Further, the tool uses "update box" to synchronize users' activities. This helps notify them (the users) of the other member's contributions. The use of "point out" attracts the attention of participants to a particular point of interest (POI) in instances where there is a heavy contribution by a member in the same location.

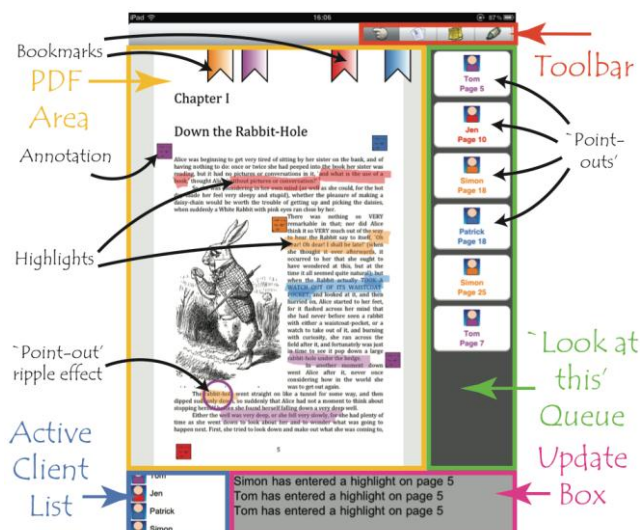


Figure 2-10: Screen shot from BuddyBooks. Adapted from “Co-reading: investigating collaborative group reading,” J. Pearson and T. Owen. 2012, *Proceedings of the 12th ACM/IEEE-CS joint conference on Digital Libraries*, pp. 325–334. Copyright 2012. Reprinted with permission.

### Kindle

Kindle<sup>12</sup> is an eBook reading system designed by Amazon. It is available on a range of platforms including Kindle iPad-app and Kindle desktop reader [29]. It allows readers to read different kinds of document formats such as newspaper, blog and PDF documents. Kindle provides an annotation feature and gives users a choice between making them public or private. Readers can add bookmarks, notes or highlights inside the eBooks and share them with other Kindle readers, or with friends on Facebook and Twitter. Communication among readers is only through the comment feature, which is more in the nature of asynchronous communication.

In a Kindle desktop reader the highlights from a book are indexed to make easy navigation inside the book. It aggregates all highlights and annotations in a report in the sidebar [29]. Also shown in the report is location information in the book, for example, page number of the added note.

Both the desktop reader and the apps provide statistical information about the “Popular Highlights” and tracks how many users have highlighted a specific passage [29].

<sup>12</sup> [kindle.amazon.com](http://kindle.amazon.com)

### 2.2.4 Digital Collection Management Tools

This part reviews the management tools related to this study. These tools allow users to create, manage, and share collections of digital content, and are selected because they support distribution of the digital collection on the Internet.

#### *Mendeley*

Mendeley<sup>13</sup> is a digital library management system. It has a web-based interface and desktop software to manage digital references and citations. Users must have an account to add references and share them with other users.

Users can create group work for sharing and exchanging knowledge. There are three types of group mode in this system:

1. Private: users are friends and the references can be seen only by them.
2. Invite only: users can share references and the public can follow and view these references.
3. Open: the public can follow and add references to the group list.

The system allows users to communicate through comments. They also can like the posted document or not. Further, the system has an annotation feature where users can take notes and highlight text inside the document and share this annotation with group members. It indexes all the annotations and highlights in a sidebar. Also, users can add an overall note about the document. This assists group members to be aware of each other's activities.

The interface of the Mendeley desktop software provides the metadata in table view (see Figure 2-11). Users can sort the collection by any metadata they choose (e.g., title, year or authors). This presentation of metadata assists users to evaluate these references based on different attributes (e.g., title, date and authors names).

Visualisation in this system is in the form of icons that represent something. Users can evaluate the reference by clicking the star. Mendeley uses visualisation icons

---

<sup>13</sup> [www.mendeley.com](http://www.mendeley.com)

to indicate that the document is read or unread or to show if there is a PDF copy in the computer store. These visualisation icons reflect personal use rather than group member interaction with a document.

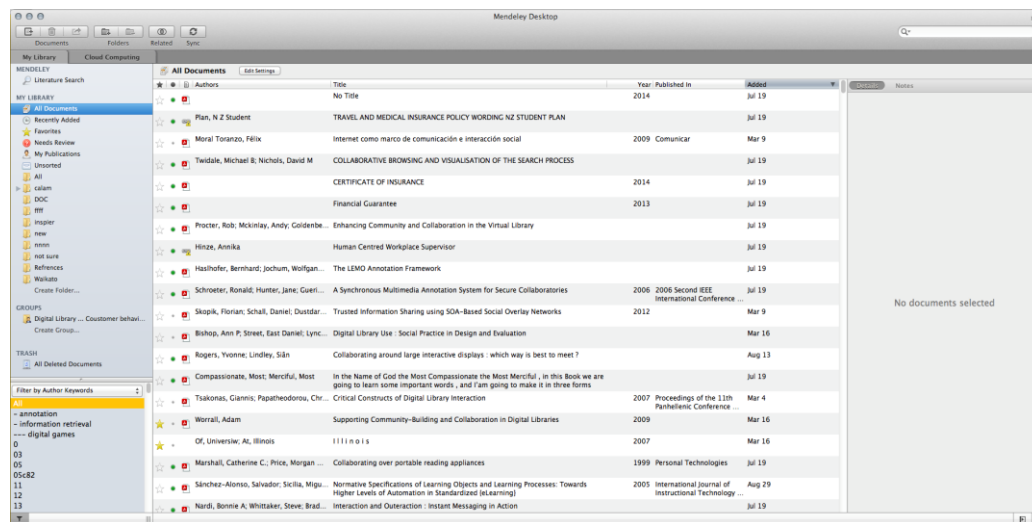


Figure 2-11: Mendeley interface

### Greenstone

Greenstone <sup>14</sup> is an open source tool that assists individuals and institutions, including universities, and public services to build their own digital collections and distribute them online. Users can install the Greenstone system and run it on their computers. They can create a collection and import all digital files (e.g. images, audio, video, and textual document) to such a collection. They manually add the metadata to each document. However, the system can extract some metadata from the document, such as author names. The collection creator can design the digital library interface. For example, they can change the parameters of the search function or the browsing (tabs).

When users browse the collection, they can search and move from tab to tab. The search function allows users to limit their search to either title, content or author or any other limitation made by the collection's creator (designer). The presentation of the search result will be in a new web page, rather than in the same web page collection. Users can read documents in HTML and view or open them

<sup>14</sup> [www.greenstone.org](http://www.greenstone.org)

in PDF. The HTML looks untidy and the structure is corrupted in some cases, which leads to more difficult reading. Annotation is not supported in this system. Further, the system is for single users rather than multiple-users, which means it is neither a collaborative nor socially interactive environment.



## 2.3 Summary and Discussion

In physical libraries patrons communicate face-to-face, therefore are aware of each other. Patrons search for books of interest to them in three ways:

- Scanning the shelves.
- Extensively examining the bookshelf content, book by book.
- Standing closer to a shelf and examining the shelf "above"/"at"/"below".

Patrons' behaviour is affected by various factors, including physical book layout or metadata presentation and their own ability. Patrons judge a book by its presentation, either the spine or cover images. Further, taller patrons tend to examine shelves above and at eye level, while shorter patrons exam the middle and bottom shelves.

When two patrons are discussing, assessing and reading together, three forms of interaction might occur:

- Read together from one book.
- Read together two copies of the same book.
- Read together from similar or related books.

Patrons in the first form use hand gestures (non-verbal) to explain and identify the location of specific information (pointing to content). Non-verbal and verbal communication is used equally in this situation. Patrons participating in the second and third forms of reading together use the reference content, verses and page numbers to identify points of interest (POI). Verbal communication is used more often in these situations. Assessment in the third case could be done through comparison of the tables of content (TOC).

In the digital environment, the following table (Table 2-1) summarises the general features of the systems discussed. It includes collection type, voice and text communication, video conferencing, action awareness, navigation among the collection, and navigation inside a document and evaluation subject. These are the expected and important features of a proposed Co-browsing GDL system.

Table 2-1: Collaborative System Comparisons

Systems	Collection type	Communication			Action awareness	Mutual navigation Among Collection	Mutual navigation inside document	Evaluation subject
		Voice chatting	Text chatting	Video conferencing				
SearchTogether [25]	G	-	+	-	+	+	-	+/-
CoSense [26]	G	-	+	-	+	+	-	-
Coagmento	G	-	+	-	+	+	+	+
Mixed-Presence Tabletop [27]	A	+	-	-	+	+	?	-
CoSearch [17]	G	-	-	-	-/+	+	-	+
Goodreads	B	-	-	-	-/+	+	-	+
LibraryThing	B	-	-	-	-/+	+	-	+
BuddyBooks [22]	B	-	-	-	-	-	+	-
Kindle	B	-	-	-	+	-	+	+
Mendeley	B	-	-	-	-	-	+	+
Greenstone	G	-	-	-	-	-	-	-

(+) Supported, (-) Does not support, (-/+) partly support, (?) Not mentioned, (G) support general digital content, (A) support artefact, (B) support eBooks<sup>15</sup>.

Systems such as Coagmento, SearchTogether [25], CoSense [26], CoSearch [17] and Greenstone serve general digital content (or the whole internet), while systems that serve specific content are Mixed-Presence Tabletop [27],

---

<sup>15</sup> Such as PDF files and information about purchased printed books

LibraryThing, Goodreads, BuddyBooks [22], Kindle and Mendeley. All the selected systems in section (2.2.1) support synchronous interaction, while Kindle and book-based network services (including the LibraryThings and Goodreads) tend to support asynchronous interaction. Mendeley supports asynchronous interaction, while there is no social functionality in Greenstone DL.

All systems support only IM communication, except for Mixed-Presence Tabletop [27], which supports audio communication, and CoSearch [17] and BuddyBooks [22], which can be used in a co-located environment, or face-to-face communication. No system has the video conferencing communication feature. Ideally, the proposed system should support three kinds of communication: text, audio and video conferencing, with users having the option of choosing which form of communication they prefer.

Navigation inside content and within a digital collection is a common user activity. Collaborative information seeking systems support only the awareness of other user's navigation among digital collections (the whole web pages), except for Coagmento (user can add annotation to a web page content) and Mixed-Presence Tabletop (it serves one kind of object) [27], while a collaborative reading system supports mutual navigation inside the content. Book-based network systems support navigation among collections through the tag feature that retrieves all books attached to a selected tag (as in LibraryThing), while navigation inside a document is not supported, since the prime use for these systems is evaluation and recommendation. Both LibraryThing and Goodreads support quantity evaluation through users' comment, and quality evaluation through the rating features. Sampling of books in these two websites is almost missing since the users evaluate books that have been read (pre-purchased or loaned).

Overall, the physical library is limited in terms of the space available for effective group-work. Clearly, Coagmento meets most of the expected features of a co-browsing system. This study will further investigate how pairs of users together browse a digital collection, while in separate locations and in front of computers (synchronous), and thus identify the features that support the co-browsing system. This study proposes Greenstone as the core study of a design that supports such synchronous interaction.

## Chapter 3

### 3.0 Methods and Design

This chapter reports on the user study that investigated the group information seeking behaviour of remote computer users browsing the same digital articles collection. The study explored their needs and determined the features that support remote share browsing in the Greenstone digital collection. The study used a combination of qualitative and quantitative methods. It used participants' observations (camera recording and screen capturing), a demographic questionnaire and a follow-up questionnaire. The use of a number of research methods served to strengthen the study of DLs [30]. The chapter begins with the users study design, followed by research validity, the result and, finally, a discussion of the result.

#### 3.1 Users Study Design

There are two methods of research -- qualitative and quantitative [31]. Qualitative research is an observation-based methodology where the data is not in the form of numbers, unlike the quantitative method, which is based on number data analysis. Broad use of qualitative studies is made in the social sciences (e.g., psychology, sociology and anthropology) [31], [32], to study human behaviour and the social world. A researcher observes and records behaviour and events in their natural settings, either in a physical manner (using a camera: e.g., [33]–[35]) or in a digital environment (using screen capturing software) (e.g., [34], [36], [37]). Examples of qualitative research methods are interviews, case studies, life stories, historical interactional visual texts and observation [31].

A qualitative research method helps researchers understand social interaction using technologies [31]. The method seeks to answer questions that have social aspects, such as:

- What type of communication do most participants choose to perform the tasks?
- How do participants share information?
- How do they share navigation of eBooks?

- What strategies do they use to accomplish the given tasks?

The present study mainly adopted a qualitative research approach to investigating the interactions between pairs of online users. However, this study combined qualitative and quantitative methods. According to [38], the best content-analytic studies use both approaches. A frequency count of phrases was used to determine the number of times certain behaviour of participants occurred.

Participants were in two different locations (rooms) and used desktop computers to browse, select and read documents from the Greenstone digital library collection.

### 3.1.1 Sample Study

A pilot study is a research project conducted on a small number of participants to allow researchers to evaluate feasibility, time and the working of recording elements [39]. A pilot study was conducted for this study to “debug” the procedure of the session and explore any issues with the study elements. Two male participants from the computer department were used in the pilot study (a PhD candidate and a Master’s student). The pilot study followed the planned procedure of the actual study. This pilot study “debug” was as follows:

- CamStudio <sup>16</sup> crashes with videos that are over the 2-gigabyte (Gb) size limit. The tool only allows users to store up to 2 Gb. After finishing the session, the data that CamStudio generated was 2.33 Gb, which could not be opened. A possible solution was to use the K-lite Codec Pack Full 10.2 <sup>17</sup> to open the corrupted video file but without audio. However, the camera recording audio can be used (or replaced) to merge its audio with the screen-recording file. For a permanent solution, we changed the setting of the tool: this is discussed in detail in Section 3.1.7.
- Synchronisation among recording elements was another issue. The time must be set in both cameras and the two computers synchronised.

---

<sup>16</sup> [camstudio.org](http://camstudio.org)

<sup>17</sup> [www.free-codecs.com/download/k\\_lite\\_codec\\_pack.htm](http://www.free-codecs.com/download/k_lite_codec_pack.htm)

- The CamStudio does not record the system audio (therefore does not record the other party's audio conversation). Therefore, identifying the exact time when the conversation was started was another issue. For later editing, using the analogue clock in both computers was a good marker to identify the start time of the session or the conversation, which assisted the researcher to merge all files and analyse the conversation.
- It was noticed that the two video screen recordings had different time lengths. The reason was that the settings of the CamStudio were different, as one recording had a smaller value of keyframe capture than the other. The settings will be discussed in more details in Section 3.1.7.
- There was a need to complete a questionnaire<sup>18</sup> after doing the session to test several variables that were related to workload, including difficulty level of the task, awareness, how rushed they were, computation, enjoyment and motivation.

After identifying the bugs in the pilot study, the actual user study was conducted. The study sample was comprised of students from Waikato University. Eight pairs (16 participants) took part in the study. Members of each pair were friends (two groups of female/female, two groups of female/ male, four groups of male/ male). Nine participants ranged in age from 18–28, seven were 29–38. Twelve of the participants had prior experience working in-group, and four did not. Eight of the participants had experience working online with a group. All participants were experienced computer users who used a computer for at least an hour a day. Computers were mostly used for writing, communicating, reading, searching, and managing life activities.

### 3.1.2 Demographic Questionnaire

After the consent form signing, the experiment started with the demographic questionnaire (see appendix A. 5). The questionnaire contained 12 questions grouped into three parts.

- The first part (questions 1 to 5) was designed to collect basic background

---

<sup>18</sup> New Ethical Approval was required when adding new method(s).

information about participants (e.g., gender, age group, full-time occupation, educational situation).

- The second part (questions 6 to 9) examined participants' general use of computers (e.g. period of time the participants had been using a computer, daily time spent on a computer, and activities).
- The third part (questions 10 and 12) examined participants' experience of group work in both physical and digital environments, the real-time tools they used for online collaboration work, and the social networks that participants used for educational purposes.

This data was used later to interpret participants' performance and behaviour during the user study session.

### 3.1.3 Tasks

Participants were asked to browse together the same pre-collected documents in the Greenstone digital library. All collection documents were related to a broad topic (E-learning) and this is the name of the collection. To observe their browsing and select information behaviours, this study asked the participants to do the following three tasks (see appendix A. 6):

**Keywords:** participant pairs were asked to find three keywords that occurred in document titles (one or two keywords could be found in some titles but only one article contained them all).

**Key concepts:** participants were asked to collect (one or more) article(s) that were related to the given topic. They were to discuss why they chose them.

**Viewpoints:** participants were asked to find the best definition of a given term. In the collection there are titles that indicate the defining aspect of the given term (e.g. what is asynchronous? Introduction to asynchronous learning; an overview of asynchronous eLearning; the definition of asynchronous). This part aimed to investigate how each pair of participants selected and discussed the proper definition for such a term.

For all three tasks, when one of the participants found the article(s) they were to inform the other. They were also to identify the location of the articles.

### 3.1.4 Digital Document Collection and Greenstone Website Interface

The digital collection was of articles about E-learning. It contained all possible selections that could provide answers to the three tasks (see appendix A. 6). For the first task there was only one article that could match the answer, whereas for the second and third tasks there were a few article titles that could help participants to anticipate the proper articles.

Using the Greenstone tool, a creator (or designer) of a digital collection can maintain and extend it, and the collection can be automatically rebuilt [40]. Greenstone system can be divided into three parts:

- Librarian Interface (GLI): an independent Java application that can build the digital library collection. It involves gathering materials and enriching the metadata, and designing the library activities and interface.
- Readers' Interface: a web page interface that can be run on any Internet browser. Users can browse the digital collection and search inside the documents and across the collection (after identifying the parameter of the search function).
- Greenstone Server: to run the web page on the standard web browser. The collection can be accessed either locally (from computer) or remotely (through the Internet).

Running GLI, there are four main steps to creating a collection (see Figure 3-1). First, gather the collection from the desktop driver. Second, enrich the metadata of the collection manually. Third, design the presentation of the collection by assigning some attributes of the four different modules: search indexing, browsing classifications, partition indexing and Document plug-ins. Fourth, create and view the collection. Sometimes, error messages appear to show that some files could not be processed or the whole collection was not built properly. A possible solution for this issue is to switch the GUI into "expert" mode (File > preferences > Mode). A full list of import and building options is shown: the collection builder then should select "verbosity" to set options to 5.



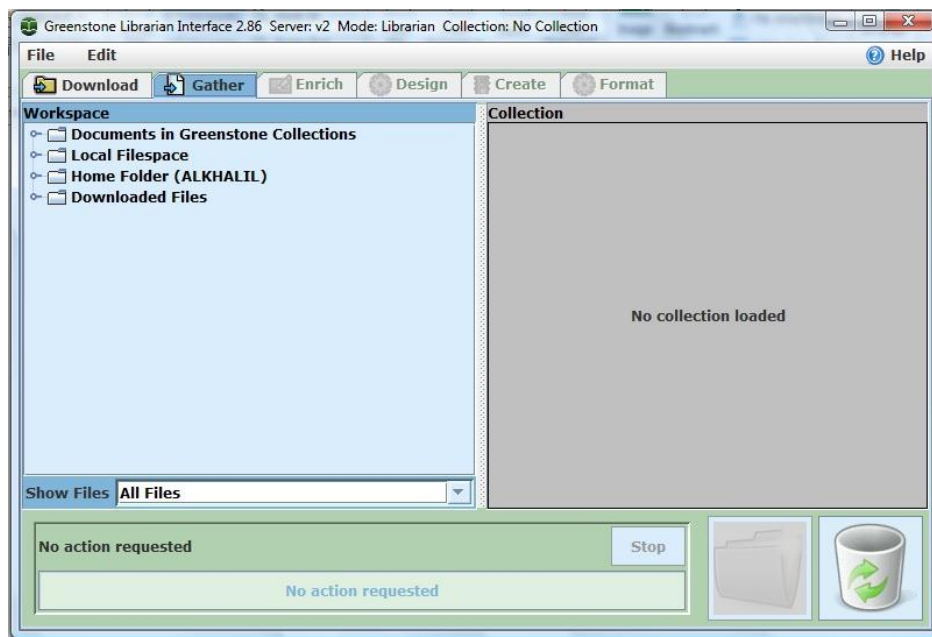


Figure 3-1: Librarian Interface (GLI)

Identical Greenstone digital library collections were built on two computers. To maintain the same metadata information in both computers, a copy of the “metadata.xml” that is added manually through the software in the first computer is pasted to the Greenstone “import” folder in the second computer. This “metadata file can be found in Windows XP, usually in the following path:

C:\Users\ (user name of the current computer) \Greenstone\collect\ (collection name) \import

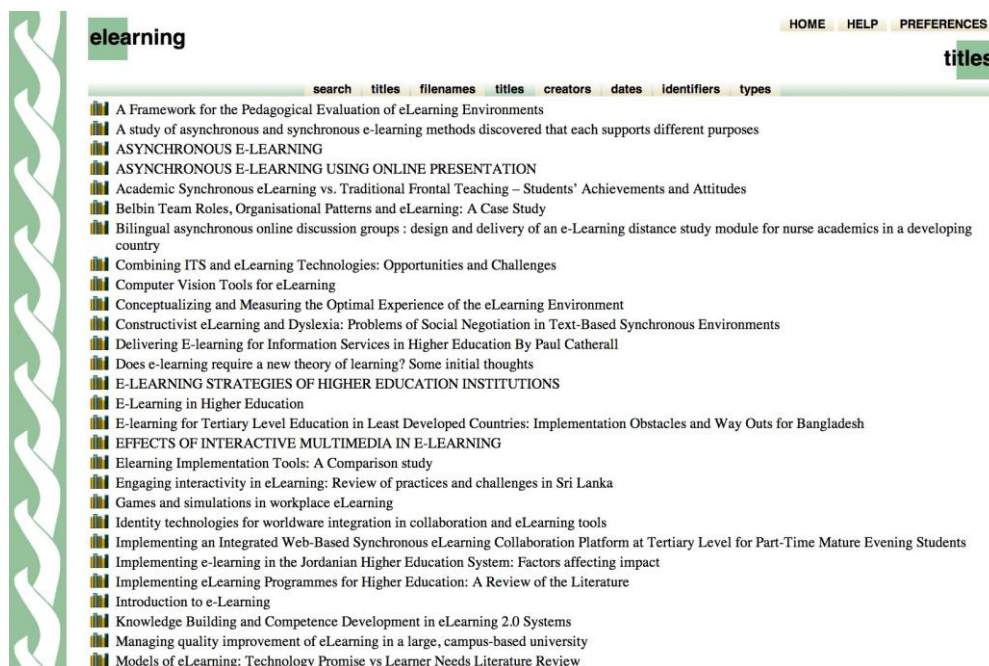


Figure 3-2: *eLearning Greenstone collection*

Figure 3-2 shows the presentation of the eLearning Greenstone collection readers' interface used in the user study.

