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**Understanding how
an audio-visual introduction
engaged
GATE students
in technology activity**

A thesis submitted in partial
fulfillment of the requirements
for the degree of
Master of Education
At



University of Waikato
By
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The University of Waikato 2010

Abstract

As a technology education provider working in a technology education centre contracted to fourteen client schools, my aim is to provide experiences of quality learning for all students visiting the centre. One of the challenges to fulfilling this aim is the limited time available to work with visiting students and the accompanying need to engage students as quickly as possible in the learning activities

This study is an investigation into how the use of an audio-visual introduction to technology class activities might meet this challenge when used in a series of three technology classes with gifted and talented (GATE) students.

A qualitative, interpretive methodology was employed to gain insights into the effectiveness of this type of introduction in quickly motivating and engaging students in technological challenges in the study. Data gathering methods included classroom observations, video recording of class sessions, interviews with students and teacher, and analysis of student work.

The study's findings indicate that carefully selected audio-visual material can provide an effective introduction to technology activities that quickly engage and motivate students to work together to find solutions to technological problems. The audio-visual introductions provided a shared experience and focus for students from different classes and schools to come together and work collaboratively towards a negotiated solution.

Acknowledgements

The Stewart-Smith family for their understanding and patient support throughout this study

GATE Student Participants from Tauranga Primary and Green Park Primary Schools

Green Park School Board of Trustees

Green Park School Principal, Mr. Graeme Lind

Teacher Responsible for GATE Students, Mrs. Lynne Mossop

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Chapter One: Introduction

1.1 Research Purpose

1.2 Background to this study

1.3 Research Questions

1.4 Overview

This chapter provides an introduction to the study by first explaining its purpose and approach and then describing the background and setting from which the project has developed. In the background to the study the key aims of the Technology Curriculum, as a guiding document for technology education in New Zealand, are briefly described along with the researchers particular interest and background in technology education. This is followed by the study's research questions and an overview of the thesis structure.

1.1 Research Purpose

The purpose of my research is to understand what happens with gifted and talented (GATE) students at the upper primary level when particular audio-visual media is used for an introduction to a technology activity. This study is intended to understand students' engagement with technology challenges associated with the audio-visual introduction. I am also interested in hearing the participants' voices, to find out to what extent this type of introduction supports learning. This study is qualitative interpretive research "characterized by a concern for the individual", to discover particular understandings (Cohen, Manion and Morrison, 2005, p.22).

The importance of the students' views is integral to the over-arching philosophy found within the Technology Curriculum. This document establishes a holistic perspective of learning technology that is inclusive of students' diverse learning needs within a modern global society. In the section on Values, the New Zealand Curriculum (Ministry of Education, 2007), indicates that student interaction contributes to the development of understanding and that decision-making encourages reflection of deeply held and important beliefs. The quality and extent of students' technological outcomes will reflect personal values of perseverance in seeking quality outcomes that have stakeholder values clearly embedded (Ministry of Education, 2007).

1.2 Background to this study

The definitive opening sentence of the New Zealand Technology Curriculum is explicit:

“ Technology is intervention by design: the use of practical and intellectual resources to develop products and systems (technological outcomes) that expand human possibilities by addressing needs and realizing opportunities.”

(Ministry of Education, 2007, p. 32).

The New Zealand Curriculum establishes a framework for individual schools to develop their local Technology programs. Within this document are socio-cultural learning intentions that can be met by a constructivist approach in teacher-learner partnerships, (Harwood and Compton, 2007). In learning technology the classroom environment is intended to establish ways for students to see the relevance of their learning experiences within the wider community. Students’ perception of a technology activity may establish relevance for them if:

“They understand what they are learning, why they are learning it and how they will be able to use their new learning” (Ministry of Education, 2007, p. 34).

This document guides teacher planning by relating creative design ideas, the use of materials, the operation of equipment and the exploration of available systems of construction, and thereby extending students’ technological literacy. Thus every technology teachers challenge is to stimulate students’ interest sufficiently that they genuinely respond with enthusiasm to a prescribed classroom activity and sustain their application through to achieving certain competencies, understandings and possibly a completed artifact.

Technology classrooms present unique opportunities for teachers to capitalize on students’ anticipation of working with equipment and materials. Throughout technology processes students curiosity may be stimulated by enjoyable experiences of thinking creatively,

sustaining critical inquiry and be further encouraged by reflective comment (Arnone and Small, 1995). There are questions I am interested in investigating that have emerged from my technology teaching practice. These questions are associated with, quickly creating student interest; assisting development of appropriate views; and optimizing individual work performance. I believe that other educators will share a common interest in seeking effective approaches not only in the quality delivery of curriculum goals, but also in meeting the individually diverse learning needs of students.