### 3.1.5 Environment

This study used two rooms each setup with the computers and recording camera (from behind participants) and transport wall to observe participants and take notes. Participants used a table to complete demographic questionnaires and follow-up questionnaires. The rooms' lights were on to allow better visibility and the temperature was at an appropriate level to run the experiment. The two rooms were located at the University of Waikato, Usability Laboratory <sup>19</sup>. The two rooms were like a home environment (flowers, some wall pictures and quiet places) (see Figure 3-3).

<sup>19</sup> [www.cs.waikato.ac.nz/research/usability/index.html](http://www.cs.waikato.ac.nz/research/usability/index.html)



*Figure 3-3: Pair of participants in separate rooms (they are anonymised)*

### 3.1.6 Medium of Communication

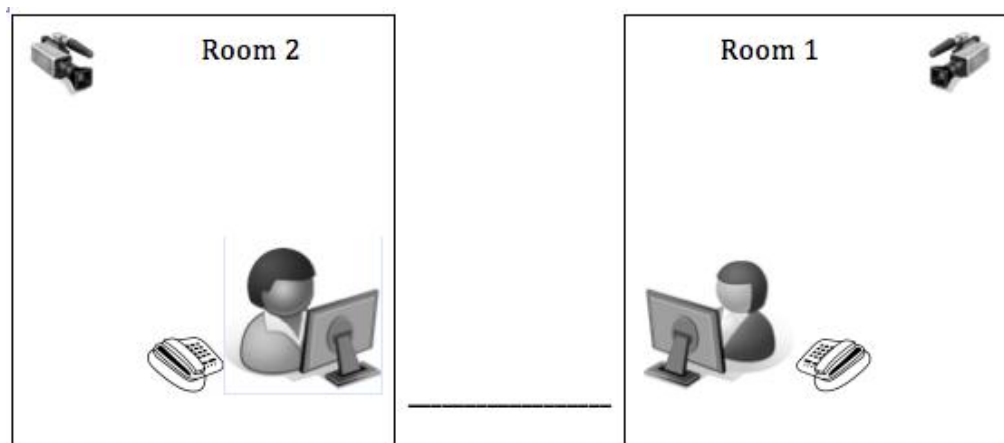
For this study, participants were provided with two kinds of communication. First, there was landline communication in each room (with partner's landline numbers showing on respective phones) (see Figure 3-4). As well, participants could use their own mobile phones (if they wanted to SMS each other). Second, there were online tools for common communication services (e.g., Skype, Google Talk and MSN). A list of user ID accounts and passwords (created only for this study) were provided for many popular services, including social networks (e.g. Facebook), emails (e.g. Gmail), and video conferencing (e.g. Skype). Participants could also use their private accounts, if they used services that were not on the list. Headphones and a desktop video camera were set up for each computer.

### 3.1.7 Recording Elements

The study combined two elements to record participants' behaviour. The following describes the two recording elements and the reasons for these choices:

**Firstly**, camera video/audio recording were used in each room (see Figure 3-4).

This tool has been used in many studies, such as [33]–[35]. The current study recorded by camera only, if participants used any (physical) medium of communication other than computer tools (e.g., landlines or mobile phones). No extra observation was to be recorded, such as of gesture or body language or eye contact. Further, the cameras were used in case the screen recorder did not record audio data. To ensure confidentiality of participants' passwords, the camera was not focused on the keyboard. Instead, the focus was from behind the participants for the purpose of observing by which means they communicated with each other (mobile phone/landlines). This position did not allow the observer to see the keyboard when they wanted to type their passwords for emails or social network accounts. The times in the two cameras were synchronised with the computer's time zone.



*Figure 3-4: Participants in two separate rooms*

**Secondly**, the users' screen activities were recorded through the screen capture tool. A number of studies have used a video screen capture method to observe users' behaviour (activities) on the screen (e.g. [34], [36], [37]), therefore, this study used it to observe the participants' behaviours on the screen and to capture their conversation (either text or audio /video based). It assisted the participants to act normally and there was no effect on their behaviour as the researcher was not present [41].

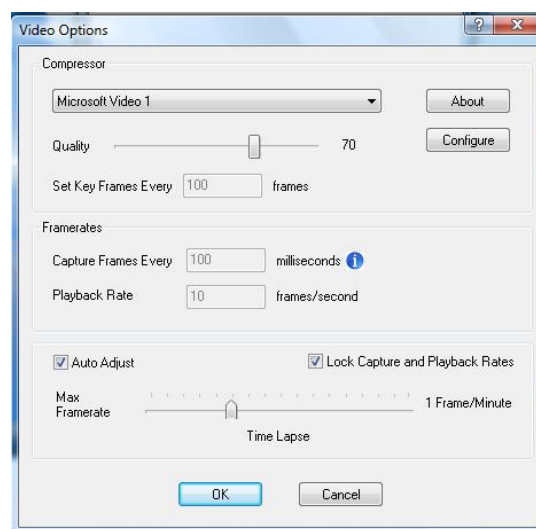
The CamStudio screen-recording tool for Microsoft Windows was used in this study. The tool meets the study requirements:

- Capture user's activities on a full screen.

- Capture the mouse activities (e.g. click and double click).
- Record audio from the microphone.
- Ensure that participants' passwords remain confidential when they log on to their private accounts. The software does not capture keyboard activity.
- Record at least 30 minutes (or up to 2 Gb).

The CamStudio can only store up to 2 Gb. For this study the following video option was set in both computers (see Figure 3-5). This setting allowed recording for more than 30 minutes:

- **Compressor:** increasing the value of the Key Frames will decrease the file size and the video quality. For a reasonable option 100 Key Frames was chosen to see the users' activities more clearly.
- **Framerates:** capturing frames every 100 milliseconds was a reasonable option.



*Figure 3-5: CamStudio Video Options*

Typically, there are three sizes of the region to capture -- the full screen, “snap to” an individual window and self-selection of a fixed-size region [41]. This study used the full screen recording to see all the activities on the screen, including cases where participants opened extra pages or identified the tool they used for communication.

Synchronising the time in both computers was another important aspect for later analysis. Before beginning to record the screen activities, the analogue clock time

was noted first, so the researcher, in editing the two videos, could identify when the two participants started the conversation.

### 3.1.8 Follow-up Questionnaire (self-report)

As the study mainly simulated the shared browsing of a digital library collection, with only the assistance of a medium of communication to exchange information, the question is, does this sharing activity have some negative implications for users in terms of cognitive load experienced. The questionnaire asked participants about their experience after they had finished taking part in the user study (see Appendix A. 7). The questionnaire responses will later be used to compare the workload with different mediums of communication. This study used a simplified version of NASA's Task Load Index (TLX) questionnaire [42]. NASA's TLX has been used in many studies to measure participant workload (e.g., [28], [43]). The participants were asked questions about how they felt after finishing the session, including the following:

- How were the tasks?
- How hurried were you to accomplish the task?
- How aware were you of your partner's activities?
- How was your competition while working with a peer?
- How was your motivation while working with a peer to find references?
- How was your enjoyment while working with a peer to find references at the same time?

The responses to these questions were recorded on a 7-point Likert scale [44]. Further, this questionnaire had a comment section for any additional feedback.

### 3.1.9 Procedure and Data Collection

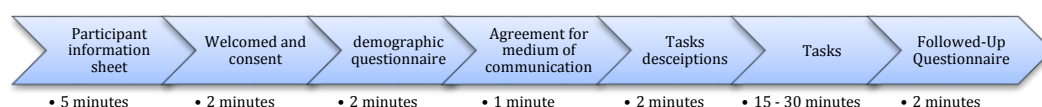
Before conducting the study session, the researcher had a checklist to make sure the environment was set up correctly and tools were working properly (see appendix A. 3). The checklist included participant information sheets, consent forms, demographic questionnaires, ID account sheets, landlines, recording cameras and recording tools.

When participants arrived at the test location, they were welcomed, asked to sit down and informed about the purpose of the study, the researcher making sure to answer any question or consideration raised on the Participant Information Sheet (see appendix A. 2), handed in before they came in. The researcher then asked participants to read the consent form and sign it before conducting the experiment (see appendix A. 4). Next, the researcher asked participants to fill in the Demographic Questionnaire (see appendix A. 5) and ask any questions while doing that. After that, the researcher asked them to read the Task Description sheet (see appendix A. 6) and ask any questions regarding that. The researcher asked them to do the tasks in order. The researcher asked members of each pair to agree on a medium of communication when they were later separated in two rooms. The researcher implied they could use the landlines or their private phone to communicate with each other. After they agreed on the communication tool, the researcher showed them the service information details (service: ID and password). If the service they chose was not on the list then they could use their own private accounts.

Participants were separated into two rooms and started to use their agreed communication tool. The researcher ran all the recording elements (cameras and software screen recording) in both experiment locations.

The participants used the Firefox Internet browser to view the Greenstone digital collection. They both had exactly the same collection with the same order and design (titles, filenames, creators, date). They started with the first task and informed each other when they had found a possible reference and so on for the next two tasks. The duration of this study was expected to be between 15 to 45 minutes for each group session.

The following flowchart (see Figure 3-6) summarises the flow of procedures in the user study.



*Figure 3-6: Procedure*

When the participants were finished, the researcher collected the data from both computers, including video and log IM (if they used text chat), and stored them in one folder (e.g., group B). For analysing, the screen recording files were stored in two computers so as to run the two video recordings simultaneously. Videos were set to start together when each participant started the session (based on the analogue clock time in both computers). Transcripts of both conversations and screen activities were extracted.

### 3.1.10 Limitations

There are some screen-recording tools that can record both audio from microphone and system audio, which means recording both participants' audio conversations. A common example of such a tool used in academic fields is Camtasia<sup>20</sup>, but because this tool can capture keyboard activities, it was not used in this study to ensure that participants' passwords remained confidential. The study assumed that participants might use their private accounts if the preferred service did not exist on the researcher's list.

As the focus of this study was on pairs who were friends, it was difficult to find students who knew each other and who could do the study together at the same time. The time schedule at the Usability lab was another issue, as the researcher needed to find the pairs who would agree to do the study and then check the lab availability and book it. Coordinating the participants and the lab was a challenge, as was finding enough participants from whom enough quality data could be gathered and analysed.

The study was conducted using Greenstone version 2.86. Greenstone version 3 might have given a different result, as the design of the reader interface is quite different from the earlier version. For example, the search box appears in every page except when opening a file or article in PDF.

The Greenstone interface was another limitation. The final readers' interface

---

<sup>20</sup> [www.techsmith.com/camtasia.html](http://www.techsmith.com/camtasia.html)



depends on the designer of the collection and what functionality and presentation they add to the collection. This study used the basic interface but did not go further to a more organised or advanced interface presentation (e.g., see the Greenstone Demo collection<sup>21</sup>). Furthermore, the main focus was on how the user interacts with the collection in its basic design format and how they evaluate, select and read documents, it being considered that this would provide sufficient results for analysis and understanding of the user's behaviour while browsing the same GDL collection.

The number of documents was considered a limitation since the collection appeared in one webpage rather than many pages. Greenstone uses the pagination method to present the whole collection in separate pages, similar to Google search results.

## 3.2 Research Validity

To ensure the quality of the research during the data collection two aspects of the research design need to be considered -- internal validity and external validity.

### 3.2.1 Internal Validity

A number of steps were taken to strengthen the internal validity of the study. As the study involved humans, an Ethical Approval application was needed. The approval for this study came from the Human Research Ethics Committee at the Department of Computer Science, University of Waikato (see Appendix A. 1). The researcher invited participants, in person, or by phone or email, to take part in the study. All participants were handed information sheets before agreeing to be involved in the study. They were informed about the task and the approximate time the study would take. The researcher followed the "instructions for experimenter" sheet (see appendix A. 3), therefore, all participants were treated equally. The researcher was involved only to answer questions about

---

<sup>21</sup> E.g., when the port number is 8282 in the computer where GDL tool is installed in then the link of the demo will be: <http://localhost:8282/greenstone/cgi-bin/library.cgi?site=localhost&a=p&p=about&c=demo&l=en&w=utf-8>

any unclear points arising from the questionnaire or task sheet, and to ask participants to choose their medium of communication and then start the study. There was no interaction with participants during the session. This equal treatment ensured impartial results. The researcher made sure that the participants understood their right to refuse to answer any particular question, to withdraw from the study before analysis commenced on the data, to ask any further questions about the study that occurred to them during their participation and to be given access to a summary of findings from the study when it was concluded.

The position of the camera recorder was from behind participants, not focused on the keyboard in order to ensure the confidentiality of participants' passwords. Further, the screen capture tool did not record users' keyboard activities.

The anonymity of participants was maintained in the publication and presentation of the results. The participants were asked to give their names but the researcher identified them by letter and number (e.g., A1:A2).

Only the researcher and supervisor knew the participants' details. No personal details gathered during the study were recorded. If participants wished to receive a summary of the study outcomes, they had to provide contact details, these were kept separate from the notes. None of the contact details will be used in any publications; at the conclusion of the study analysis contact details were to be destroyed.

The researcher did not promote any communication tool; each pair of participants agreed on one and then the researcher showed the information sheet for the accounts and their passwords.

### 3.2.2 External Validity

The main criteria of external validity is the process of generalization and whether results obtained from a small sample group, often in laboratory surroundings, can be extended to make predictions about the entire population (explorable<sup>22</sup>).

To strengthen the external validity in this study, a comparison of findings with those of similar studies took place. Comparing with other studies' findings, the result of this study can be generalized to extended population or reject them.

### 3.2.3 Data Analysis

Qualitative data was collected using two recording elements: the screen capture tool and camera. The people in each of the eight groups, or pairs, (16 participants) were known to each other (friends) and were from the Faculty of Computing and Mathematical Sciences, Faculty of Arts and Social Sciences and Management School. The common ground among participants was that they were friends. The participants' activities during the sessions were video and audio recorded and screen captured, and/or notes taken (in the case when participants wished not to be video/audio recorded). All participants' conversations and screen activities were transcribed and served as the primary sources of data. To analyse and interpret these transcripts, two well-known approaches, content and conversation analysis, were used. For conversation analysis, the transcripts were divided into three forms of communication -- telephone, text chatting and video conferencing -- and assessed in association with screen activities, whereas the content analysis was used to identify the codes and categorise the transcript contents.

The qualitative analysis describes the phenomena, classifying them and extracting concepts. The data analysis in this research is classified into four steps under the guidance of [31], [45], [46] and related works such as [47]–[49].

#### **Step 1:** Transcribe the electronic medium conversation

From the audio or video recording and IM log, the researcher constructs a detailed

---

<sup>22</sup> [explorable.com/external-validity](http://explorable.com/external-validity)

transcription of all participants' conversation. Screen activities are added to these transcripts. Conversation elements are used to explain the activities recording on the screen and on the camera (see Table 3-1).

*Table 3-1: Conversation Elements*

Conversation Elements	Description	Example
[ ]	To describe the activities on the screen	[Search via internet explorer]
( )	To describe the behaviour captured on the camera	(Pick up the phone) (Try to text his partner)
{ }	The research can summary the conversation of a participant.	{Read the whole title}
(00:00)	To identify the time pause for silence	(00:30)

### **Step 2:** Categorising and coding the content

The decision on how to code the sentences was mostly inspired by aspects that have been discussed in the related works (see section 2.0). Using previous studies to identify themes and codes is a useful approach [50]. For example, pointing to content or bookshelves [6] or division of labour [17].

### **Step 3:** Frequency count

After the transcripts were coded, the content was analysed to find out which activities occurred the most. Chunks of some conversations were used as an example instead of presenting the whole conversation in each session, as the patterns of conversation were similar and could be categorised. Instead, count frequency analysis methodology was used to show the occurrence of each code. Several studies have used this technique to reduce the repeated repetition of results (e.g., [51]).

### **Step 4:** Interpreting and concluding the data

A discussion about the findings of the current study is connected with previous studies.

Two software programmes were used to analyse the data. First, InqScribe<sup>23</sup> was used to code the screen activities. It allows the researcher to play and transcribe videos in the same window. The researcher can add notes, insert frequently used text and insert time codes anywhere in the transcript. Second, Microsoft Excel was used for data analysis. It was used for the questionnaire data and also for organising the transcript data and to number the transcript lines and analyse the coding or the pattern of each sentence (or message). Excel helps to categorise and count the frequency of each code.

---

<sup>23</sup> [www.inqscribe.com](http://www.inqscribe.com)

### 3.3 Result and Data Analysis

The purpose of this study has been to investigate the group information-seeking behaviour of remote computer users who are browsing the same digital articles collection. This has been accomplished by observing, through camera and screen recordings, participants who are sitting in two separate locations and browsing, together, the same Greenstone digital library collection. The data in the user study is both qualitative and quantitative.

Two types of questionnaires were handed to participants. The first was the demographic questionnaire that asked basic information about participants and their experience in a group work environment (both physical and online). Second, a follow-up questionnaire asked participants to assess their experience after finishing the session.

Basically, this section begins with the demographic questionnaire followed by the observation results from the recording elements, then the follow-up questionnaire and, finally, the researcher discusses these results.

#### 3.3.1 Demographic Questionnaire Data

Table 3-2 shows the information collected in the demographic questionnaire (see AppendixA.5). Sixteen people participated in the study (10 males and 6 females). Of the participants, 15 (93.75%) were between 18 and 38 years old, and one participant (6.25%) was 39 years old. All participants were students at Waikato University: 3 PhD (18.75%), 1 Master (6.25%) and 12 Bachelor (75%) students.

The participants were asked to indicate how long they had been using a computer and how much use per day. The responses varied from one to four years to more than ten years. Two participants (12.5%) had been using a computer from one to four years while the rest (87.5%) had more than five years experience. The majority of the participants had been using a computer over the past ten years. Five participants (31.25%) used a computer for about three hours per day, six (37.5%) for about four to six hours and five (31.25%) for more than six hours. Participants used a computer for several activities, including mainly writing, communication and life management, followed by reading and searching activities.

The participants were asked if they had group study experience or not. Twelve (75%) had experience of group study opportunities in the same place and at the same time, while the rest (25%) did not. Those who had experience had worked in-group for education purposes for various papers, including computer science, marketing, management and mathematics-related subjects. An equal number of participants had experienced working online with a group, as had not (50%). Ten participants (62.5%) used social media for education purposes while the rest (37.5%) did not. Most participants reported they had experience working online with the subjects related to computer science or E-commerce, while physics and education-related subjects was less reported.

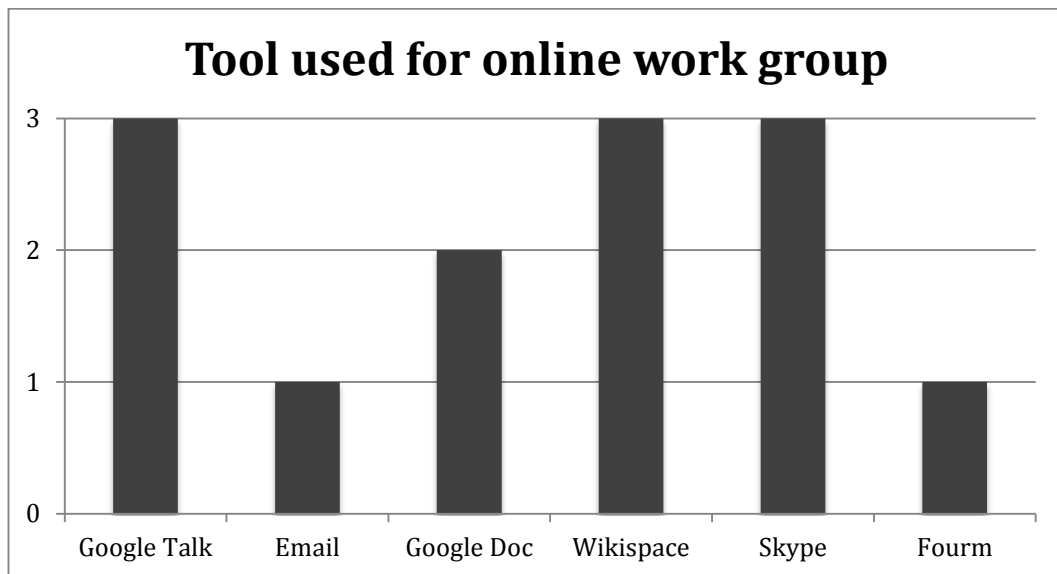
Table 3-2: Demographic Questionnaire Data

		Frequency	Per cent
<b>Participants</b>	Male/Male	4	50%
	Female/ Female	2	25%
	Male/ Female	2	25%
<b>Age group</b>	18–28	9	56.25%
	29–38	6	37.5%
	39–48	1	6.25%
<b>Study</b>	PhD	3	18.75%
	Master	1	6.25%
	Bachelor	12	75%
<b>Years using computer</b>	1–4	2	12.5%
	5–10	6	37.5%
	>10	8	50%
<b>Computer usage per day</b>	1–3	5	31.25%
	4–6	6	37.5%
	>6	5	31.25%
<b>Group study opportunities</b>	Yes	12	75%
	No	4	25%
<b>Working online with a group</b>	Yes	8	50%
	No	8	50%
<b>Using social networks services for education reasons</b>	Yes	10	62.5%
	No	6	37.5%

Social networks are beneficial tools for enhancing the experience of a group working online. Figure 3-7 shows the tools participants reported having experience with in working online with a group. These tools were used to communicate with other group members and provide a platform of features that assisted them to achieve their tasks. Video conferencing is the most used of the tools, including Google Talk and Skype. Other popular tools are collaborative



writing tools, including Google Doc and Wikispace <sup>24</sup>. Forum and email are the least used: they tend to be more asynchronous tools, as they do not provide real-time communication.

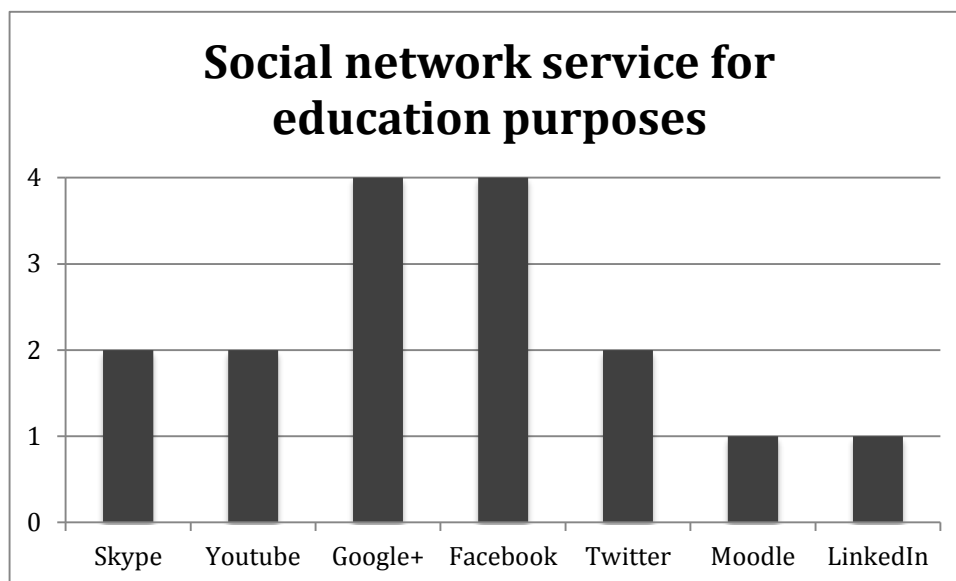


*Figure 3-7: Tool used for online group work, a participant may be mentioned more than one*

Figure 3-8 shows the level of social network use by participants for education purposes or gaining knowledge. Most participants had used social network services for education purposes. Facebook and Google Plus are the most used tools, followed by Skype, Twitter and YouTube.

---

<sup>24</sup> [www.wikispaces.com](http://www.wikispaces.com)



*Figure 3-8: Social network service for education purposes, a participant may be mentioned more than one*

### 3.3.2 Recording Elements Data

The researcher used the camera-recording tool to observe whether participants used external devices to communicate with each other, including landlines and mobile phones. All participants agreed to be recorded on camera, except for two groups who refused to be recorded through the camera, but agreed to their screen activities being recorded (one group used the text chat conversation and the other used the audio conversation through Skype). This section presents the communication channels and conversation analysis then summarises these themes in regard to frequency of descriptive sentences.

#### *Communication Channels*

None of the participants were observed using their own devices. The current study divides the mediums of communication into four forms: audio chatting, video conferencing, text chatting, and video conferencing and shared screen. Figure 3-9 shows that most participants used video conferencing; three groups used Skype (group B, D and F), and two groups (group C and I) used audio-based chatting (Call in Skype and landline). Also, two groups (group G and H) used text-based

chatting (IM in Skype, WebQQ service). Only one group (group E) used video conferencing and shared their screen through Skype.

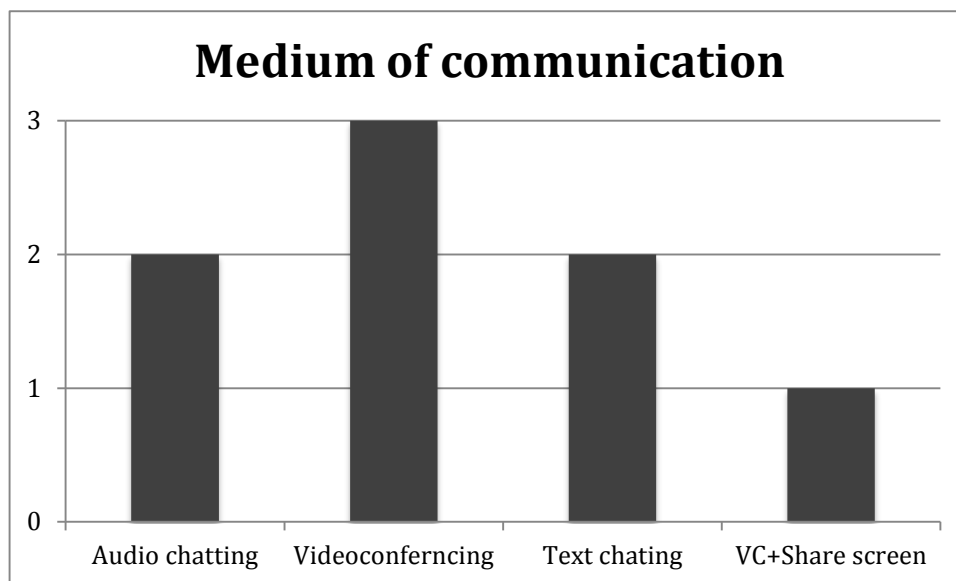


Figure 3-9: Medium of communication, only one option for each group

#### *Time Spent on Tasks*

The following table (see Table 3-3) presents the time that every group spent on each task. The time was recorded in seconds. In several cases talk unrelated to the given tasks was observed. This talk was “humorous” exchanges or related to technical issues with communication (e.g. how I can share my screen?).

Table 3-3: Time Spent by each Group (in seconds)

Group	Task one time	Task two time	Task three time	Non-related talk time	Total time
B	65	264	63	20	412
C	156	82	314	0	552
D	250	330	495	190	1265
E	37	240	360	600	1237
F	311	362	481	133	1287
G	154	122	304	0	580
H	62	193	251	0	506
I	303	462	492	93	1350
<b>Average Task Time</b>	167.25	256.875	345	129.5	898.625

Figure 3-10 shows the average completion time graph for the tasks completed by all of the test participants.

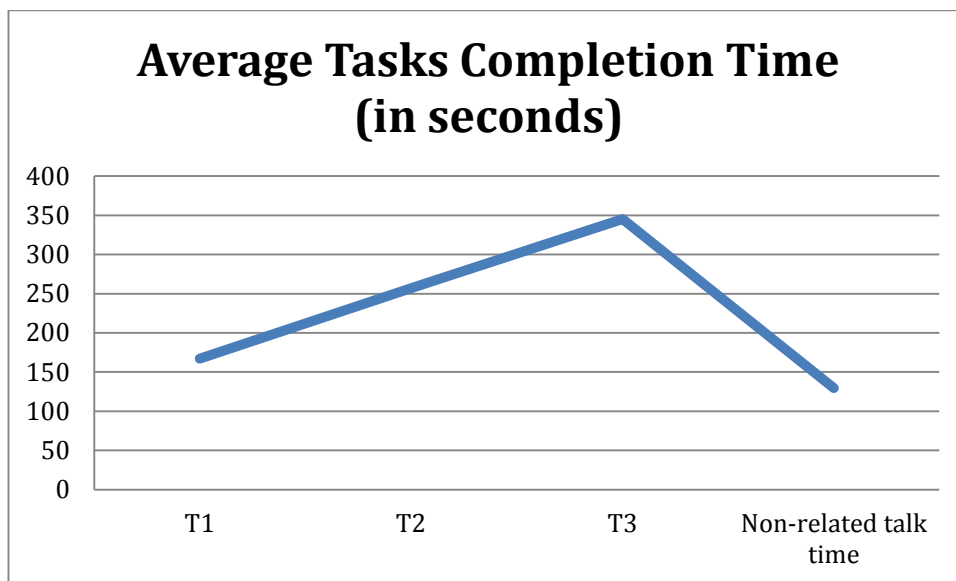


Figure 3-10: Average Task Completion Time (in seconds)

### *Conversation Analysis*

This part presents results about the participants' conversation during the sessions. The three tasks were designed to reveal behaviour or activities of users working in-group (see 3.1.3). Parts of some conversation from the transcripts are used to illustrate the participants' observed behaviour and screen activities, instead of presenting the whole conversation in each session, as the patterns in them are similar and can be categorised.

As mentioned before the categorization of all conversation transcripts has been mostly based on aspects from previous studies mentioned in chapter (2.0). A count of participants' frequency of screen activities and the codes from transcripts are used in this study. After reading all transcripts and relating the messages to previous studies, two main categories were identified: search box and browsing awareness, and information referencing awareness. Other findings that related to group work were added.

### *Search Box and Browsing Awareness*

Figure 3-11 illustrates that searching the collection was the most frequent activity that users performed, in comparison to browsing the collection. There were two search boxes: Firefox and Greenstone search box. Most users used the Firefox search box. Related to Firefox highlighting, there were two modes: “highlighting all” mode which highlights all of the keywords on a page content and “highlight one by one” mode which highlights one keyword at a time, with movement between them being by keyboard commands “next” and “previous”. Most participants used the Firefox search box for finding keywords on the current webpage. One group (group G) was observed to use it for searching inside the document. Most users (5 participants) used the “highlight one by one”, whereas three participants were observed to use the “highlight all” button.

It had been observed that users exchange information about queries. Participants displayed different levels of ability or skill in dealing with either Greenstone or Firefox search boxes. When they shared their queries, several participants spelled the queries wrongly (see example 1).

#### **Example 1:**

**C2:** [searches for all of the key phrases in Firefox search box] (00:7)  
[changes query] [failed] (00:10) what word(s) did you put?

C1: you may have spelled it wrong

**C2:** {reads the word}

C1: what are you looking for?

**C2:** what word should I put

C1: It is ... {tells him the word}

**C2:** yea [reformulates search query]

Example 1 shows that C2 input all of the given keywords in Firefox and failed to match them with webpage content, while C1 put in the right words and did not know what C2's query was. He then shared his query by reading it aloud. Then C1

reformed his search to be the same as C2. They can continue collaborating with the articles.

In group D, participant D2 was trying to share his query, but his partner (D2) was busy browsing the collection.

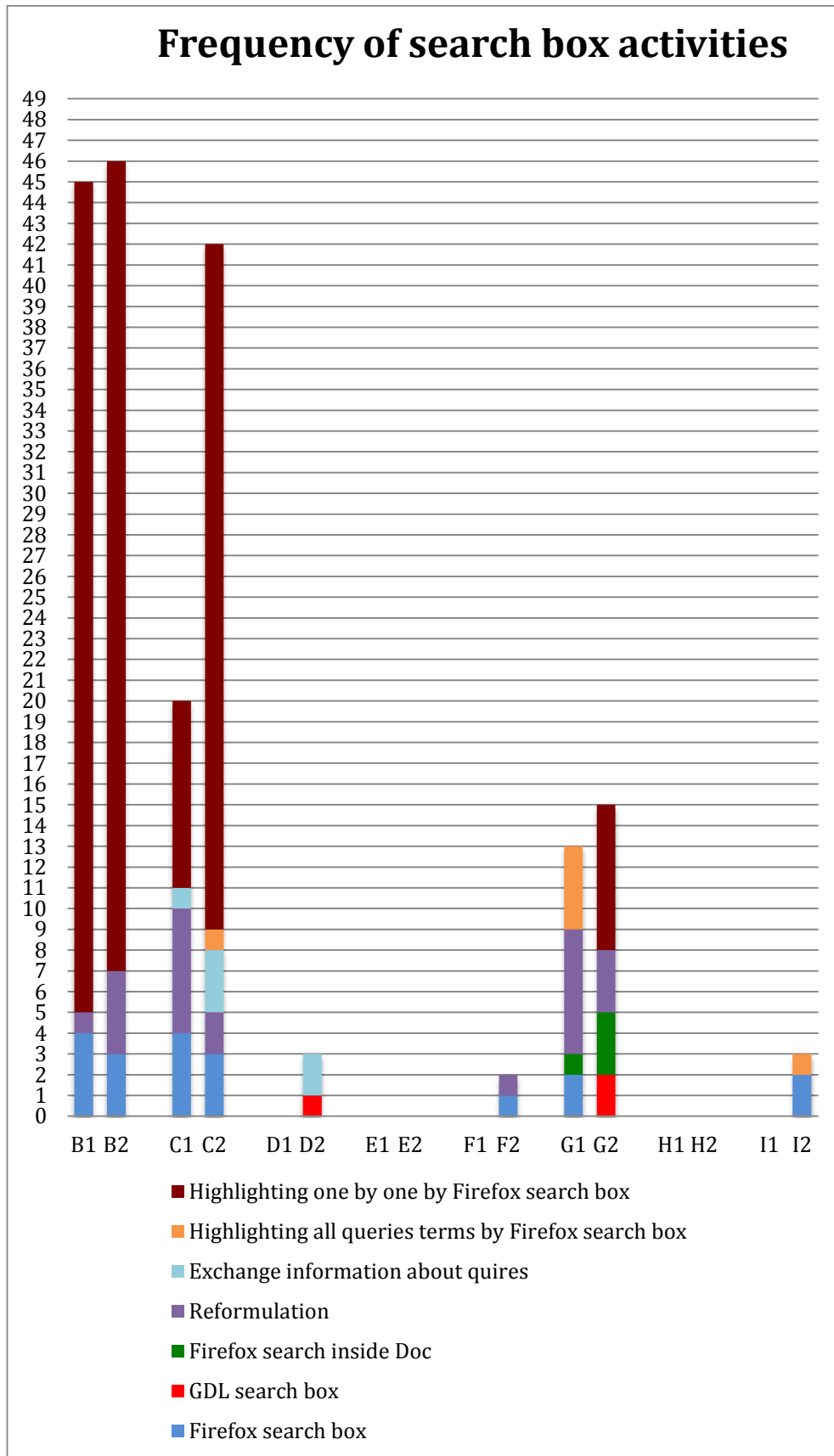


Figure 3-11: Frequency of search box activities

### *Information Referencing Awareness*

Two types of information referencing were used: across the collection and inside the document. When participants tried to direct their partner to the same point across the collection or inside the document, considerable time and effort was expended for everyone to arrive at the sought after point. Participants were observed to use different techniques to direct each other to the target information. Participants who used oral communication (landlines, videoconferencing and audio calling through Skype) referred to the point of interest (POI) by reading aloud first and when they failed to come together to the target document or text they used the count reference line to direct each other. For negotiating inside a document, they used the page-, paragraph-, line-number and content referencing (e.g., “below the table”, or “The paragraph that starts ‘Asynchronous is’”). The next example illustrates the referencing statement (see example 2).

#### **Example 2:**

**D2:** I found one and I think it is a good one [read the title]

D1: Ok where?

**D2:** [Counts the lines]

D1: [Moves the cursor when hears the count]

**D2:** It is number fifteen from the top [read the title aloud]

D1: yup yup

Example 2 shows that D2 informs D1 that he has found an article and D1 asks questions to identify the location of the article. D2 starts to count the order of the articles. D1 follows him by counting with him to the target article.

All participants were observed referencing information across the collection, except those who were using the chat-based communication (group G and H); they use the “copy and paste” technique to exchange such information (see Figure 3-12). They copied and pasted their finding on the IM instead of identifying the article’s location among the collection. For task three (see appendix A. 6) participants were asked to find the best definition for “asynchronous eLearning”, Group D referred to the document title thinking it could give a definition of the given term. Groups D, E and F opened the document and started referencing



inside it together for the best definition, while group C exchanged the information orally instead of reading the document, and text-chatting groups G and H also used “copy and paste” to exchange the information.

Related activity that could effect the referencing was opening either a PDF file or HTML format file for the same document. Most participants were reading PDF documents (see Figure 3-12). In group I, I1 read an HTML document format while his partner read the same document in PDF format. Another case occurred with group (G), but they read at their own pace since they used text-based communication.

Another related activity to referencing was opening tabs in both Greenstone digital library (GDL) page and Firefox Internet Explorer. Most participants opened links (tabs) in the GDL (see Figure 3-12). They were trying to open the file document or to view the references in different browsing classifications (e.g., year). Those who used another web application service for communication (group G, WebQQ service), opened a Firefox tab to chat and move between the two tab. Further, in group C, C1 was observed to open the document file in another Firefox tab and to read between these two tabs. In Greenstone DL, to open a file click on the title which opens another webpage and this webpage has two document formats (PDF and HTML); the user then clicks on the one they want to use to view the document. All users experienced this process except group B and participant E1 (see Figure 3-12). Further, the search result opens in a new webpage with a different ranking of the result.

Users were observed several times to appear to be lost while they used the Greenstone search box or moved between webpage. When users used the Greenstone search box, the result was shown in a new page.

### **Example 3:**

C1: You find it!!

C2: Ok, I think I found a definition.

C1 How did you find it?

C2: I opened the articles from the top, third one

C1: From the top? {Viewing the result of the Greenstone query}

**C2:** You can click on the icon and open the file {open the link and two documents appear with two different icons for opening the file either in HTML or PDF}

C1: [move from section to section]{lost track}

**C2:** Oh no, no, it is the third one; where are you?

C1: {read titles}

**C2:** Ok, Ok probably you are on different pages

Participants in example 3 were facing an issue with browsing since there were many links, leading them to open and move between pages. User C1 open the file from the collection list while user C2 used the search function of Greenstone and opened the result, which retrieved documents in a different order than C1.

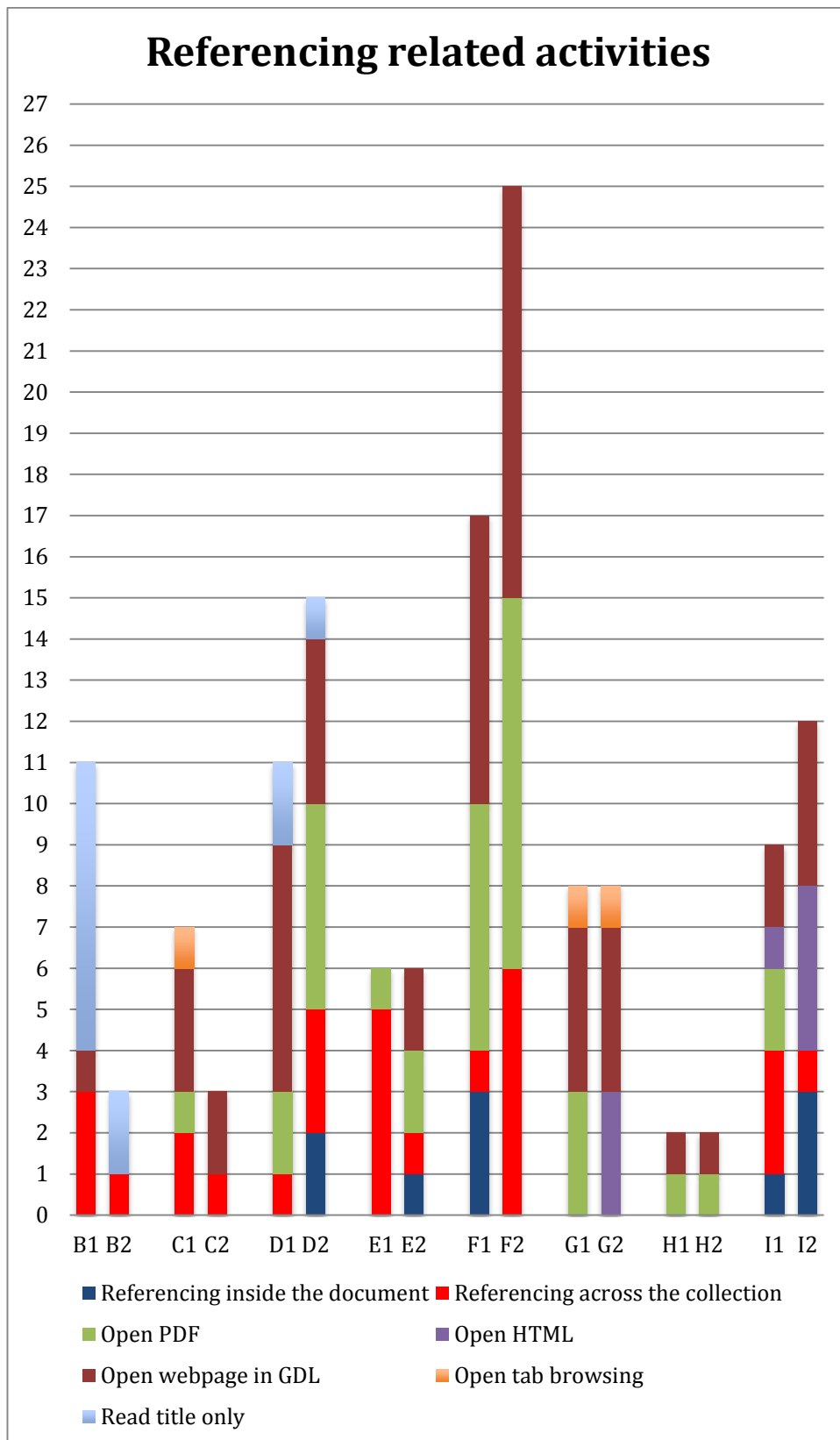


Figure 3-12: Referencing related activities

### *Evaluation the information*

The second task asked participants to evaluate references across the collection, while the third task asked them to find the definition of a given term inside documents, which leads to evaluating a selective piece of information inside a document (see appendix A. 6). Most participants used qualitative statements to give their opinion about a document (e.g. “this is good”) while a “like” statements was not used (e.g. “I like this one”) (see Figure 3-13). Text-based communication groups read and evaluated the information at their own pace and shared it with others through “copy and paste”. Only participant D1 asked about the type of document (“What type of document is this? Is it from newspaper or journal?”). Most participants asked their partner for their opinion of information that was mentioned (see Figure 3-13).

#### **Example 4:**

**F1:** Yes that is it, what do you think?

**F2:** [read the title] Mmmm yea it seems good. It has a synonym of the term “higher education”.

**F1:** What do you think?

**F2:** Yes, I think it is good one

In Example 4, participant F1 found an article and presented it to F2. He then asked him for his opinion and evaluation of the document from its title. F2 read and examined the title and matched the keyword with its synonym in the title.