In my current position of technology education provider contracted to client schools I consider it imperative to effect quality learning outcomes for all students. To achieve these outcomes there are a number of practical constraints that have to be addressed such as, the limited time available, lack of student pre-history, and arranging meaningful learning experiences. In my experience, approaches to teaching technology that are based on students being given teacher-directed design briefs for technology, often fall short of curriculum objectives, because they underutilize students' potential creativity, and rarely stimulate individual initiative. How may I encourage students to respond in a way that overcomes the issues of disinterest, lack of personal relevance and isolation?

The merging of personal and professional interests have led me to embark on this research journey to better understand a practice I became interested in over a decade ago. The problem of how to engage students in meaningful learning activities quickly is one that is familiar to many educators. In the context of a technology centre there also exists mutual unfamiliarity for both student and teacher. Resourced with curriculum information and a selection of materials and tools, how does the teacher develop conceptual understandings and formatively develop technological competencies appropriate to the individual's learning needs?

I have sought the means to quickly engage students working on a technology activity they see as worthwhile and choose to complete. In recent years teaching technology, I have trialed a way to quickly involve students in planned learning activities from a 'cold' arrival

in unfamiliar surroundings to ‘warm’ interest in attempting a technology challenge. The topic introduction by way of an audio-visual experience is the starting point for a technology unit of work. The carefully selected film introduction presents students with whom I have no previous teaching relationship a way of identifying an authentic technological need, irrespective of their prior experiences.

Throughout this study I have sought ways to better understand how an audio-visual introduction might engage students in technological challenges. In the technology teaching/learning program studied in this project students were guided through multi-level processes with many opportunities to exercise their initiative. The processes involved active choices as students attempted to produce their technological solutions. This included: observing, listening, thinking, and identifying potential ideas, problems and solutions.

1.3 Research Questions

This study set out to investigate how effective an audio-visual introduction might be in engaging GATE students in technological problem-solving activity. The three essential research questions that I set out to investigate are:

1. Does the audio-visual introduction used in this study quickly engage students with technology activities?
2. Does the shared audio-visual introduction encourage students to work together?
3. What influence does the audio-visual introduction have on students’ views of and response to the technology learning activity?

1.4 Overview of the thesis

The introduction has identified the background, purpose and the associated research questions. Chapter Two provides a review of relevant research relating to teaching and learning technology as well as GATE students and the powerful effects of film media on audiences. Chapter Three outlines the methodology for this study, the data gathering methods and ethical considerations. Chapter Four describes the research setting, the participants, and how the research was carried out.

The events, as they took place in the three technology sessions are described throughout the sub-sections of Chapter Five. Chapter Six contains analysis of the data and addresses the research questions. In the final Chapter Seven my closing discussion is presented with the implications for teaching technology and suggestions for future research.

Chapter Two: Literature Review

2.1 Technology Education

2.2 Audio-Visual

2.3 GATE: Gifted and Talented Education

2.4 Comment

This chapter reviews the research that informs this study and is presented in three main sections. The first section looks at research in technology education and the second section examines literature specifically on the use of audio-visual media to engage learners. In the third section research into the particular needs of gifted and talented (GATE) students is considered and the chapter finishes with a summary of the review.

2.1 Technology Education

Technology Education in New Zealand has evolved from a trade-based subject of manual type industry training into the present much broader curriculum that is organized around three strands of Technological Practice, Technological Knowledge and The Nature of Technology (Ministry of Education, 2007). In the traditional style of technology program the teacher issued students with a construction task to prescribe their activity through content-based production criteria. This established an objective interest in learning a particular set of skills to meet an arbitrary outcome from the prescribed set of materials. Irrespective of a students individual interest or personal disposition, all students were instructed in the same program as a form of knowledge acquisition, (Kress, 2000). Student achievement in such sequential activities dictated by an ordered method was regarded as a transmission process of knowledge from the expert to the student, (ibid). In the way an apprentice learns the craft from the tutelage of an experienced practitioner.

In recent years, student individual uniqueness is considered an integral factor in the dynamic of an inquiry style technology program. Students are also more likely to be encouraged to take responsibility for class activity decisions when as stakeholders, they are committed alongside the affected parties or beneficiaries of any design interventions. This learning approach invites students to make a difference in peoples' lives through original design and with multiple entry and exit points. Interest in class work is a reflection of complex social and cultural considerations that reflect personal views and incorporate aesthetic, economic, and social values (Hickey & Zuiker, 2005). This approach implies that being a student requires a range of conscious choices with associated goals beyond the classroom and

extending from the personal to global. The students' background and interests influence their learning outcomes by inviting socially responsible behavior in a community of fellow learners (Boekaerts, de Konning and Vedder, 2006). Investigations into present classroom activities uncover students' intentions and are helpful for understanding their engagement with activities and which goals motivate their behavior.