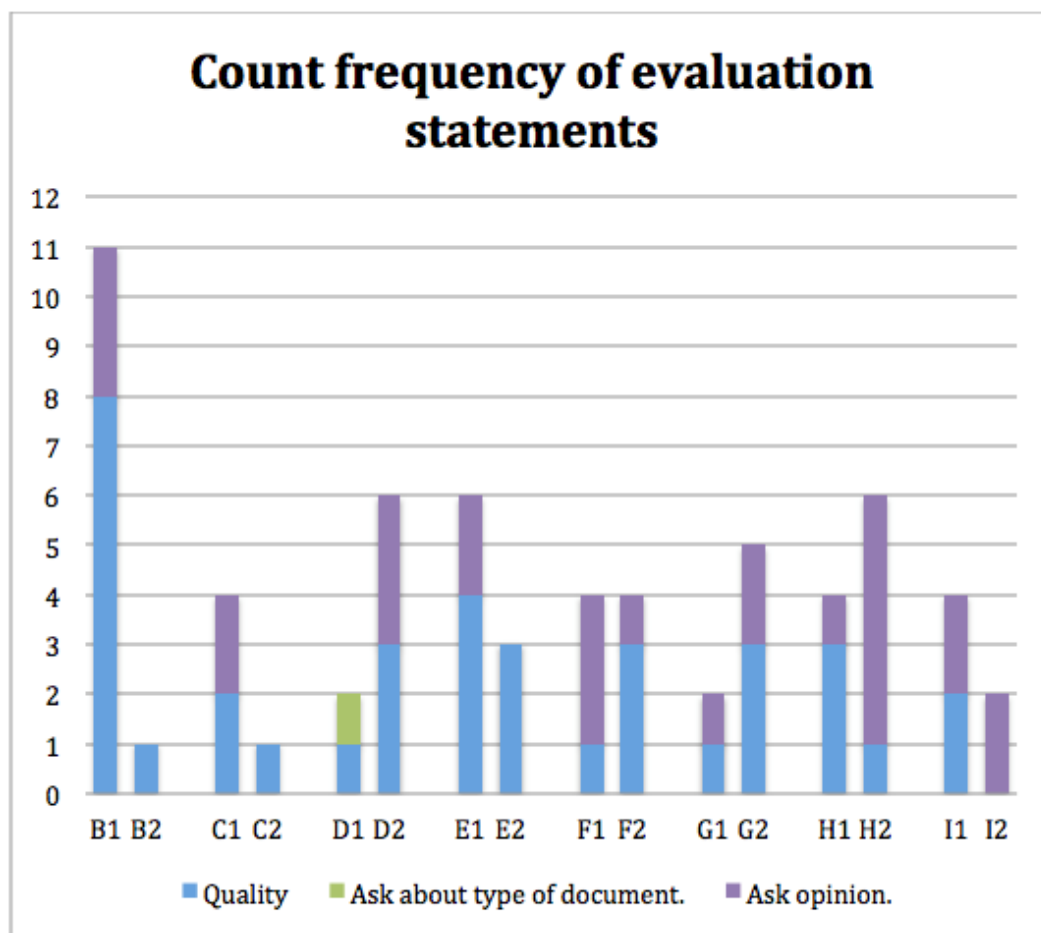


Figure 3-13: Count frequency of evaluation statements

#### Other Finding

**Awareness of progress:** Awareness between participants in online group interaction was common in all sessions. Users tried to be aware of the progress of their partner. They used statements that told the other party about their current situation (e.g., I am reading ..., I am looking for ...).

**Division of labour:** Only two groups divided the task between them to save time. Group C: “I will read the first one, you do another”. The participants were observed dividing a task that required them to find the definition of a given term. Participant C1 found an article he decided to take time to read part and asked C2 to find another one to read.

**Encouragement:** in some cases, participants were seen encouraging each other to find articles (e.g., “try again”, “you are good”).

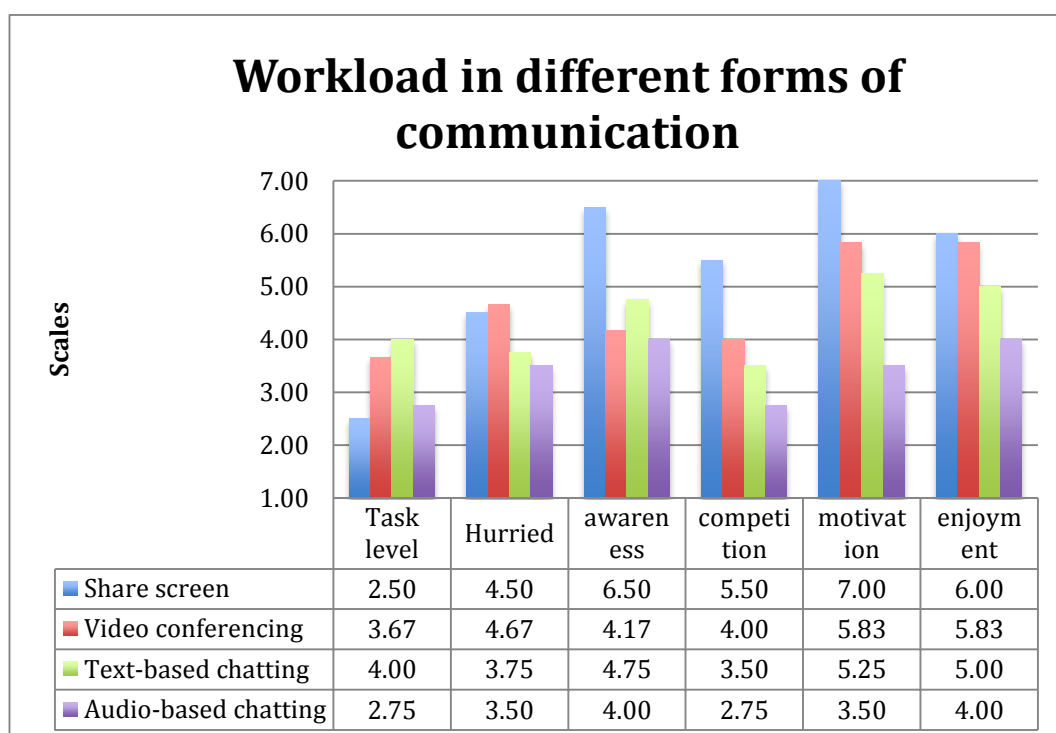
**Sharing prior knowledge:** participants shared their knowledge about some

definitions to clarify the task (e.g. D1 asked D2: “Do you know what asynchronous means?” D2 gave a negative response and D1 started to explain to his partner).

**Video calling position:** it was noted that most participants using video conferencing positioned the video screen on the top of the screen.

### 3.3.3 Follow-up Questionnaire Data

The Followed Questionnaire (see appendix A. 7) asked six questions to extract participants’ workload experience after the session. These questions were asked about task level, hurriedness, awareness, completion, motivation and enjoyment. The responses to these questions were recorded on a 7-point Likert scale [44]. Further, this questionnaire had a comment section for any additional feedback.



*Figure 3-14; Workload in different forms of communication*

Figure 3-14 shows the workload that participants experienced in the experiment sessions. All participants reported low values for the task level, which indicates the level of ease, except for participants using the text-based conversation, who reported the task level to be moderately easy. Regarding the hurried to complete

the tasks, participants with video conferencing and share screen were moderately hurried to accomplish the tasks while other were slightly not hurried. In terms of awareness, share screen participants were considerably aware of each other's activities, while text-based, video conferencing and audio-based chatting participants were moderately aware. The share screen group reported considerable competitiveness; video conferencing groups were moderately competitive. Participants using the share screen reported high levels of motivation followed by video conferencing participants and text-based chatting groups who were considerably motivated, and audio-based chatting participants who reported slight motivation. Also, participants using the share screen reported higher levels of enjoyment, than video conferencing participants and text- and audio-based chatting participants.

Overall, share screen participants returned positive statements on workload, followed by video conferencing participants and text-based chatting participants. Participants who used the audio conversation made negative statements about the workload.

### 3.4 Discussion

Starting with the demographic finding of the study, as expected most students had experience of group work, either in the real world (as group study) or working online with a group. In this study sample, 75% of students had experience of group study and 50% had worked in groups online. This indicates a need in people for a social aspect to information seeking.

As expected, the results show that most respondents used social networks. This finding is similar to that of several previous studies, such as [52]–[54], that have found a high percentage of university students use social networks, particularly Facebook. Further, a number studies, such as [54], have highlighted the use of social networks to support student educational purposes. Not surprisingly, this finding is indicative of the high popularity of social network sites nowadays, and the impact that they are likely to have on people's daily lives.

It should be noted that the study did not address some potentially confounding variables. Several factors have the potential to impact on the findings, such as age and gender distribution among the participant sample, the study target population, education levels and possible cultural differences between the participants. The study sample consisted of international students (Asians, Europeans, Indians etc.) this potentially confounding variable was not considered.

Returning to the main research questions: “What are the group information-seeking behaviors (or activities) of remote computer users who are browsing the same digital articles collection?” Firstly, in term of medium of communication most participants selected video conferencing to communicate with peers. This finding is consistent with Isaacs and Tang study that found people are more willing to establish discussions through video calling rather than audio calling [55], [56]. A related and unexpected result was that most video conferencing users positioned the video calling screen in the upper part of the screen. A possible reason for this is ease on their eyes since the favoured position was at eye level.

Secondly, to identify users activities (or behavior) from both parts -- the screen and conversation -- three simple tasks were designed (see appendix A. 6). The first task was about finding keywords. This task was expected to explore users' behaviour related to two main concepts, search box and browsing, and how much



time users spent exchanging such information. The second task was about finding key concepts. The purpose of this task was to explore users' behaviour mainly related to referencing across the collection and also to evaluate these references. The third task was about viewpoint. The aim of this task was to explore user behaviour that is mainly related to referencing and evaluation inside the document. Overall, the activities observed are mostly related to three main aspects -- search boxes, information referencing and evaluating the information.

Even though there were about 54 articles in one page of the collection, most users preferred search boxes to browsing the collection. According to Nieleesen, users tend to look first for the search box when they visit a web page [57]. Another surprising result is that users prefer Firefox search box to the Greenstone search box. Possible reasons for this preference could be that they are used to using the Internet explore search box in any webpage, the query term highlighting the functionality of Firefox, and that it is displayed in any pages when they move between pages. Another reason could be that the Greenstone search link does not encourage them to click on it. Nieleesen found that the use of a search engine increased by 91% when he added a search-box to his website, instead of a link (link that take user to a page with search box) [57]. When participants shared their queries, they read them aloud and two main issues appeared; firstly the queries might be spelled wrong, and secondly, a user might use a different search box than a peer (e.g. G1 used Firefox search box while G2 used Greenstone). Further, some users reformulated their queries many times while their partner may have quickly got the right (or successful) queries. The co-browsing website navigation should display the search box in every page and this navigation exists in Greenstone version 3. Further, the entire query should be highlighted on the current web page. Providing a button to allow users to share their queries is essential to avoid duplication of effort and therefore save time.

In this study, awareness of a peer's activities was most often related to referencing the information across the collection and inside the document. During mutual navigation, users used phrases that indicated the gesture needed to direct the attention of others to a point in the text by language. They used page-, paragraph-, or line-number or referred to content or layout of the page (e.g. "in the bottom" or "third one", "below the table", "line four", "the second paragraph"). This finding is similar to Pearson's observation when she investigated co-located group readers

referencing behaviour [22]. The analysis of verbal communication behaviour indicates that the Co-browsing GDL system should support remote pointing gestures and identify their location across the web page. A common solution is to provide a “telepointer” that allows users to effectively guide and direct each other through the collection; therefore verbal instructions can be reduced. The solution to identifying users location across the collection and inside a long document is to use a “multi-users scrollbar”. The solutions to referencing inside the same page are to use the “point out” feature and “highlight” the text to identify more specific information or the work process (e.g., point to a person’s face on a picture and say his name).

The presentation of the metadata collection in Greenstone impacts on the users' work while browsing the collection together with a peer. The website navigation of Greenstone DL is not sufficient for co-browsing. The reason may be that the many links and tabs available for moving between pages make it hard for participants to identify their current location to each other. For example, one person was viewing the collection by author name and the other by title (see example 3, group C). Further, the search result may be another issue since Greenstone DL presents the result in a new page and users may have a different page order than their partner, which means it is hard to reference them by counting the lines to each other to arrive at the target document. The Co-browsing GDL should present the result in the same view table collection and keep users on the same page.

Although the third task asked participants to find viewpoints, most users did not divide the task between themselves; only one group divided the task by reading different documents. A possible explanation of this finding is that the groups were of two people and they might not have needed to divide the task since there was no contribution overload (or conversation) that at times might need to be reduced by dividing a task.

The results of the follow up questionnaires show that the given tasks were reasonably easy for all groups. They either had prior knowledge of the topics or they could easily understand them. Awareness in those who used the share screen was at a higher level since they could see each other's screen activities. Surprisingly, the participants using text-based chatting reported high levels of

awareness of each other's activities. A possible reason could be that while they worked individually at their own pace they expected each other to immediately share their achievements in each task. The participants who used audio as a medium of communication had a negative response. The interruption of each other while doing the task could be a possible reason for such a response.

## **Requirements**

These requirements are identified to support users who are browsing together the same Greenstone digital library collection from separate locations. These requirements are being inspired by the related systems (See Chapter 2.0), as well as been identified from the data analysis of the user study.

- Identity: User need to identify their peer therefore can control whom to follow their activities and communicate with.
- Communication: Medium of communication is the core element in online group works. Users need to have different options of medium communication including text based chatting and audio and video calling.
- Referencing awareness: Users need to be aware if their peers referencing activities inside the document and within digital collection.
- Share right information: Users need to share only the right queries. Also they need to share the selected references.
- Information presentation: Users need to have all metadata in one page rather in different pages.
- Visualisation: Users need to identify the location of the documents of their partner that is currently reading.
- Navigation: Users need to identify the web page elements. Also, reduced the number of links and keep them in one interactive page.

## Chapter 4

### 4.0 Proposed System

To assess a system that supports shared browsing of the same collection in the Greenstone digital library a prototype was developed. This chapter begins with the prototype background, then analyses the system requirements, before explaining the prototype design. Chapter 5 discusses the usability test of this prototype.

#### 4.1 Prototype Overview

Making a prototype, or prototyping, is an effective approach to testing new design ideas [58]. It assists a designer in solving problems and understanding what a user might want after performing a usability test. A designer can evaluate multiple ideas in the early phase of development [59] after which the system can be implemented. Prototyping is fast and cheap in contrast to building a fully functional system. Designers need basic materials (e.g., paper) or a computer-based design application to present their ideas. Basically, there are two types of prototypes: low-fidelity and high-fidelity prototyping [58]. Low-fidelity prototyping “does not look very much like the final product” unlike the high-fidelity prototype [58].

##### 4.1.1 Low-Fidelity Prototyping

Low-fidelity prototyping is a quick and easy way to translate the high-level design concepts of a system into a testable artefact. It may be drawn on a piece of paper by hand or computer application (printed, paper prototyping) or be a picture made by an application (on the computer screen). Paper prototyping is a simple way of testing the usability of a proposed system and can provide a great deal of useful feedback that can be used to improve the system. Different forms of low-fidelity prototype include index cards, Wizard of Oz and sketching storyboard [58]. The sketching storyboard form of a paper prototype is used in this study. It involves elements that include people, desk, camera and simple sketches (e.g., icons, buttons and windows).

#### 4.1.2 Limitations

Hi-fidelity prototyping was not employed in this study due to the time constraints on programming simulated software for the proposed system. Further, reviewing several network services (e.g., Google Doc) that could simulate a large portion of the proposed system's features was not possible since there is a need to communicate between all features and show some links between them. For example, pointing to content by clicking on the cell, storing shared references and search queries allows selecting references or identifying all a user's activities by unique colour.

### 4.2 Requirements for the Co-browsing GDL System

This section discusses in detail the Co-browsing in GDL system requirements. These requirements have been inspired by the related systems (See Chapter 2.0), as well as having been identified from the data analysis of the user study (See Section 3.4). These requirements are important to ensure the quality of a collaborative system's share browsing capability, remotely or locally, at the same time, of the same collection. This section reviews techniques from previous studies (or systems) that can support the Co-browsing GDL's requirements. A Co-browsing GDL prototype can be seen in (4.3).

#### • Identity

Identity is an important aspect in a system that involves multi-users. When sharing "information activities" with other members, such as highlighting, conversation, telepointer and shared queries, it is essential to distinguish between group members. The colour code and nickname for participants are essential in a collaborative and social network system in order to assist participants to distinguish each other's activities. This technique is used in many services (e.g., Google Doc) and collaborative systems (e.g., CoSearch [17] and BuddyBooks [22]). The colour-coded and nickname technique is considered to be an easily distinguishable approach that is suggested by [60]. Further, identifying a member by name and colour will allow users to select whom to follow. Allowing a user to select users to follow is a feature of the SearchTogether system [25]. It keeps

users focused on the users they are currently interacting with, rather than seeing all users' activities and making the workspace more complex.

- **Communication**

A real-time and remote work environment needs a direct communication channel. Through communication, users can discuss and evaluate the references. The result of this study shows that participants use different types of communication tools, but identifying the reasons why they choose a certain tool is not discussed in this study. Typically, there are three options of communication: text-, audio- and video-based conversation. These options are used “together” in several popular social network systems, such as Facebook and Skype. The Co-browsing GDL proposed system allows users to choose the medium of communication they prefer, which seems to be important in a successful social-based system. When users want to call in video or audio, they click on their icons and a list of nicknames of users who are currently browsing the same collection shows up.

- **Share the right information**

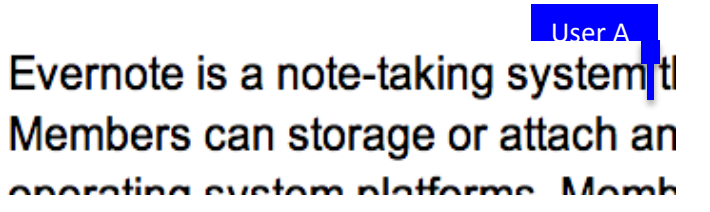
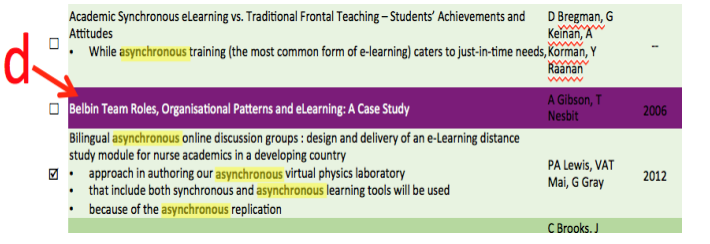
Sharing only the right information must be taken into account when designing a collaborative system. Systems such as SearchTogether [25], CoSense and CoSearch [17] provide a sharing-the-queries feature with all group members, including the right and wrong queries. However, the user study results show that participants only shared the right queries with peers. Therefore, providing a button that allows a user to share queries that she or he thinks are valuable is an important feature. For share referencing, users can click on the check boxes to select a number of references they want to share with peers. Sharing the right information is important in avoiding undesired duplication of effort, as a user knows what queries have already been tried or referencing is been reviewed.

Peers can see the shared queries and selected references in the “Update box” area. The “Update box” allows users to track their peers' activities while progressing the discussion.

• **Referencing awareness:**

Awareness is associated with “referencing the information” in many synchronous collaborative systems. Providing referencing features will assist users to navigate peers’ locations or points of interest. A common approach in many collaborative writing systems is using the “telepointer” technique (e.g., Google Doc). Telepointer is an essential feature in a real-time environment system [61]. It increases the awareness of members through identifying their location and activities. This technique is about tracking users’ mouse movements or activities among the document content. In reviewing related systems, the use of the “telepointer” technique is common on services that provide for collaborative writing and editing, but there is no system support for the “telepointer” in a “read only” web page. Adding such a feature to the GDL could help users identify the location when their peer clicks on the reference cell. The following table (see Table 4-1) illustrates the difference between the traditional telepointer in Google Doc and the proposed one in the Co-browsing GDL.


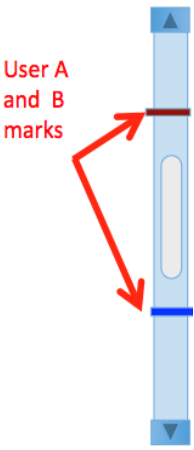
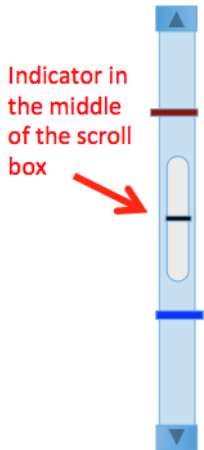
*Table 4-1: Telepointer*

	<p>Google Doc’s telepointer. User can move the telepointer across the text</p>
	<p>Proposed Co-browsing GDL telepointer. User clicks on the title and a user colour-coded highlight the whole cell that contains this title.</p>

Further, for identifying the “browser view” of other members a common approach is using the “multi-user scrollbar pointer”. If the collection or the open documents are long, then showing an overview of where members are through their color-coding in the scrollbar of the collection or document can be useful. This approach helps users modify their “browser view” to be the same as that of whom, for

instance, calls to see a piece of information in a certain page or across the collection --"what you see is what I see". There are, commonly, two types of "multi-user scrollbar pointer". The following table (see Table 4-2) illustrates the difference between these two styles and the proposed style for the Co-browsing GDL.

*Table 4-2: Multi-user Scrollbar Pointer*

		
<p>This type is good to adjust the scroll box, but it takes space if many users are involved.</p>	<p>This type does not take space, but it is hard to view exactly the same view with peers, especially when they use the "point out" feature inside a document.</p>	<p>This is the proposed design for the Co-browser GDL. It saves space and user can adjust the view by using the indicator in the middle of the scroll box.</p>

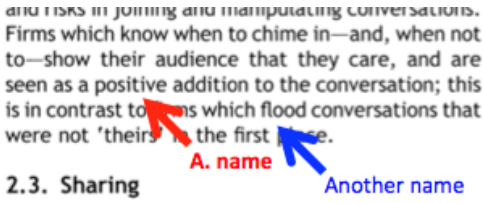
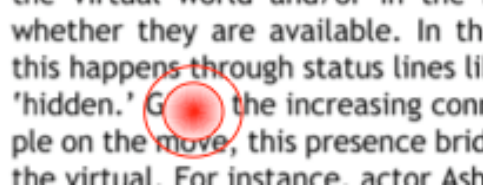
For referencing inside the document, annotation is used in many systems either for personal or public use. To determine how to support the annotation, it is important to know how, why, and for what purpose annotation is used in a synchronous environment. The annotation helps a group reader to quickly identify the location of the point of interest (POI) while discussing the target information [22]. Annotation has three main elements: a value, an anchor and a visual form [29]. The value is the data that is added by the reader to the document, the anchor is the link between these data or between passages in this document, the visual form is the presentation of these values (e.g., highlight, underline and circle) [29]. There are two main types of annotation. The first is writing that comes in the form of marginal comments on the text, and the second is marking annotation such as underling, circling, highlighting and rating. For synchronous interaction the use of



highlighting could be an essential feature that assists users to navigate in real time the location of the POI.

Table (see Table 4-3) presents two different approaches of pointing out more specific POI inside a document: multi-cursors telepointer and “Point out” technique. These approaches assists group readers to quickly identify a specific location when all group arrive at the target page. It seems useful when remote users discuss a complex diagram or explain an element of a picture.

*Table 4-3: Approaches of pointing out more specific POI inside a document*

 <p>2.3. Sharing</p> <p>Sharing represents the extent to which users ex-</p>	<p>Flexible JAMM<sup>25</sup> proposed to use multi-cursors telepointer with colour codes to identify the movement of group members, but this could lead to complexity and lose the user's focus.</p>
	<p>The proposed technique for identifying the point of interest in Co-browsing GDL is inspired by BuddyBooks “point out” technique [22]. It assists users to identify the POI by clicking on the target part.</p>

The proposed system of Co-browsing GDL has “point out” feature to support mutual navigation inside the document. As mentioned before, the users identifying the reference activities of each other by the colour codes.

### **Information presentation:**

Information presentation is an important aspect of any system. Metadata allows users to evaluate resources (e.g., evaluate based on document authors). It is important to present a large amount of information about references in a consistent manner [62], particularly in the case where users are browsing the same collection. A common approach to presenting metadata is “view table” (or

<sup>25</sup> [people.cs.vt.edu/~shaffer/JAMM/](http://people.cs.vt.edu/~shaffer/JAMM/)

tabular) which can communicate large amounts of information [63]. Typically, the metadata are presented in rows and columns, which allow users to evaluate the references based on that attribute or they can sort the references by specific attribute [62]. This way of presenting information is used in many digital collection systems [63]. System such as Mendeley uses this type of presentation in the desktop version. The “view table” allows Mendeley users to sort the references by any attribute (e.g., title, date or authors’ names) and therefore evaluate these references based on these attributes.

The sort features in many digital collections’ “view table” seem to support single users, while in cases where there are many users, who are viewing the same collection together, it will be difficult for them to identify which reference they are looking at for each other, if each one sorts the collection according to their purpose. As a result, the Co-browsing GDL will use the un-sortable “view table” presentation (fixed). This way will take into account the “multi-users scrollbar pointer”, as all users view the same list order, which means the system can identify in which location (or part) the users are viewing.

Search result presentation is another important aspect in this system. As the system involves multi-users, the result must be shown in the same “view table”. Showing the search result in different pages could affect the “referencing” awareness of each other. Two main aspects should be taken into account: summary of results presentation and highlighting the query terms. According to [64], showing the summary of search results in bullet “list style” significantly improved the performance in users’ readability of results, in comparison with the “normal-bolded style” (e.g., Google). Using query highlighting is an effective method to increase user experience. Highlighting can be seen in three different ways: reverse video, bold text or with a coloured background (searchuserinterfaces<sup>26</sup>). A coloured background is used in many applications. When a user uses more than one word in the query term, it is suggested a different colour be assigned to each word [65]. However, in cases where there are multi-users and each one has been colour-coded, this method would appear to be difficult to use, especially when searching inside the document (user could

---

<sup>26</sup> [searchuserinterfaces.com](http://searchuserinterfaces.com)







highlight some text or words). Instead, using one colour to highlight key terms could be a better option.

The Co-browsing GDL system should display the “list style” search result under each title and use the coloured background to highlight the query term in the title and on the list summary (see Table 4-1).

- **Visualisation:**

Icons are used to present information. They help users interact with the collection while browsing and reading the document. All Greenstone versions use visualisation to enhance the experience of users. Table 4-4: shows the proposed icons for the Co-browsing GDL.

*Table 4-4: Icons for the Co-browsing GDL*

Icon	Description
	Currently reading.
	Open file icon in PDF.
	Audio Communication.
	Video Communication.
	User colour-coded.
	Open file icon in HTML.

Providing such visualization in Co-browsing GDL could increase user's awareness of each other activities. Icons are used to identify, for instance, which document are currently opened and by whom.

- **Navigation:**

Navigation is an essential element in any successful website. It allows users to find all needed information in one location and faster and easier. The following points are the aspects of the Co-browsing GDL in terms of web navigation:

- Search box must be in every page. When users feel lost they look for a search function and since it is impossible to predict when and where they will feel lost, it is important to make the search box available in every page [57]. This aspect is present in the Greenstone version 3.0.
- The search result must be on the same page collection. As mentioned before, when users enter a query, it must be highlighted on the collection and retrieve the matching words from inside the document and presents them as a summary in a bulleted list under each title.
- Video calling must be in the top-most position. As noted in the user study, many users positioning the video screen on the top of the computer screen, therefore the video position should be fixed in the top part of the website.
- Communication is on the bottom right. This is the usual place in many social network services.
- Follow member and update box is on the right of the page. Most services use the same location, therefore users get used to it.
- View collection and document will be in the middle of the page. There is no external tab that can be opened to keep all members in the same place.

The drawback of the current Greenstone tool is that there are too many options or links. This makes the website hard to use or to navigate important information in one place [66] and at the same time.

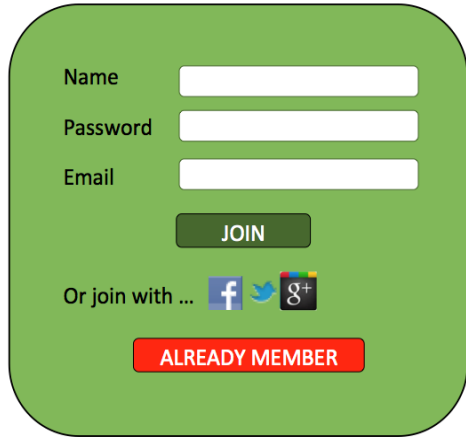
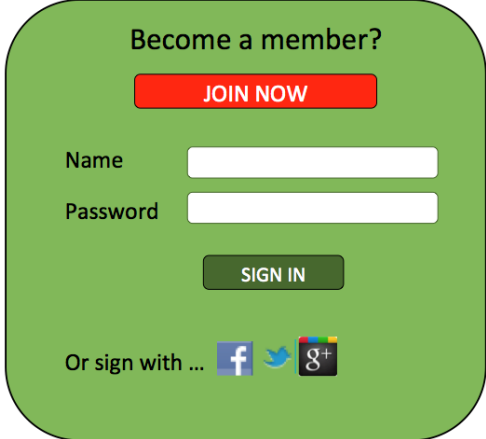
### 4.3 Co-browsing GDL Prototype

The users' main activities are to share browse the same collection with those who are in the same Greenstone digital library. The layout of the Co-browsing GDL consists of six main regions: collection path/ join/ login/ logout region, search box and video screens region, identity region, share information region, communication region, and view region (see Figure 4-4). Microsoft PowerPoint is used to draw the prototype since it is easy to use and the interface appearance can be close to the real system.

My Greenstone Library >> E-learning				Join	Login	? Help	\$ Preferences
				<input type="text"/> <input type="button" value="Search"/>			
title	Authors	Year	Published in				
A Framework for the Pedagogical Evaluation of eLearning Environments	S Britain, O Liber	2004	Bangor: University of Wales				
A study of asynchronous and synchronous e-learning methods discovered that each supports different purposes	S Hrastinski	2008	Educause quarterly				
ASYNCHRONOUS E-LEARNING	Adrian LADO	--	Inderscience				
ASYNCHRONOUS E-LEARNING USING ONLINE PRESENTATION	A Hadiana,	--	PP Informatika-LUPI				
Academic Synchronous eLearning vs. Traditional Frontal Teaching – Students' Achievements and Attitudes	D Bregman, G Keinan, A Korman, Y Raanan	--	Educational Technology Research and Development				
Belbin Team Roles, Organisational Patterns and eLearning: A Case Study	A Gibson, T Nesbit	2006	Annual Conference of the ...				
Bilingual asynchronous online discussion groups : design and delivery of an e-Learning distance study module for nurse academics in a developing country	PA Lewis, VAT Mai, G Gray	2012	Elsevier				
Combining ITS and eLearning Technologies: Opportunities and Challenges	C Brooks, J Greer, E Melis, C Ullrich	2006	Springer				
Computer Vision Tools for eLearning	FL Coutinho, TT Santos, CH Morimoto	--	Citeseer				
Conceptualizing and Measuring the Optimal Experience of the eLearning Environment	R Davis, D Wong	2007	Wiley Online Library				
Constructivist eLearning and Dyslexia: Problems of Social Negotiation in Text-Based Synchronous Environments	BP Woodfine, M Batista Nunes, DJ Wright	2005	Citeseer				
Delivering E-learning for Information Services in Higher Education By Paul Catherall	P.Catherall	2005	libr.org				
E-Learning in Higher Education	D Laurillard	2006	--				

Figure 4-1: Interface of the start page of GDL system

Figure 4-1 shows the start page of the Co-browsing GDL system. It presents all reference metadata in “view table”. Users can join or login from this page.

 <p>The join interface features a green rounded rectangle with the following elements: 'Name' label and input field, 'Password' label and input field, 'Email' label and input field, a dark green 'JOIN' button, 'Or join with ...' text followed by Facebook, Twitter, and Google+ icons, and a red 'ALREADY MEMBER' button.</p> <p><i>Figure 4-2: Join interface of the Co-browsing GDL</i></p>	 <p>The login interface features a green rounded rectangle with the following elements: 'Become a member?' title, a red 'JOIN NOW' button, 'Name' label and input field, 'Password' label and input field, a dark green 'SIGN IN' button, 'Or sign with ...' text followed by Facebook, Twitter, and Google+ icons.</p> <p><i>Figure 4-3: Login interface of the Co-browsing GDL</i></p>
--	---

The above figures present the forms of joining (see Figure 4-2) and logging in (see Figure 4-3). Users need to assign their names and passwords and their email for the case of verifying or resetting their password. It allows users to connect their account to the popular social networks. This seems to be a faster and easier way to join and log in.

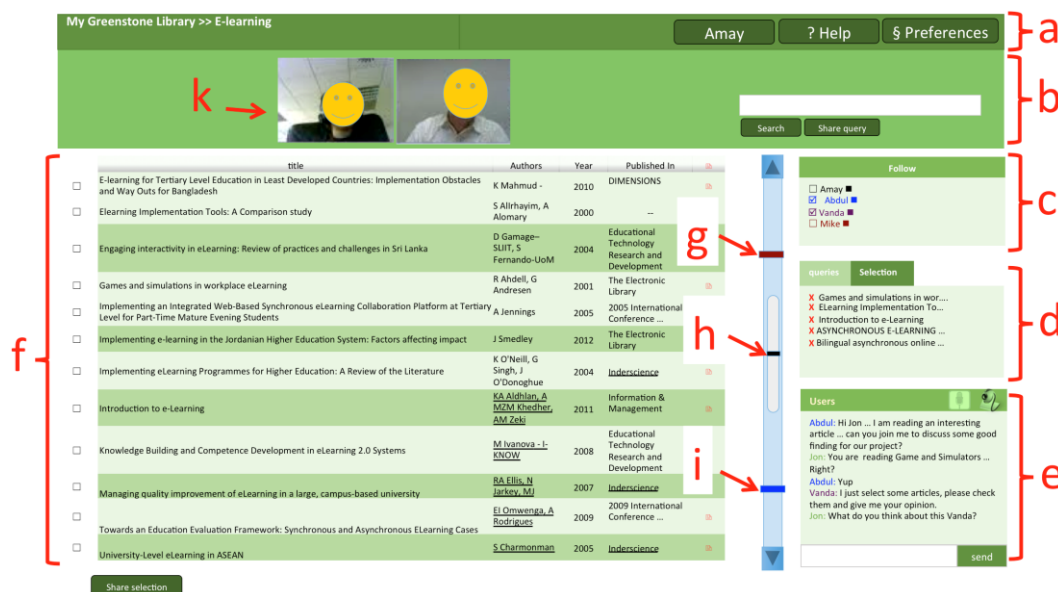


Figure 4-4: Co-browsing GDL interface

Figure 4-4 shows the six main regions of the Co-browsing GDL: (a) presents the path of the collection/opened document. User can see her/his name, looking for help, or changing the preferences; (b) presents the search box where users can enter and share their queries beside the video calling screen(s); where users can enter and share their queries beside (k) the area for the video calling screens; (c) presents the members' identities, including, nicknames and colour codes. Users can select whom to follow their activities; (d) presents the shared queries and references; (e) presents the three forms of communication: text, audio and video chatting; (f) presents the view of the "view table" collection. Also when a user opens a document, it will open in this area; (g) user "A" pointer; (h) the middle pointer inside the scroll box; and (i) user "B" pointer.

My Greenstone Library >> E-learning

Amay ? Help \$ Preferences

asynchronous

Search Share query

	title	Authors	Year	Published in
<input type="checkbox"/>	A Framework for the Pedagogical Evaluation of eLearning Environments	S Britain, O Liber	2004	Bangor: University of Wales
<input type="checkbox"/>	A study of asynchronous and synchronous e-learning methods discovered that each supports different purposes	S Hrastinski	2008	Educause quarterly
<input type="checkbox"/>	allow the association to conduct asynchronous meetings with the			
<input type="checkbox"/>	Asynchronous transfer mode			
<input type="checkbox"/>	Redesign Annotation Based Asynchronous Discussion System			
<input type="checkbox"/>	ASYNCHRONOUS E-LEARNING	Adrian LADO	--	Inderscience
<input type="checkbox"/>	In addition, in asynchronous mode, two product terms are used for Set and Reset			
<input type="checkbox"/>	class using synchronous and asynchronous learning-management systems.			
<input checked="" type="checkbox"/>	ASYNCHRONOUS E-LEARNING USING ONLINE PRESENTATION	A Hadiana	2000	PP Informatika-LUPI
<input type="checkbox"/>	Asynchronous learning is learning that happens independent of time and space.			
<input type="checkbox"/>	Asynchronous activities use technologies such as blogs, wikis, and ...			
<input type="checkbox"/>	Academic Synchronous eLearning vs. Traditional Frontal Teaching – Students' Achievements and Attitudes	D Bregman, G Keinan, A Korman, Y Raanan	--	Educational Technology Research and Development
<input type="checkbox"/>	While asynchronous training (the most common form of e-learning) caters to just-in-time needs,			
<input type="checkbox"/>	Belbin Team Roles, Organisational Patterns and eLearning: A Case Study	A Gibson, T Neuhart	2006	Annual Conference of the
<input type="checkbox"/>	Bilingual asynchronous online discussion groups : design and delivery of an e-Learning distance study module for nurse academics in a developing country	PA Lewis, VAT Mai, G Gray	2012	Elsevier
<input checked="" type="checkbox"/>	approach in authoring our asynchronous virtual physics laboratory			
<input type="checkbox"/>	that include both synchronous and asynchronous learning tools will be used			
<input type="checkbox"/>	because of the asynchronous replication			
<input type="checkbox"/>	Combining ITS and eLearning Technologies: Opportunities and Challenges	C Brooks, J Greer, E Melis, C Ullrich	2006	Springer
<input type="checkbox"/>	Computer Vision Tools for eLearning	FL Coutinho, TT Santos, CH Morimoto	--	Citeseer

Share selection

Follow

☒ Saad ☐ Amay ☒ Abdul ☒ Vanda ☐ Mike

queries Selection

Abdul: university and elearning  
Jon: synchronous and asynchronous

Users

Abdul: Hi Jon ... I am reading an interesting article ... can you join me to discuss some good finding for our project?  
Jon: You are reading Game and Simulators ... Right?  
Abdul: Yup  
Jon: I just select some articles, please check them and give me your opinion.  
Vanda: What do you think about this Jon?

send

Figure 4-5: Co-browsing GDL information presentation

Figure 4-5 shows the search result presentation when a user searches for a key term. The key terms will be highlighted in yellow in both the titles and the summaries (c) for the documents that contain the query (b). Users can click on the cell of a reference (d) to be shown to other users (who have already selected his or her activities to be followed) (c). When a user opens a document to read, two icons appear: “opened book” icon and “square” color-coded to represent who is currently reading the document (e). Buttons for share information are: share selection and share query. A user can click on the “share selection” button after he click one check boxes (f), these selections appear in (g) box. When a user wants to share his query, he can click on the “share query” button (a) and the query will appear in (h) box.



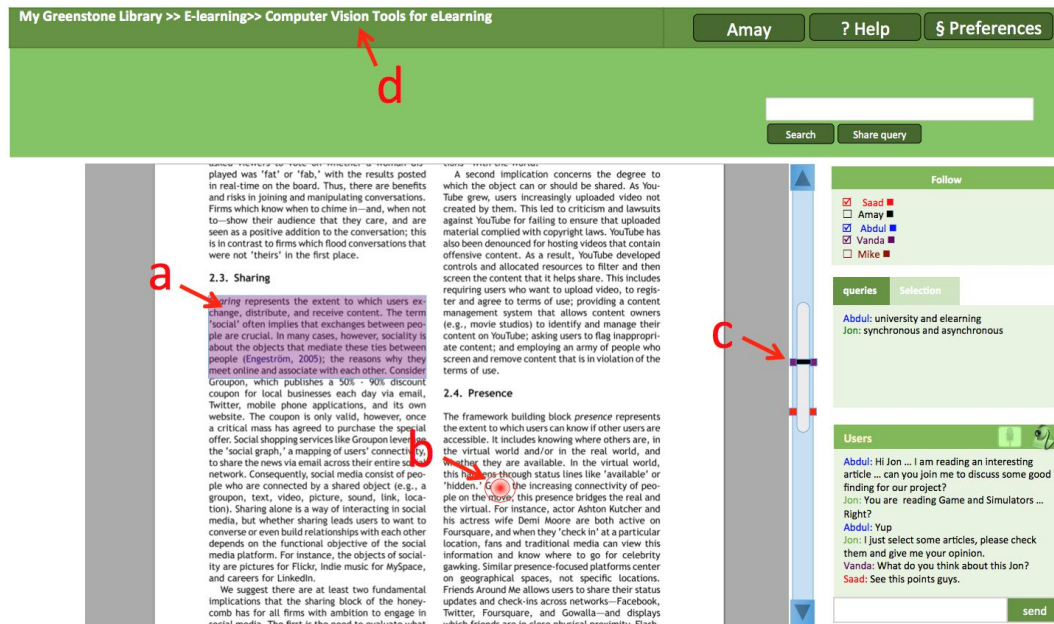


Figure 4-6: Co-browsing GDL reading a document view

Figure 4-6 shows the interface of reading a document. A user can highlight a piece of information inside the document (see Figure 4-6, a) and can call for more attention to a specific word by using the “point out” (see Figure 4-6, b). They can use the “middle scroll pointer” to adjust the view of the paper, “let me see what you are seeing” (see Figure 4-6, c). When users want to come back to the collection, they can click on the collection name from the path (see Figure 4-6, d).

## 4.4 Scenarios

In human computer interaction, scenario is a small story, which describes the work of a system. The following two scenarios illustrate the functioning of the Co-browsing GDL, in real time communication and in both remote and co-located environments.

### 4.4.1 Scenario: Separate Location, Separate Screen, Same Time

Rebecca, Trish, Matheio and Graeme are friends. They normally hold a book club discussion every month, but currently they are in separate cities. They decide to use the Co-browsing GDL to discuss a book they have read that month and to select the next book to be read. They join the Co-browsing GDL system and each of them gets a personal color-coding. The group members choose a time each month for an online meeting.

The meeting time arrives; therefore they login to the service. All group members use video calling and their screens can be seen at the top of the system. When they finish the book discussion, they decide to browse the collection and select a book to be read for the next meeting. Rebecca finds a good one, so she calls for attention through the video calling function. They ask her where the document relating to the book she is talking about is. She then clicks on the cell that contains that document and the cell is highlighted so that the others can see what she is looking at. They like the document/book; therefore they decide to select it. She clicks on the check box against that document and then clicks on the “share selection” button. They continue looking for more documents/books before the whole group finally decides which one to read by the end of the session. In this case they agree to go with Graeme's suggestion.

This scenario illustrates the work of Co-browsing GDL for remote users and using some features: referencing across the collection using “telepointer” and selecting a document that is agreed on by the group.

#### 4.4.2 Scenario: Same Location, Separate Screen, Same Time

Sami, Jone, Alex and Mario are university students. They have the same projects and need to come together to discuss some documents related to their project. They book a room in the library to discuss their project and help each other to understand what they are doing. Each of them uses their own computer. They login to the Co-browsing GDL to review together the project collection. As the communication is face-to-face, there is no need to use the communication feature.

Mario finds a promising document, but he notices that there is a figure within one of the chapters that is not fully explained. He asks the group to join him in discussing that document. The group members find Mario's location across the collection through "multi-users scrollbar pointer" and then identify the current open document through the "open book" and his "square" color-coded icons. They also find his location inside the document through the "multi-users scrollbar pointer". As all group members are now viewing the same page, they start using the "point out" feature to discuss the figure. Alex highlights a paragraph that links to that figure.

There are some terms in their project that need to be identified. Jone looks for the definition of the word "folksonomy". He finds a successful key term that could retrieve all possible definitions. He uses "folksonomy is" as a query. He then shares this query with the others by clicking on the "share queries" button. He asks group members to click on it from the query box area. Group members click on that query and start to read together from the result and decide which definition is the best. The presentation of the result is: all query responses are highlighted in yellow, and each response is retrieved and summarised under its document title.

This scenario illustrates the work of Co-browsing GDL for a co-located group using some features: the awareness of which document is currently being read and by whom, referencing across the collection and inside the document using the "multi-scroll pointer", referencing inside the document using "point out" and highlighting features, selecting a document that is agreed on by the group, share queries and the presentation of the results.

## **4.5 Limitations**

The user preference is considered to be a limitation since each user can change the preference to suit their purpose, and this could affect group work activities. For example, when a user inputs the search query in uppercase letters then the system will not retrieve queries in lowercase letters, and therefore similarity of results between peers may be affected.

## Chapter 5

### 5.0 Usability Test

Usability is defined as: “The extent to which a product can be used by specified product users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use” [67]. Effectiveness relates to how well users accurately accomplish the tasks using the product, efficiency deals with how quickly users can complete a task accurately and correctly after they have learned the basic operation, while satisfaction relates to the fulfilment users get in using the system [68]. This study uses these three aspects to measure users’ feedback (or opinion or response) on the proposed Co-browsing GDL system. The usability test structure and design are inspired by the usability test of Bakhtyar and Afridi [69].

This section begins with usability evaluation methods (5.1), followed by test design (5.2) and procedure (5.3). It then presents the result and data analysis (5.4) and finally discusses the results (5.0).

#### 5.1 Usability Evaluation Methods

An evaluator needs to follow certain methods of usability evaluation. It is important to perform usability evaluation of a proposed system, for, as [58] point out, without evaluation the designer cannot be sure about the usability of her/his proposed system(s), and what users want. There are a number of usability evaluation methods such as coaching method, questioning-asking protocol, teaching method, think aloud protocol, and questionnaire (Usabilityhome<sup>27</sup>). To evaluate the usability of the proposed Co-browsing GDL system, this study selected two methods: think aloud protocol and questionnaire.

---

<sup>27</sup> [www.usabilityhome.com/FramedLi.htm?FeatureI.htm](http://www.usabilityhome.com/FramedLi.htm?FeatureI.htm)

### 5.1.1 Think Aloud Protocol

The think aloud protocol (TA) test gives participants tasks to perform and then requires them to voice their thoughts [58]. This protocol is used in many usability studies to investigate a product interface [70]. Basically, participants explain their actions by verbalizing their thoughts while doing the tasks. Therefore, the evaluator can get valuable data from their speech and by observing their performance. The benefit of this method is that the evaluator can easily judge the participants' actions and what they think about the target system's interface. The evaluator can also figure out what difficulties or issues the participants faced while interacting with the proposed system. A challenge with the TA is to avoid the "silent period" that may occur; it is assumed that participants may feel uncomfortable verbally communicating their thoughts [58]. A possible solution is that the evaluator could interrupt and remind participants to think out aloud [58] or could ask questions during this period [71].

### 5.1.2 Follow-up Questionnaire

Another common method of collecting additional data from users, and further evaluating system usability, is to use a questionnaire. A questionnaire is used to explore the three elements of usability: effectiveness, efficiency and satisfaction with a proposed system. Two question formats can be used: closed-response (yes/no) and open-ended. One method of scaling responses to the survey research questionnaire.

## 5.2 Designing the Test

This section discusses the task design for the think aloud protocol and the follow-up questionnaire.

### 5.2.1 Task Design

Designing the test tasks was based on the interface elements. The tasks should cover all of the proposed system's important areas and be representative of the

real task of the system (usabilitynet<sup>28</sup>). Eight different tasks were designed and a number of steps were set for each task. Three tasks were general in nature (1, 2 and 8: join/ login/ logout) and the rest were related to communication, referencing among the collection and inside the document, search box, and sharing selected references. Table (see Table 5-1) outlines the tasks used in conducting the test.

*Table 5-1 Tasks for Usability Tests*

<b>Task 1: JOIN TASK</b>	
	<ol style="list-style-type: none"> <li>1. Join the service.</li> <li>2. Enter your username, password and email; you can also join Facebook, Twitter and Google Plus.</li> </ol>
<b>Task 2: LOGIN TASK</b>	
	<ol style="list-style-type: none"> <li>1. Log in to the service by using your Greenstone username and password; you can also log in through Facebook, Twitter and Google+.</li> </ol>
<b>Task 3: COMMUNICATION TASK</b>	
	<ol style="list-style-type: none"> <li>1. Go to the communication area.</li> <li>2. Use the chat text to chat with the group members.</li> <li>3. Select the one you want to chat with and tell them about what document you are looking for.</li> <li>4. Call her/ him by the audio.</li> <li>5. Now, use the video calling to talk to the group.</li> </ol>
<b>Task 4: REFERENCING AMONG COLLECTION TASK</b>	
	<ol style="list-style-type: none"> <li>1. Select those whose activities you want to see.</li> <li>2. Ask your partner to show you (or point out) what the reference that she/he thinks is the right one for "eLearning in higher education".</li> <li>3. Show your partner the reference that you think is right.</li> <li>4. Identify your partner's location through the multi-user scrollbar pointer.</li> </ol>
<b>Task 5: REFERENCING INSIDE THE COLLECTION TASK</b>	
	<ol style="list-style-type: none"> <li>1. Identify the document that your partner is currently reading.</li> <li>2. Click on the reference that you want to read.</li> <li>3. Ask your partner to read the document that you are currently reading.</li> <li>4. Show them the passage that you want to discuss by highlighting.</li> <li>5. Go to the figure 2.4 in page 10 and use "point out" to explain the process that is shown in that figure.</li> <li>6. Go back to the collection.</li> </ol>

---

<sup>28</sup> [www.usabilitynet.org/trump/index.htm](http://www.usabilitynet.org/trump/index.htm)

Task 6: SEARCH BOX TASK	
	<ol style="list-style-type: none"> <li>1. Search for the word “asynchronous”.</li> <li>2. Check the results.</li> <li>3. Share this word with your partner.</li> <li>4. Ask your partner to click on your shared queries and discuss the references to view the right definition of the “asynchronous”.</li> <li>5. Find your partner's shared queries.</li> </ol>
Task 7: SHARE SELECTED DOCUMENTS TASK	
	<ol style="list-style-type: none"> <li>1. Select three documents and share them with your partner.</li> <li>2. Delete one of them.</li> <li>3. Check your group members’ selected references.</li> </ol>
Task 8: LOGOUT TASK	
	<ol style="list-style-type: none"> <li>1. Log out of the system.</li> </ol>

These tasks were enough to extract data about usability issues with the proposed Co-browsing GDL system, since it is designed to allow participants to interact with a paper prototype and test all the proposed system interface elements.

### 5.2.2 Follow-up Questionnaire Design

This study used a follow-up questionnaire to measure the three elements of usability of the proposed Co-browsing GDL system, It used the Likert-scale questionnaire format [44]. Table (see Table 5-2) shows the follow-up questionnaire that was used after the test had been conducted.

*Table 5-2: Follow-up Questionnaire*

Sr.	QUESTIONS	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
		1	2	3	4	5
1.	The join form is easy to use.					
2.	The log in form is easy to use.					



3.	The position of the login and join buttons is consistent.					
4.	Co-browsing GDL login and join is up to my expectations from a typical social system.					
5.	The Join and log in to the service by connecting with other social networks is satisfactory.					
6.	The icons/labels used in Co-browsing GDL log in and join forms help me in identifying different actions.					
7.	It is easy to select whom to communicate with.					
8.	Co-browsing GDL communication is up to my expectations from a typical Facebook system.					
9.	It is accurate and quick to identify whom to communicate with.					
10.	It is useful to identify accurately users' names by colour while communicating.					
11.	The position of the video calling screen is consistent.					
12.	I feel comfortable having different communication options.					
13.	The unique colour for participants used in "follow member" area helps me in identifying their actions.					
14.	The icons/labels used in Co-browsing GDL communication help me in identifying different actions.					
15.	I find Co-browsing GDL to be a complete solution for share browsing the same collection.					
16.	It is accurate and quick to identify who is clicking on the reference cell.					
17.	It is clear and quick to open a document.					
18.	It is accurate and quick to modify the view of the collection to be the same as my partner's through the "scroll pointer".					
19.	Presenting the metadata in table view is clear.					
20.	The icons/labels used in Co-browsing GDL collection list help me in identifying different actions.					
21.	I can quickly identify the location of the currently discussed passage by the "point out" feature.					
22.	It is accurate and quick to arrive at the same page that my partner is currently viewing using the "scroll pointer".					
23.	The unique highlight colour for each user that is used inside a document helps me to identify who added the highlight.					
24.	The document path helps me back to the collection.					
25.	I find Co-browsing GDL to be a complete solution for sharing the right queries.					
26.	The search box position is useful.					
27.	I find Co-browsing GDL to be a complete solution for sharing my selected documents with other.					
28.	Logging-out of Co-browsing GDL is an easy task.					
29.	Activity of my partner on a shared document is shown					
30.	Learning to operate the system is easy.					
31.	Design is for all levels of users.					
32.	Co-browsing GDL's interface is comfortable to work with.					
33.	The interface of Co-browsing GDL is graphically pleasing.					

The purpose of the above questionnaire is to gather data from participants regarding their experience and opinion of the proposed Co-browsing GDL system. It has been taken into account that these questions measure the attributes of the three usability aspects: effectiveness, efficiency and satisfaction. The following

table (see Table 5-3) shows each of these attributes as represented by a set of questions in the questionnaire.

*Table 5-3: Question Division*

USABILITY ATTRIBUTES	QUESTION NUMBER	TOTAL
Effectiveness	1,2,4,7,8,9,10,16,25,27,29.	11
Efficiency	17,18,21,22,28,30.	6
Satisfaction	3,5,6,11,12,13,14,19,20,23,24,25,26,31,32,33.	16

### 5.2.3 Participants

According to Nielsen, 85% of usability tests five participants can observe issues. Therefore, five students were selected to participate in the usability tests [72]. Five male were students studying different majors. Expert users were not selected in this test since the interest was more in the voice and intermediate users' interaction to the Co-browsing GDL and what the misconceptions/ problems they experienced while using the proposed paper prototype.

## 5.3 Procedure

Ethical approval was required before conducting the usability study. Ethical approval was granted by the human research ethics committee in the Department of Computer Science at the University of Waikato (see Appendix B.1). Potential participants were each given a participant information sheet (see Appendix B. 2) and encouraged to ask any questions they might have. Participants could choose the time and place with which they felt comfortable. A brief introduction was given about the proposed system and the study “What participants will do?” Each participant was asked to sign a consent form beforehand (see Appendix B. 3). Then, the evaluator ran the camera to record the session and handed the task sheet to the participant. Participants were asked to perform the given task and explain their thoughts aloud (see Table 5-1). When a participant stopped talking during the task, the evaluator asked and reminded her or him to explain their thoughts or asked questions such as “What do you think of this?” or “What do you expect

when you click on this button?” or “How do you do this?” A timer was used to report the time spent on each task. Discussion related to improving the system was not part of the procedure and the researcher stop the clock if it happens. After finishing the tasks, participants were asked to fill in the follow-up questionnaire (see Table 5-2). Finally, the participant was thanked for her/ his time and participation.

## **5.4 Result and Data Analysis**

This section presents the results of the usability test. The results have been extracted from observation of the test participants during the test and participants' feedback through the follow-up questionnaire. Section 5.4.1 shows the time spent on tasks, section 5.4.2 deals with observation of the test participants during the test and section 5.4.3 is about the participants' feedback in the follow-up questionnaire. Section 5.5 is a discussion of the results.

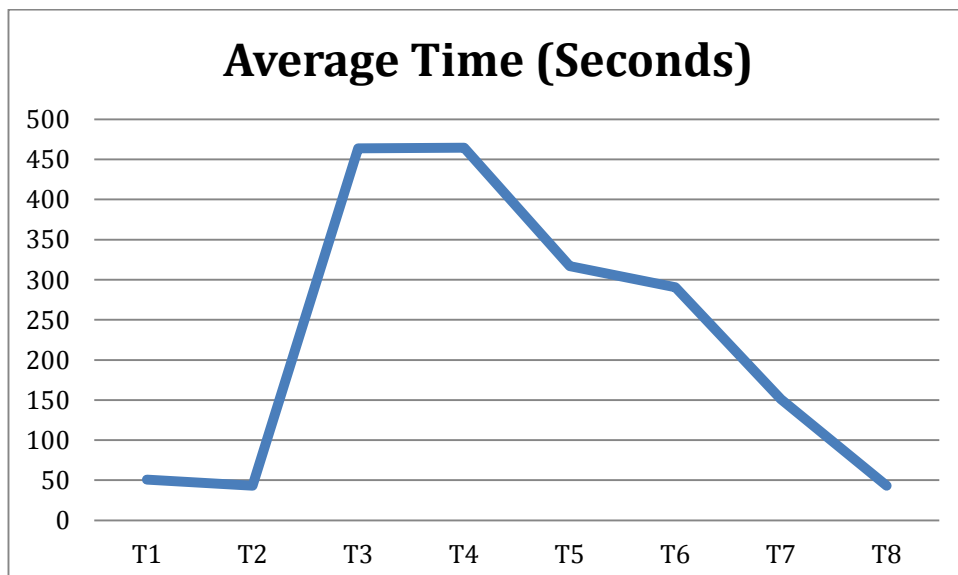
### **5.4.1 Time Spent on Tasks**

The researcher recorded time spent by the test participants performing each task. The total time all participants spent on the tasks in think aloud protocol was 2 hours and 53 minutes. Any time spent discussing improvements to the system was not counted. Table (see Table 5-4) shows the time each participant spent on a given set of tasks.

*Table 5-4: Task Timings (in seconds) in Think Aloud Protocol*

	Participants ID					Average Task Time
	User A	User B	User C	User D	User E	
Task 1 time	89	30	40	60	35	50.8
Task 2 time	61	31	33	50	41	43.2
Task 3 time	480	395	491	530	423	463.8
Task 4 time	454	446	480	444	500	464.8
Task 5 time	360	201	261	400	363	317
Task 6 time	250	325	340	312	226	290.6
Task 7 time	100	190	145	160	160	151
Task 8 time	16	61	60	50	30	43.4
Total Test Time	1810	1679	1850	2006	1778	1824.6

The following graph shows the average completion time of all tests participants in performing the think aloud protocol evaluation method (see Figure 5-1).



*Figure 5-1: Average Task Completion Timing (in seconds)*

### 5.4.2 Task Observations

During task performance in the usability tests, participants were carefully observed and notes taken about any misconceptions/problems faced, and a video recording was used for further observation. These observations can be used to address problems experienced by the test participants, thus making use of the Co-browsing GDL system more effective, efficient and satisfactory. The following subsections discuss comments by the participants while performing the given tasks on the Co-browsing GDL paper prototype.

#### **Task 1**

Task 1 was a general task about joining the Co-browsing GDL system. The user had to first visit the Greenstone DGL system webpage and then sign up using user ID, password and email. They could also use their social network services, including Facebook, Twitter and Google+ to connect with the service. The participants made the following comments during the performance of this task:

- Only one box to assign a password is not enough, in case the wrong password is entered.
- There is no form to add more information about me in the profile.
- There are not enough options for signing in through another social network.
- The green colour is not good.

#### **Task 2**

Task 2 was also a general task to do with signing into the Co-browsing GDL system. The user had to enter his or her ID and password or can login through the social network services. Participants made the following comments during the performance of this task:

- There is no link to reset the password.
- There is no option to view the password's letters.
- There is no save option for adding my ID and password to the service.

### Task 3

Task 3 related to using the Co-browsing GDL communication function. The participant had to use the chat text to communicate with all group members accessing the same collection. Then s/he had to select a member of the group and discuss the collection. The participant also had to use the audio and video calling functions. The participants made the following comments during the performance of this task:

- I cannot reject the video calling of others, in the event I want to conserve Internet data usage.
- There is confusion between the follow member box and the menu list of available members.
- There are no emotion symbols in text chat dialog.
- I cannot use the audio to talk to a group of members, instead of just one.
- The icons are unclear.
- The dialog chat box pop up could cover the “point of interest” when using the “point out” feature inside a document.
- There is no picture profile for each member.
- The audio calling is confusing and users do not know how to call their partner.
- The text box for writing a message is small.

### Task 4

Task 4 related to referencing among the collection. The user had to select a member and follow their referencing activities. The participant was then asked to identify the reference the member/partner was looking (clicking) at. Also, the participant had to point to the reference. Further, the participant had to identify her or his partner’s location on the GDL web page through the multi-user scrollbar pointer. Participants made the following comments during the performance of this task:

- Users are not aware of who is following their activities.

### **Task 5**

Task 5 involved referencing inside the collection using the Co-browsing GDL system. The participant had to identify the location of the current reading documents. They also had to identify the point of interest (POI) that had been highlighted by a peer who was currently reading the same document, and point out more specific words or parts of a picture. The participants made the following comments during the performance of this task:

- Opening the file action is not clear.
- There is no private option that stops a member following my activities in a certain document.
- The icon for opening the file is not clear.
- There is no back button, or clear way of going back to the collection.

### **Task 6**

Task 6 related to search box activities of the Co-browsing GDL system. The participant had to use the system search box and view the result, and also share queries with group members and view others' shared queries. The participants made the following comments during the performance of this task:

- Search queries cannot be deleted.
- There is no box for private queries.

### **Task 7**

Task 7 involved sharing selected documents in Co-browsing GDL. The user had to share documents with a partner, and also delete and check references shared by group members. The participants made the following comments during the performance of this task:

- Deleting selected references by any one could impact on the work group.
- There is no notification feature in case new references are added by other group members.

- There is no box for private selected references that cannot be viewed by others.

### **Task 8**

Task 8 was a general task about signing out of Co-browsing GDL. The user had to log out of the system. The participants made the following comments during the performance of this task:

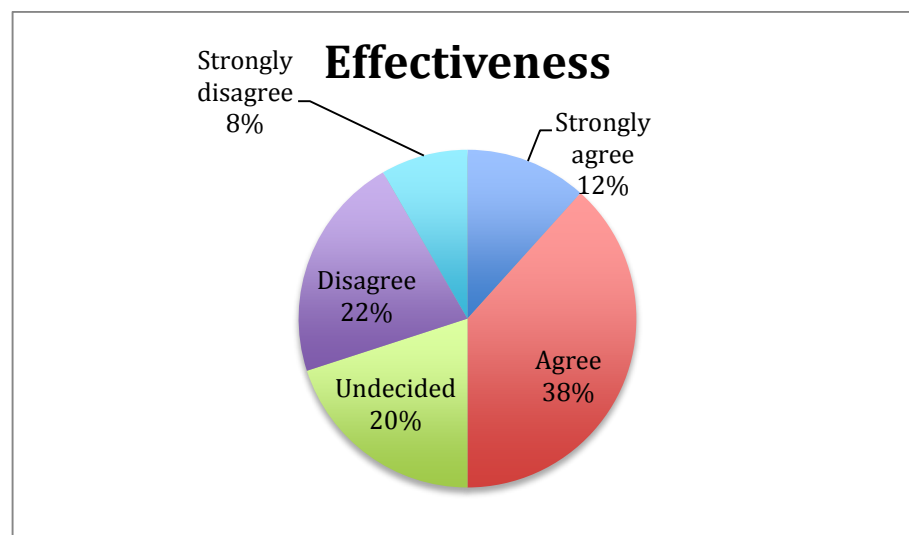
- Log out by clicking on the nickname button is not clear.



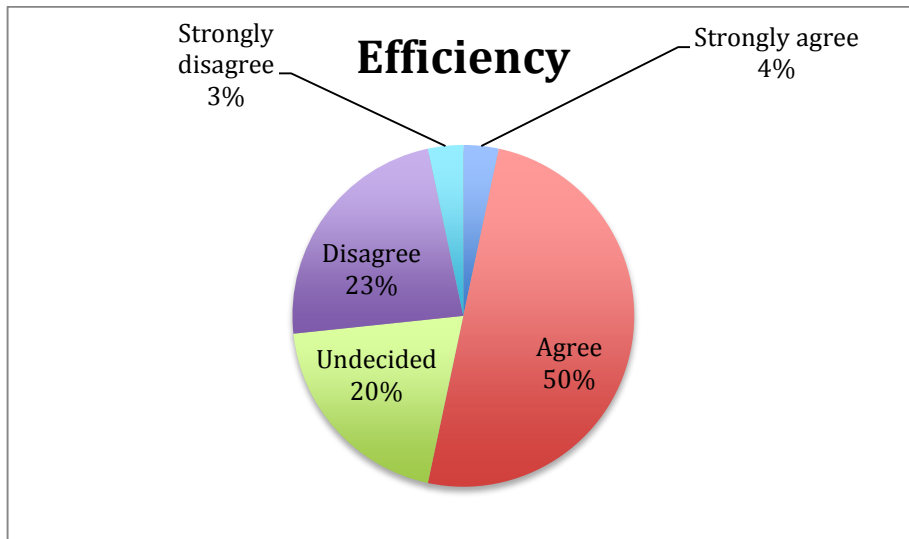
### 5.4.3 Follow-up Questionnaire Feedback on the Think Aloud Protocol

After performing the usability test, a follow-up questionnaire was handed to the test participants for their feedback, so as to assess how effective, efficient and satisfactory they thought the proposed Co-browsing GDL system was. The structure of the questionnaire is outlined in section 5.2.2 of this thesis.

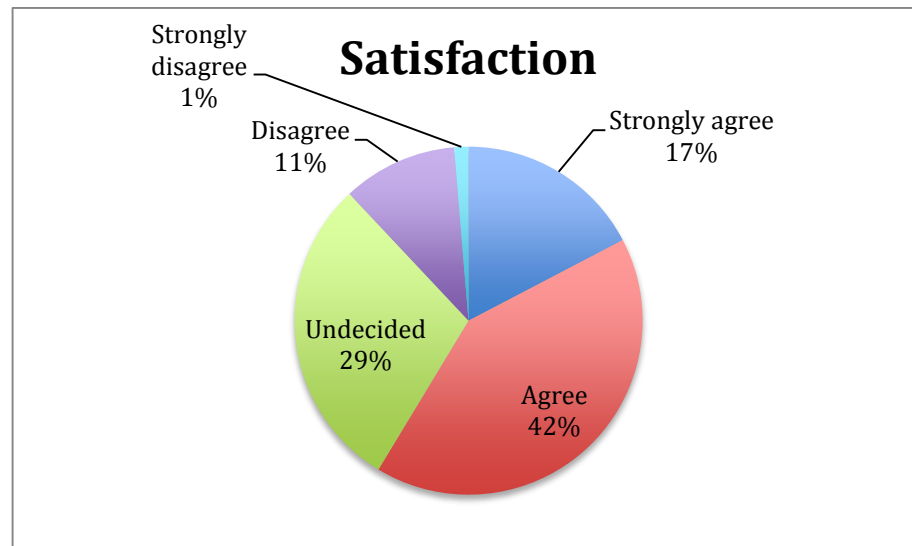
Five participants were given the questionnaire. Thirty-three questions were asked; 11 were related to the effectiveness of Co-browsing GDL, 6 to the efficiency of Co-browsing GDL, and 16 questions to the level of satisfaction a user felt while interacting with the Co-browsing GDL prototype. When analysed, the responses to questions showed 12% of the users "Strongly agreed" that Co-browsing GDL was effective, 38% marked "Agree", 20% marked "Undecided", 22% marked "Disagree" and 8% marked "Strongly disagree". For the efficiency of Co-browsing GDL, 4% of the users strongly agreed it was efficient, 50% agreed, 20% were undecided, 23% disagreed and 3% strongly disagreed. When questions related to the user satisfaction with Co-browsing GDL were asked, 17% strongly agree, 42% agreed, 29% were undecided, 11% disagree and 1% strongly disagreed. These results are represented clearly in Figure 5-2, Figure 5-3 and Figure 5-4.



*Figure 5-2: Effectiveness of Co-browsing GDL using Think Aloud Protocol Method*



*Figure 5-3: Efficiency of Co-browsing GDL using Think Aloud Protocol Method*



*Figure 5-4: Satisfaction of Co-browsing GDL using Think Aloud Protocol Method*

## 5.5 Discussion.

This section relates to the analysis of the usability test. Section 5.5.1 discusses the usability assessment of Co-browsing GDL and section 5.5.2 discusses the validity and reliability of results.

### 5.5.1 Usability Assessment of Co-browsing GDL

The study assessed the usability of the proposed Co-browsing GDL system. For the usability test evaluation, ISO 9241-11 criteria have been used [73]. An analysis of the result has helped the researcher identify issues related to the usability of the proposed Co-browsing GDL system. The following subsections are a discussion of end user feedback on the three usability aspects, effectiveness, efficiency and satisfaction followed by the common usability problems experienced by end users while interacting with the proposed system.

#### *Effectiveness*

Effectiveness relates to the accuracy and completeness of goals [44]. In the case of the Co-browsing GDL system, participants had problems with communication. Several tasks were not done well, the reasons being: confusion between “follow” activities and communication, non-availability of a “back” button for the collection, a lack of awareness of who is following whom, icons and their colour and the label names. Addressing these issues could increase the effectiveness of the system. The overall test evaluation from questionnaire shows that 12% of participants strongly agreed and 38% agreed that the Co-browsing GDL prototype was effective.

#### *Efficiency*

Efficiency relates to completing a task quickly [44]. It has been noted that the proposed Co-browsing system has issues related to efficiency. The general tasks (join/ login/ logout) were performed quickly, while the performance of other tasks varied. Most participants took some time to complete tasks related to communication. They spent time figuring out how to communicate with specific

users. The “follow” member activities region and communication region confused them. Integrating the "follow" member part with the communication region could increase the efficiency of the system. Further, the follow-up questionnaire data indicated a positive response from participants in terms of efficiency. Four percent of participants strongly agreed that the Co-browsing GDL prototype was efficient, and 50% agreed.

### *Satisfaction*

Satisfaction is the extent to which users are comfortable, and have positive attitudes towards the use of the product [44]. Most participants noted discomfort with the colour of the buttons, background, and icons. The label names for some buttons or parts were not clear (e.g. “follow” button). The sizes of the texts, particularly in the view table, were small. Further, concern with privacy was another aspect mentioned, and participants wanted control over which of their activities should be for public view and which should not. Taking account of these issues and adding boxes for private use could increase the satisfaction of the users. Questionnaire results show a positive response regarding overall satisfaction with the system; 17% of participants strongly agreed on satisfaction with the system and 42% agreed.

### *Participants’ suggestions to improve the Co-browsing GDL*

All participants were master students in computer science, except for one who was studying management, and, as such, they may have had experience with usability tests. During and after the think aloud protocol, participants and the researcher discussed suggestions on improving the user experience of Co-browsing GDL. As mention before, discussions during the session were not counted and the researcher used a timer to stop and start the time. The suggestions are as follows:

- Privacy in the Co-browsing GDL is missing. Users suggest have more control over their information activities. When they read a document, they might want to hide certain activities in some instances. They also want to control query sharing in terms of

deleting and private queries. Users need to have their own selection box.

- Notification in Co-browsing GDL is missing. Users suggest having a feature that supports the contribution awareness of others. When they add new information; notification of the queries or selected box could increase productivity and make the group work more enjoyable, as they feel other group members are working and that encourages them to do more work.
- Evaluation of the materials in the Co-browsing GDL through communication only is not enough. Users suggest adding both qualitative (comments) and quantitative (rating) evaluation to the selected document; therefore, a user can review references in their own time and at their own pace and rate these selected references later. Also, they suggested adding a comments option, for instances where people are busy and a user does not want to disturb them.
- Integrate the “follow” region with communication region. Users suggested adding icons beside each member in the “follow” region. The icons should represent the medium of communication: chatting, audio and video calling.

### 5.5.2 Validity and Reliability of Results

The validity and reliability of qualitative research results can be examined through factors such as credibility, transferability, dependability and conformability [74].

The factors are as follow:

#### *Credibility*

Credibility means the research results are believable from the perspective of the participants; therefore, the participants can judge the credibility of the research by themselves [44]. To establish the credibility of the usability test, the data was gathered using two methods. First, a questionnaire was designed to assess the usability test. The questions were on a scale from “strongly agree” to “strongly disagree”. Second, with the think aloud protocol, participants were free to speak their thoughts when interacting with the paper prototype.

### *Transferability*

Transferability means that the findings achieved from the study are applicable in other contexts [44]. To achieve the transferability of the usability test, the context is described in detail and considers the assumptions in the study. The assumptions for this study were; The participants were male and aged between 20-35, all were university students from the computer science faculty except for one who was from the management school; the place and time were selected by participants; the methods used were Think Aloud Protocol and the research context was the usability of the Co-browsing GDL proposed system, paper prototype. A possible threat is that many participants had no experience of the think aloud protocol method and that may affect the results.

### *Dependability*

Dependability refers to the fact that any potential for changes in the result must be explained by the researcher [44]. To achieve dependability in this study, the participants were all students from the same university. According to participants' time of availability (morning, afternoon and evening), their performance in the study may have been affected. Productivity and tiredness were not identifiable. A possible threat to validity is that a participant could answer the long questionnaire quickly and with less focus, or not remember exactly different features of the system after finishing the think aloud protocol phase. Another possible validity threat is that using the low-fidelity prototype could affect the usability test results.

### *Conformability*

Conformability means that other researchers can confirm the research results in a meaningful way [44]. To achieve conformability, usability test guidelines from previous studies were followed. The study was conducted in compliance with the think aloud protocol method using ISO 9241-11 criteria on end-users. The use of test procedure, tasks and questionnaire design by others was well documented.

## Chapter 6

### 6.0 Conclusion, Recommendations, Scope of the Study and Limitations and Future Works

This chapter begins with a conclusion to the thesis (6.1), followed by recommendations (6.2) and the scope and limitations of the study (6.3) and, finally, possible future work (6.4).

#### 6.1 Conclusion

The Greenstone digital library web page does not support a multi-user platform. Providing the social interaction platform in such digital library has some potential advantages such as increase the serendipitous discovery of eBooks, sharing the informal information and assists each other to selecting documents. The study was to investigate a pair of non-located users interacting and collaborating, using computers for browsing the same Greenstone DL collection. Therefore, identify the suitable features to support their needs.

The user study findings showed the importance of providing features to reduce the time and effort spent on referencing, search box activities and metadata presentation. Users consume time when there are no additional features beside the communication medium to progress their work session. The current study proposed Co-browsing GDL system that could assist users to browse together the same collection, in real time. Features including “multi-users scrollbar” and “telepointer” across the collection and the “point out” and “highlighting” inside the document, could improve the group users experience of “referencing the information”, while they are browsing together the same collection. Further, the “view table” is a suitable and sufficient method of presenting metadata, particularly in case of co-browsing the same collection. The presentation of the search results on the same “view table” and highlighting the query terms is essential to keep group users browsing the same collection. The study suggests providing buttons to allow users to share their successful queries or to share referencing, which could enhance the work group session.

Finally, the study conducted a usability test to explore any issues about the Co-browsing GDL proposed system. The findings that have been identified can assist in the building of better Co-browsing GDL system. Issues are mainly related to communication part, label names, colors. Further, there were some suggestions by participants, which could also improve the system, these are related to: privacy, notification, quantitative and qualitative evaluations and integrating the communication part with “follow” part.

## **6.2 Recommendations**

The study recommends the development of not only the Greenstone, but also online bookstore websites, to provide co-browsing features to link remote friends and family in browsing the same collection. Users are influenced by the recommendation of their friends, family members and colleagues about digital objects to be loaned, download or purchased. Further, the popularity of social websites indicates the considerable amount of time users spend on such sites. This will potentially allow companies and marketers to attract many people to their website and increase the chances of making decisions about an item based on the recommendations of their friends or family.

## **6.3 Scope of the Study and Limitations**

The target population of the study was a sample of students from the University of Waikato in 2013. The study focused on the interactions of users while accessing the Greenstone digital library collection of articles (textual materials), and this is a limitation since the study outcome could be different if the study had been applied to a multimedia collection or to another type of digital content such as video or audio.

Further, the study observed the social interaction and collaboration between two remote users (one-to-one) who were browsing the same Greenstone DL collection as an information source in search of references. The number of group members may be considered a limitation since the “many-to-one” or “many-to-many” forms may give a different result. The coordination, call for attention, and agreement on



the right references may have an effect on a bigger group.

This study has focused on the synchronous interaction mode. The result is expected to be different if the study was to concentrate on asynchronous interactions; hence, features that support it are to be identified. Therefore, the right features for the asynchronous mode will be different, such as persistence, notification and awareness.

The materials that the study is dealing with are academic articles. A different outcome may arise if the study focused on another type of material content, such as eBook novels. The written structure and the presentation of the metadata may play a role in making a decision to select an eBook novel. For example, the presentation of eBook cover images could have a greater influence on user choice than if the collection was displayed as a list.

## **6.4 Future Works**

The current study was conducted on university students. In reviewing the literature, no similar studies were found with which to compare the findings of this study. Therefore, future studies can be conducted and their results compared with the results of this study. Doing this, the current study results can be then generalized to an extended population. Further, replicating the study using different methods, a bigger group and larger sample size could be helpful in generalizing the result and, therefore, strengthen its external validity.

Greenstone is an open source tool, therefore for future work adding the requirements of the current study to such a tool and implementing the proposed Co-browsing GDL system. Adjusting the presentation of the metadata to be “view table” and adding “telepointer”, “multi-scroll pointer”, “point out”, “highlighting”, share search queries and documents, essential features to be considered to support the Co-browsing environment.

Further studies are needed to investigate the case of a big collection, which has many page numbers. The investigation could focus on the infinite paging and the number paging methods. The investigating could be around the infinite pagination and the number pagination methods. Tracking peer activity in such methods could be different. Further studies could apply the same conceptual framework to other

websites, such as those for online bookstores and online marketing, and compare the results with the findings of the current study. This would strengthen the external validity of this study.

The current study focused on one collection and assumed all users were browsing the same collection. Therefore, further study is needed into user interaction in the case of many collections. Tracking users' activities across collections could be useful in enhancing the co-browsing experience.

In terms of measuring and assessing the experience of users after a share browsing session, a more advanced questionnaire could be designed with more questions to gain more insight into user workload.

## 7.0 References

- [1] S. J. Cunningham, "How Children Find Books for Leisure Reading : Implications for the Digital Library," *Proc. 11th Annu. Int. ACM/IEEE Jt. Conf. Digit. Libr.*, pp. 431–432, 2011.
- [2] S. J. Cunningham, "Children in the physical collection: Implications for the digital library," *Proc. Am. Soc. Inf. Sci. Technol.*, vol. 48, no. 1, pp. 1–10, 2011.
- [3] A. Hinze, D. McKay, N. Vanderschantz, C. Timpany, and S. J. Cunningham, "Book selection behavior in the physical library: Implications for ebook collections," *Proc. 12th ACM/IEEE-CS Jt. Conf. Digit. Libr. June 10-14*, pp. 305 – 314, 2012.
- [4] D. McKay, A. Hinze, R. Heese, N. Vanderschantz, C. Timpany, and S. J. Cunningham, "An exploration of ebook selection behavior in academic library collections," *Theory Pract. Digit. Libr. Lect. Notes Comput. Sci.*, vol. 7489, pp. 13–24, 2012.
- [5] C. Timpany, H. Alqurashi, A. Hinze, S. J. Cunningham, and N. Vanderschantz, "Shared browsing and book selection in an academic library," 2012.
- [6] S. J. Cunningham, N. Vanderschantz, C. Timpany, A. Hinze, and G. Buchanan, "Social Information Behaviour in Bookshops: Implications for Digital Libraries," *Res. Adv. Technol. Digit. Libr. Lect. Notes Comput. Sci.*, vol. 8092, pp. 84–95, 2013.
- [7] R. Oldenburg, *The Great Good Place: Cafes. Coffee Shops, Community Centers, Beauty Parlors, General Stores, Bars, Hangouts, and How They Get You Through the Day*. Marlowe & Company, 1989, p. 384.
- [8] B. Bickart, Schindler, and R. M., "Internet forums as influential sources of consumer information," *J. Interact. Mark.*, vol. 15, no. 3, pp. 31–40, Jan. 2001.
- [9] D. Smith, S. Menon, and K. Sivakumar, "Online peer and editorial recommendations, trust, and choice in virtual markets," *J. Interact. Mark.*, vol. 19, no. 3, pp. 15–37, Jan. 2005.
- [10] R. R. Sinha and K. Swearingen, "Comparing Recommendations Made by Online Systems and Friends," *DELOS Work. Pers. Recomm. Syst. Digit. Libr.*, vol. 106, 2001.
- [11] J. Grudin, "Computer-supported cooperative work: History and focus," *Computer (Long. Beach. Calif.)*, vol. 27, no. 5, pp. 19–26, 1994.
- [12] S. Hrastinski, "Asynchronous and synchronous e-learning," *Educ. Q.*, vol. 31, no. 4, pp. 51–55, 2008.

- [13] C. Shah, "Collaborative information seeking: A literature review," *Adv. Librariansh.*, vol. 32, pp. 3–33, 2010.
- [14] D. McKay, P. Shukla, R. Hunt, and S. J. Cunningham, "Enhanced browsing in digital libraries: three new approaches to browsing in Greenstone," *Int. J. Digit. Libr.*, vol. 4, no. 4, pp. 283–297, Oct. 2004.
- [15] M. S. Ackerman, "Providing Social Interaction in the Digital Library," in *Proceedings of the First Annual Conference on the Theory and Practice of Digital Libraries*, 1994, pp. 198–200.
- [16] M. Blackie and J. Dent, *Information systems for agriculture*. Applied Science Publishers, 1979, pp. xii, 176.
- [17] S. Amershi and M. Morris, "CoSearch: a system for co-located collaborative web search," *Proc. SIGCHI Conf. Hum. Factors Comput. Syst.*, pp. 1647–1656, 2008.
- [18] P. Barden, R. Comber, D. Green, D. Jackson, C. Ladha, T. Bartindale, N. Bryan-kinns, T. Stockman, and P. Olivier, "Telematic Dinner Party : Designing for Togetherness through Play and Performance," *Proc. Des. Interact. Syst. Conf.*, pp. 38–47, 2012.
- [19] R. Rettie, "Connectedness , Awareness and Social Presence," *6th Annu. Int. Work. Presence; 6-8 Oct. 2003, Aalborg , Denmark.*, 2003.
- [20] A. Hinze, D. McKay, N. Vanderschantz, C. C. Timpany, and S. Jo, "Book selection behavior in the physical library: Implications for ebook collections," *Proc. 12th ACM/IEEE-CS Jt. Conf. Digit. Libr. June 10-14*, pp. 305–314, 2012.
- [21] Z. Liu, "Reading behavior in the digital environment: Changes in reading behavior over the past ten years," *J. Doc.*, vol. 61, no. 6, p. 700, 2005.
- [22] J. Pearson, T. Owen, H. Thimbleby, and G. Buchanan, "Co-reading: investigating collaborative group reading," *Proc. 12th ACM/IEEE-CS Jt. Conf. Digit. Libr.*, pp. 325–334, 2012.
- [23] H. Stelmaszewska and A. Blandford, "From physical to digital : a case study of computer scientists ' behaviour in physical libraries," *Int. J. Digit. Libr.*, vol. 4, no. 2, pp. 82 – 92, 2004.
- [24] M. R. Morris, "A survey of collaborative web search practices," *Proceeding twenty-sixth Annu. CHI Conf. Hum. factors Comput. Syst. - CHI '08*, pp. 1657 – 1660, 2008.
- [25] M. Morris and E. Horvitz, "SearchTogether: an interface for collaborative web search,"

*Proc. 20th Annu. ACM Symp. User interface Softw. Technol.*, pp. 3–12, 2007.

- [26] S. Paul and M. Morris, “CoSense: enhancing sensemaking for collaborative web search,” *Proc. SIGCHI Conf. Hum. factors Comput. Syst.*, pp. 1771 – 1780, 2009.
- [27] P. Robinson and P. Tuddenham, “Distributed Tabletops: Supporting Remote and Mixed-Presence Tabletop Collaboration,” *Second Annu. IEEE Int. Work. Horiz. Interact. Human-Computer Syst.*, pp. 19–26, Oct. 2007.
- [28] D. Yoon, H. Peng, and B. Xu, “Let me show you what i read: exploring referencing strategies for e-books,” *CHI’13 Ext. Abstr. Hum. Factors ...*, pp. 97–102, 2013.
- [29] J. Koch, “Social Reading—A study of computer-supported literature-discussions,” 2012.
- [30] A. Blandford, S. Keith, I. Connell, and H. Edwards, “Analytical usability evaluation for digital libraries: a case study,” *Proc. 4th ACM/IEEE-CS Jt. Conf. Digit. Libr.*, no. January, pp. 27 – 36, 2004.
- [31] B. Hancock, *Trent Focus for Research and Development in Primary Health Care An Introduction to Qualitative Research*. Trent Focus Group, 2001.
- [32] J. Iacono, A. Brown, and C. Holtham, “Research Methods – a Case Example of Participant Observation,” vol. 7, no. 1, pp. 39–46, 2009.
- [33] C.-W. Chung, C.-C. Lee, and C.-C. Liu, “Investigating face-to-face peer interaction patterns in a collaborative Web discovery task: the benefits of a shared display,” *J. Comput. Assist. Learn.*, vol. 29, no. 2, pp. 188–206, Apr. 2013.
- [34] M. Magnusson, “Synchronous Text Reviewing over Internet Synchronous,” Royal Institute of Technology, 2004.
- [35] M. Balaam, G. Fitzpatrick, J. Good, and E. Harris, “Enhancing interactional synchrony with an ambient display,” *Proc. 2011 Annu. Conf. Hum. factors Comput. Syst.*, pp. 867–876, 2011.
- [36] N. Diakopoulos, “COLLABORATIVE ANNOTATION, ANALYSIS, AND PRESENTATION INTERFACES FOR DIGITAL VIDEO,” 2009.
- [37] S. M. Akkersdijk, “How children search with an image based interface,” *hmi.ewi.utwente.nl*.
- [38] R. Weber, *Basic content analysis*, 2nd ed. SAGE Publications, 1990, p. 96.
- [39] D. Altman, “Why do a pilot study ?,” 2005.

- [40] I. H. Witten, R. J. McNab, S. J. Boddie, and D. Bainbridge, "Greenstone: a comprehensive open-source digital library software system," *Proc. Fifth ACM Conf. Digit. Libr. 02-07 June*, pp. 113–121, 2000.
- [41] B. Imler and M. Eichelberger, "Using screen capture to study user research behavior," *Libr. Hi Tech*, vol. 29, no. 3, pp. 446–454, 2011.
- [42] S. Hart and L. Staveland, "Development of NASA-TLX (Task Load Index): Results of Empirical and Theoretical Research," *Hum. Ment. Workload*, 1988.
- [43] C. Shah, "A framework for supporting user-centric collaborative information seeking," *ACM SIGIR Forum*, vol. 44, no. 2, p. 88, 2011.
- [44] J. Nielsen, *Usability Engineering*. Academic Press, 1993, pp. xiv, 358.
- [45] A. Lacey and D. Luff, *Qualitative data analysis*. 2001, pp. 320–357.
- [46] M. Q. Patton and M. Cochran, "A Guide to Using Qualitative Research Methodology." pp. 1–30, 2002.
- [47] D. McKay, "Gotta keep'em separated: why the single search box may not be right for libraries," *Proc. 12th Annu. Conf. New Zeal. Chapter ACM Spec. Interes. Gr. Comput. Interact.*, pp. 109–112, 2011.
- [48] M. Handel and J. Herbsleb, "What is chat doing in the workplace?," *Proc. 2002 ACM Conf. Comput. Support. Coop. Work*, pp. 1–10, 2002.
- [49] J. O'Neill and D. Martin, "Text chat in action," *Proc. 2003 Int. ACM Sigr. Conf. Support. Gr. Work*, vol. 33, no. 0, pp. 40–49, 2003.
- [50] Y. Zhang and B. Wildemuth, "Qualitative analysis of content," 2009. [Online]. Available: [http://www.ischool.utexas.edu/~yanz/Content\\_analysis.pdf](http://www.ischool.utexas.edu/~yanz/Content_analysis.pdf). [Accessed: 11-Oct-2013].
- [51] S. Akcan, "Effective teaching strategies for oral second language use in German and French first-grade immersion classrooms," The University of Arizona, 2002.
- [52] N. B. Ellison, C. Steinfield, and C. Lampe, "The Benefits of Facebook 'Friends': Social Capital and College Students' Use of Online Social Network Sites," *J. Comput. Commun.*, vol. 12, no. 4, pp. 1143–1168, Jul. 2007.
- [53] J. Raacke and J. Bonds-Raacke, "MySpace and Facebook: applying the uses and gratifications theory to exploring friend-networking sites," *Cyberpsychol. Behav.*, vol. 11, no. 2, pp. 169–74, Apr. 2008.

- [54] M. D. Roblyer, M. McDaniel, M. Webb, J. Herman, and J. V. Witty, "Findings on Facebook in higher education: A comparison of college faculty and student uses and perceptions of social networking sites," *Internet High. Educ.*, vol. 13, no. 3, pp. 134–140, Jun. 2010.
- [55] E. Isaacs and J. Tang, "Studying video-based collaboration in context: From small workgroups to large organizations," *Video-mediated Commun.*, pp. 1–32, 1997.
- [56] S. Whittaker and B. O'Conaill, *The role of vision in face-to-face and mediated communication*. Lawrence Erlbaum, 1997, pp. 23–49.
- [57] J. Nieves, "Search and You May Find," 1997. [Online]. Available: <http://www.nngroup.com/articles/search-and-you-may-find/>. [Accessed: 12-Dec-2013].
- [58] J. Preece, Y. Rogers, and H. Sharp, *Interaction design: beyond human-computer interaction*. 2002, pp. xxiii, 519.
- [59] C. Snyder, *Paper Prototyping: The fast and easy way to design and refine user*. Elsevier Science USA, 2003, pp. xxiv, 378.
- [60] J. A. M. Villarroel, P. de la Fuente, A. Pedrero, "Visualizing Shared Highlighting Annotations," *HCI Relat. Pap. Interacción 2004*, pp. 195–204, 2006.
- [61] C. Gutwin, J. Dyck, and J. Burkitt, "Using Cursor Prediction to Smooth Telepointer Jitter," *Proc. 2003 Int. ACM Siggr. Conf. Support. Gr. Work*, pp. 294 – 301, 2003.
- [62] C. Grün, J. Gerken, H.-C. Jetter, W. König, and H. Reiterer, "MedioVis – A User-Centred Library Metadata Browser," *Lect. Notes Comput. Sci. (including Subser. Lect. Notes Artif. Intell. Lect. Notes Bioinformatics)*, vol. 3652, pp. 174–185, 2005.
- [63] A. McCormac, K. Parsons, and M. Butavicius, "The use of metadata visualisation to assist information retrieval," 2007.
- [64] A. Aula, "Enhancing the readability of search result summaries," *Proceedings*, 2004.
- [65] P. Baudisch, B. Lee, and L. Hanna, "Fishnet, a fisheye web browser with search term popouts: a comparative evaluation with overview and linear view," *Proc. Work. Adv. Vis. Interfaces AVI*, pp. 133 – 140, 2004.
- [66] N. Anwar; and A. Kwoka, "Web Site Usability Technical and Social Perspectives," Blekinge Institute of Technology, 2012.
- [67] N. Bevan, "Usability is quality of use," *Proc. 6th Int. Conf. Hum. Comput. Interact. Yokohama*, 1995.

- [68] D. . Wixon and C. Wilson, *The Usability Engineering Framework for Product Design and Evaluation*, in *Handbook of Human-Computer Interaction*, 2nd ed. In Handbook of Human-Computer Interaction, ed. M. Helander, Amsterdam, 1997, pp. 653–688.
- [69] S. Bakhtyar and Q. Afridi, “Performance Evaluation of Two Different Usability Evaluation Methods in the Context of Collaborative Writing Systems,” Blekinge Institute of Technology, 2010.
- [70] J. Ramey, T. Boren, E. Cuddihy, J. Dumas, Z. Guan, M. van den Haak, and M. De Jong, “Does think aloud work?: how do we know?,” *CHI '06 Ext. Abstr. Hum. factors Comput. Syst.*, pp. 45–48, 2006.
- [71] X. Faulkner, *Usability Engineering*. Palgrave Macmillan, 2000, p. 256.
- [72] J. Nielsen, “Why you only need to test with 5 users,” pp. 1–5, 2000.
- [73] “ISO 9241-11: Ergonomic requirements for office work with visual display terminals ( VDTs ) - Part 11 : Guidance on usability,” 1998.
- [74] Y. S. Lincoln and E. G. Guba, *Naturalistic Inquiry*, 1st ed. SAGE Publications, 1985, p. 416.



## 8.0 Appendixes

### Appendix A: User Study Documents

This appendix contains all documents related to the user study experiment including:

- Ethical Approval (see A.1)
- Participant Information Sheet (see A.2)
- Researcher instructors (see A.3)
- Consent Form (see A.4)
- Demographic Questionnaire (see A.5)
- Tasks Description (see A.6)
- Follow-up Questionnaire (see A.7)

*A. 1 Ethical Approval*

Computing and Mathematical Sciences  
*Rorohiko me ngā Pūtaiao Pāngarau*  
The University of Waikato  
Private Bag 3105  
Hamilton  
New Zealand

Phone +64 7 838 4021  
[www.scms.waikato.ac.nz](http://www.scms.waikato.ac.nz)



THE UNIVERSITY OF  
**WAIKATO**  
*Te Whare Wānanga o Waikato*

29 October 2013

Saad Alzahrani  
C/- Department of Computer Science  
THE UNIVERSITY OF WAIKATO

Dear Saad

**Request for approval to conduct an experiment study involving human participants for your Masters Degree**

I have considered your request to conduct a study for your research project *Share browsing in Greenstone Digital Library*, involving human participants.

No participant names will be recorded for the study, their questionnaires will be numbered sequentially. If they have given their names for contact for a summary of the results, these will not be disclosed in any resulting publications. All information/data and audio/video/screen recordings will be stored in the FCMS data archive for five years and then destroyed.

The procedures described in your request are acceptable.

The research participants' information sheet, consent form, and questionnaire meet the requirements of the University's human research ethics policies and procedures.

Yours sincerely,

**Mike Mayo**  
Human Research Ethics Committee  
Faculty of Computing and Mathematical Sciences

## A. 2 Participant Information Sheet

**Participant Information Sheet****Ethics Committee, Faculty of Computing and Mathematical Sciences****Project Title**

*Co-browsing the Greenstone digital library collection*

**Purpose**

*This research is conducted as partial requirement for the Master Degree of Computer Science. This project requires the researcher to conduct research on his thesis through observation.*

**What is this research project about?**

*This research is to investigate how remote users are browsing together greenstone digital library collection. Based on that, the researcher will develop a system that commensurate with their needs. This system should assist remote users to share browsing the digital library collection and enhance the social interaction among them.*

**What will you have to do and how long will it take?**

*The researcher will introduce you to your partner. You and your partner will talk about how to communicate with each other before you are separated in two separate rooms in the Computer Science building: (G.1.12) and (G.1.15). You will be video/ audio recorded and screen recorded. You will be given three sheets:*

- 1. Research Consent Form: you will fill in your name, date and sign to agree to fill in the Demographic Questionnaire and do the experiment. For our research, you will also sign for the use of your video/ audio recording and your computer screen recording.*
- 2. Demographic Questionnaire: You will fill in some basic information about you and answer some questions about your life experience regarding computer uses.*
- 3. Descriptions of tasks: it describes what you will do during the session. You and your partner will do together some tasks while browsing the collection. You will perform the tasks on computers simultaneously in two different rooms.*

*All the parts are expected to be 45 minutes to an hour.*

**What will happen to the information collected?**

*The information collected will be used by the researcher to write a master thesis (COMP 594). It is possible that articles and presentations may be the outcome of the research. Also, the outcome of this paper may be published and presented at conferences. The demographic questionnaires, screen recordings and video/ audio recordings will be stored in the FCMS data archive for 5 years then they will be destroyed. Only the researcher and supervisor, Annika Hinze, will be privy to the un-anonymised notes and documents and this data will be stored in a protected computer that has a password for logging in. No one can login except the researcher. Your name will not be used in the publications and every effort will be made to disguise your identity. If your images are used, we will disguise your identity (blurred). To ensure confidential of your passwords, the camera will not focus on your keyboard.*

**Declaration to participants**

*If you take part in the study, you have the right to:*

- Refuse to answer any particular question.*
- Withdraw from the study before 30/11/2013*
- 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 either:*

**Researcher: Saad Alzahrani**  
**The University of Waikato**  
**Department of Computer Science**  
**Room G.2.06 Phone at (07)8384466 Ext 6011**  
[saadbz300@hotmail.com](mailto:saadbz300@hotmail.com)

**Supervisors: Annika Hinze**  
**The University of Waikato**  
**Department of Computer Science**  
**Room: G.2.04 Phone at (07)8384052**  
[hinze@cs.waikato.ac.nz](mailto:hinze@cs.waikato.ac.nz)

### A. 3 Researcher instructors

#### Instructions for experimenter

In both locations (computer):

- Open the webpage of the greenstone digital library collection.
- Have the following ready:
  - Your notebook and pen.
  - Pens for participants.
  - Participant Information Sheet.
  - Research Consent Form.
  - Demographic Questionnaire.
  - Tasks Descriptions.
  - Follow-Up Questionnaire
  - Check the phones are working in both locations (landlines).
  - ID and passwords list for communication service.
- Check the recording elements (battery charge and setting of the time).
- Check the setting of the Camstudio are the same in both computers.
- Welcome participants.
- Explain nature and procedure of experiment.
- Fill in date, time and participant's ID (letter/number) on Research Consent Form, Demographic Questionnaire, Tasks Descriptions, Tasks Descriptions and Follow-Up Questionnaire.
- Ask participants to fill in the Demographic Questionnaire form.
- Make sure participant sign the Research Consent Form.
- Put Research Consent Form a side and do not put it with other sheets.
- Ask the two participants to agree on medium of communication when they are separated. Imply to them that they are allowed to use the phone beside the computer to contact with the other party (show them the partner's number).
- After the agreement, if the service they choose are in the account list (ID: Password) then hand the list to them. If it is not in the list, ask them to use their own account.

In each room:

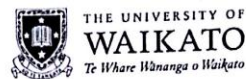
- Ask participants to read the task descriptions and see if there is any question about them.
- Warm up: ask participant to contact with each other through any kind of medium communication (e.g., Emails, SN, VC) and exchange files or links.
- Run the video recording.
- Show the time analog for the computer and then.
- Run the screen capture video.
- Ask participant to start the task in order.
- When they finish the session ask them to fill in the Follow-Up Questionnaire form.
- Provide bar chocolate for each one after they finish.
- Name the video files by participants' ID (letter/number) and then collect the two videos in one folder that named by group letter (e.g., group B).

**Participants' identity and date/time of the sessions**

Session number	Participants" alphabetic/number	Date and time
1	A1:A2	.... / .... : ....
2	B1:B2	.... / .... : ....
3	C1:C2	.... / .... : ....
4	D1:D2	.... / .... : ....
5	E1:E2	.... / .... : ....
6	F1:F2	.... / .... : ....
7	G1:G2	.... / .... : ....
8	H1:H2	.... / .... : ....
9	I1:I2	.... / .... : ....



## A. 4 Consent Form

**Research Consent Form**

Ethics Committee, Faculty of Computing and Mathematical Sciences

### Co-browsing the Greenstone digital library collection

#### Consent Form for Participants

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 before data analysis has begun 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**.

Name: \_\_\_\_\_

Signed: \_\_\_\_\_ Date: \_\_\_\_\_

#### Additional Consent as Required

I agree/do not agree (please circle one) to my actions being audio recorded.

I agree/do not agree (please circle one) to my actions being video recorded.

I agree/do not agree (please circle one) to my actions being screen recorded.

I agree/do not agree (please circle one) to my images (blurred) being used.

Name: \_\_\_\_\_ Signed: \_\_\_\_\_ Date: \_\_\_\_\_

**Researcher: Saad Alzahrani**  
The University of Waikato  
Department of Computer Science  
Room G.2.06 Phone at (07)8384466 Ext 6011  
[Saadbz300@hotmail.com](mailto:Saadbz300@hotmail.com)

**Supervisors: Annika Hinze**  
The University of Waikato  
Department of Computer Science  
Room: G.2.04 Phone at (07)8384052  
[hinze@cs.waikato.ac.nz](mailto:hinze@cs.waikato.ac.nz)

## A. 5 Demographic Questionnaire

### Share browsing in greenstone digital library



### Demographic Questionnaire

Participant ID (letter/No):

#### Questionnaire

I am Saad Alzahrani. First of all, I would like to thank you for agreeing to participate in this research project. Your help is very much appreciated.

The purpose of the experiment is to investigate how remote users browse together in a greenstone digital library collection. I'm doing this research as part of my master's degree in computer science. Please feel free to ask questions if there's anything you're not clear about.

I'd like to reiterate that the information you give will be treated confidentially and collectively, not individually. There are no right or wrong answers—I am interested in your own experiences, and social interaction. So please be as honest as you can in your responses.

Before starting the experiment, I would appreciate if you can complete this questionnaire.

1. What is your gender?

☐ Male

☐ Female

2. What is your age group?

☐ 18 - 28

☐ 29 - 38

☐ 39 - 48

☐ > 48

3. What is your full time occupation:

.....  
.....

4. Currently, are you studying?

☐ Yes

☐ No.

a. What are you studying?

.....

5. What is your highest education level?

☐ Nothing

☐ High School

☐ Diploma

☐ Bachelor

☐ Postgraduate Diploma

☐ Masters

☐ PhD

---

6. Do you use a computer as part of your work/ education?

☐ Yes

☐ No.

7. How many hours do you spend on computer in a day?

☐ < 1

☐ 1 - 3

☐ 4 - 6

☐ > 6

8. How many years have you used a computer?

☐ < 1

☐ 1 - 4

☐ 5 - 10

☐ > 10

9. What activities do you use the computer for as part of your work/ education?

.....  
.....  
.....  
.....  
.....



10. Have you been involved in group study opportunities? (If yes, please specify for which subjects).

☐ Yes

☐ No.

.....  
.....  
.....

11. Do you have experience in working online with a group? (If yes, please specify for which subjects and what kind of tool do you use to communicate).

☐ Yes

☐ No.

Subject(s):

.....  
.....  
.....

Tool(s) for communication:

.....  
.....  
.....

12. Do you use social network(s) for study purpose (e.g., Facebook, LinkedIn or Google+)? (If yes, could you name them, please)

☐ Yes

☐ No.

.....  
.....  
.....

## A. 6 Tasks Description

### Tasks Descriptions



Ethics Committee, Faculty of Computing and Mathematical Sciences

#### Tasks descriptions

In this study you are using the computer to browse together the greenstone digital library collection in two different locations. You can use any medium of communication to communicate with your partner. There will be landlines in both locations, which you can use, if you wish.

You have three different tasks: (please, do them in order and with your partner who is located in the other room).

1. Browse together the given greenstone collection. Find an article that contains in its title, the following keywords "eLearning", "tools" and "case study". You should both be in agreement that you have found the right article.

Write the title of the article:

.....

2. In the same collection, together find the best (or informative) article about eLearning for higher education and agree on it.

Write the title of the article:

.....

3. What is the definition of asynchronous eLearning?  
Agree on the article(s) that best describe this definition.

Write the title of the article(s):

## A. 7 Follow-up Questionnaire

**Share browsing in greenstone  
digital library**

**Follow-Up Questionnaire**

Participant ID (letter/No):



**Follow-Up Questionnaire**

Please read the statements below, and indicate how it applied to your experience browsing the same collection with your partner from remote place. There are no right or wrong answers.

**1. How were the tasks?**

7	6	5	4	3	2	1
Extremely hard			moderately			easy

**2. How hurried were you to accomplish the tasks?**

7	6	5	4	3	2	1
Extremely hurried			moderately hurried			not hurried at all

**3. How aware were you of your partner's activities?**

7	6	5	4	3	2	1
Extremely aware			moderately aware			not aware at all

**4. How was your competition while working with peer?**

7	6	5	4	3	2	1
Extremely competitive			moderately competitive			not competitive at all

**5. How was your motivation while working with peer to find references?**

7	6	5	4	3	2	1
Extremely motivated			moderately motivated			not motivated at all

6. How was your enjoyment while working with peer to find references at the same time?

7                      6                      5                      4                      3                      2                      1  
Extremely fun                      moderately fun                      not fun at all

Please check that you have answered all the questions.

**Please write down any additional comments you may have about your experience with remote browsing.**

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....

Thank you very much for your time and participation.

## Appendix B: Usability Test Documents

This appendix contains all documents related to the usability test including:

- Ethical Approval (see B.1)
- Participant Information Sheet (see B.2)
- Consent Form (see B.3)

*B. 1 Ethical Approval*

---

Computing and Mathematical Sciences  
*Rorohiko me ngā Pūtaiao Pāngarau*  
The University of Waikato  
Private Bag 3105  
Hamilton  
New Zealand

Phone +64 7 838 4021  
[www.scms.waikato.ac.nz](http://www.scms.waikato.ac.nz)



THE UNIVERSITY OF  
**WAIKATO**  
*Te Whare Wānanga o Waikato*

13 February 2014

Saad Alzahrani  
C/- Department of Computer Science  
**THE UNIVERSITY OF WAIKATO**

Dear Saad

**Request for approval to conduct an experiment study involving human participants for your Masters Degree**

I have considered your request to conduct a study for your research project *Share browsing in Greenstone Digital Library*, involving human participants.

No participant names will be recorded for the study, their questionnaires will be numbered sequentially. If they have given their names for contact for a summary of the results, these will not be disclosed in any resulting publications. All information/data and audio/video/screen recordings will be stored in the FCMS data archive for five years and then destroyed.

The procedures described in your request are acceptable.

The research participants' information sheet, consent form, and questionnaire meet the requirements of the University's human research ethics policies and procedures.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'Lyn Hunt'.

**Lyn Hunt**  
Human Research Ethics Committee  
Faculty of Computing and Mathematical Sciences

## B. 2 Participant Information Sheet

### Participant Information Sheet



#### Ethics Committee, Faculty of Computing and Mathematical Sciences

##### Project Title

Co-browsing the Greenstone digital library collection

##### Purpose

This research is conducted as partial requirement for the Master Degree of Computer Science. This project requires the researcher to conduct research on his thesis through observation.

##### What is this research project about?

This research is to evaluate the usability of the Co-browsing the Greenstone digital library proposed system. Based on that, the researcher will identify the misconception/problems of the proposed system and know what the user wants. This proposed system should assist remote users to share browsing the Greenstone digital library collection and enhance the social interaction among them.

##### What will you have to do and how long will it take?

The participant will interact with the Co-browsing Greenstone digital library paper prototype and speaks out aloud their thought while interacting with this prototype. You will choose the time and the location you feel comfortable in. You will be video/ audio recorded. You will be given three sheets:

1. **Research Consent Form:** you will fill in your name, date and sign to agree to do the experiment and fill in the Follow-Up Questionnaire. For our research, you will also sign for the use of your video/ audio recording.
2. **Tasks Descriptions:** it describes what participant will do during the session. You will interact with the prototype and explain your thoughts.
3. **Follow-Up Questionnaire:** participant is asked to fill in the questionnaire after finishing the test session.

All the parts are expected to take 45 minutes to an hour.

##### What will happen to the information collected?

The information collected will be used by the researcher to write a master thesis (COMP 594). It is possible that articles and presentations may be the outcome of the research. Also, the outcome of this paper may be published and presented at conferences. The questionnaires and video/ audio recordings will be stored in the FCMS data archive for 5 years then they will be destroyed. Only the researcher and supervisor, Annika Hinze, will be privy to the un-anonymised notes and documents and this data will be stored in a protected computer that has a password for logging in. No one can login except the researcher. Your name will not be used in the publications and every effort will be made to disguise your identity.

##### Declaration to participants

If you take part in the study, you have the right to:

- Refuse to answer any particular question.
- Withdraw from the study before **15/2/2014**
- 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 either:

**Researcher: Saad Alzahrani**  
The University of Waikato  
Department of Computer Science  
Room G.2.06 Phone at (07)8384466 Ext 6011  
[saadbz300@hotmail.com](mailto:saadbz300@hotmail.com)

**Supervisors: Annika Hinze**  
The University of Waikato  
Department of Computer Science  
Room: G.2.04 Phone at (07)8384052  
[hinze@cs.waikato.ac.nz](mailto:hinze@cs.waikato.ac.nz)

### B. 3 Consent Form

#### Research Consent Form



#### Ethics Committee, Faculty of Computing and Mathematical Sciences

Participant ID (Letter): \_\_\_\_\_

#### Co-browsing the Greenstone digital library collection

##### Consent Form for Participants

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 before data analysis has begun 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**.

Name: \_\_\_\_\_

Signed: \_\_\_\_\_ Date: \_\_\_\_\_

##### Additional Consent as Required

I agree/do not agree (please circle one) to my actions being audio recorded.

I agree/do not agree (please circle one) to my actions being video recorded.

Name: \_\_\_\_\_ Signed: \_\_\_\_\_ Date: \_\_\_\_\_

Email: \_\_\_\_\_

**Researcher: Saad Alzahrani**  
The University of Waikato  
Department of Computer Science  
Room G.2.06 Phone at (07)8384466 Ext 6011  
[Saadbz300@hotmail.com](mailto:Saadbz300@hotmail.com)

**Supervisors: Annika Hinze**  
The University of Waikato  
Department of Computer Science  
Room: G.2.04 Phone at (07)8384052  
[hinze@cs.waikato.ac.nz](mailto:hinze@cs.waikato.ac.nz)