In New Zealand the Technology Curriculum aims for broad literacy goals providing for the needs of students to become critically aware citizens who recognize that there will be opportunities in our man-made environment for meeting everyday needs through purposeful intervention in the design of artifacts or systems. Addressing these opportunities, students develop technological literacy with knowledge of ways to deal with what many consider problems (Blomdahl, 2007). New Zealand researchers have recognized our diverse culture from a synthesis of studies (Alton-Lee, 2003) that provides a rationale for managing technology classes in a way that acknowledges individual differences and encourages self-regulation in decision-making. There is a fundamental need to quickly connect students' regardless of background, with a democratic opportunity to become technologically involved in productive activities (Compton, 2007). In the most recent Technology Curriculum support documents (Ministry of Education, 2008) mention is made that contemporary knowledge has its origins in the social constructs of human interaction within our environment.

The New Zealand Curriculum (Ministry of Education, 2007) has set out a framework for promoting lifelong learning incorporating sound principles, attitudes and social values (Compton, 2007). This learning area is organized into three strands; Technological Practice, Technological Knowledge and the Nature of Technology, providing a wide range of realistic program contexts. The Technological Practice strand identifies investigating the practice of others as a way of assisting students to understand how they might develop with plans, models and product concepts, their own products or systems in response to an identified need. The Technological Knowledge strand includes learning about technological products and systems and how they work. The Nature of Technology strand directs students to the interface between the social character of technology and impacts created by the application

of products and systems within communities. Relating curriculum direction to technology programs the Ministry of Education documents from (2007; 2008) guide teachers with foundation statements to arrange rich learning environments embedded in scenarios for both personal and social responses.

Constructive learning from classroom activities that emulate real world physical or social contexts links each of these three strands and highlights embedded general understandings. A contemporary inquiry style technology program invites subjective student-led designs to connect with personal values (Bondy, 2003). The students' views reflect the affective mode of their accumulated experiences supporting a constructivist view of learning (Lave, 1991; Hennessy, 1993). Significant learning events taking place in a context that affects the student personally become a meaningful addition to their expanding knowledge base.

Engaging interest

Inviting students to take part in an activity requires a stimulus to quickly interest and sustain their engagement. Opportunities for students to take risks (non-harmful) with their imaginative designs for technology products have an attraction, by allowing freedom for personal expression. Students describe the nature of their procedural and conceptual understandings through their conversations when discourse explores possibilities for personally relevant design solutions (Moreland, 2003). The continual routine of questioning from amongst members of student groups and the teacher may be seen as a creative and analytical activity. Questions from students that are noted in social group situations (Harpez, 2005; Brown, 1994) comprise an active role in their own learning, whilst creating further understanding of technology processes and product solutions.

In a New Zealand study (Gawith, 2003) showed that technology education programmes that are open to diverse and constructive behaviors were likely to encourage students to take risks with the type of ideas they discovered. Lewis, (2005) refers to technology activities that involve different types of thinking as being important for “problem finding” as students

become engaged and creative learners, (p. 43). Treadwell (2008) suggests that fun is a valuable aspect of inclusive classroom activities. The fun in learning activities becomes a function of class engagement. There is benefit for both teachers and students able to recognize the benefit of humor and serendipity. A style of teaching that allows learning to occur from unexpected sources may contribute useful discoveries that are recognized later in reflecting on experiences and sharing views. Through activities of this kind, Treadwell (2008) suggests that the teacher creates a rich learning environment that incorporates multiple concepts and allows thoughtful answers to emerge.

Prather (2000) draws attention to the availability of suitable resources in the early stages of addressing a technology activity. Several commentators (Huizinga, 1955; Caillois, 1962; Provenzo, 1991; and Stallabrass, 1996) suggest that by having materials to allow experimental play students may generate multiple solutions and initiate discussion regarding design suitability. Sufficient time to think ideas through before having to act is likewise valuable for student engagement. Providing material resources and the time for students to respond to the technological activity may stimulate creative visualizing of potential solutions (Ings, 2003) enhancing the learning experience (Horne, 2007).

Teachers attempting to motivate students to investigate an activity will find curiosity a useful tool. Curiosity has been described as frequently initiating and stimulating students to both explore the materials and evaluate ideas. Direct experience with a technology activity has the potential to stimulate students' curiosity in critically examining their own and others' ideas (Lewis, 2005). Bruner (1962) describes the notion of "effective surprise" taking a person beyond the common ways of experiencing the world to being engaged with a sense of wonder or astonishment, (p. 3). The links between students' unexpected initial experiences and creative productivity identifies a motivating engagement in subjective contexts (Lewis, 2005; Horn, 2007; Treadwell, 2008).

Instigating collaboration

Students arranged in small groups respond in the classroom environment to achieve their goals in a variety of ways. The social arrangements in a technology class facilitate collaborative work styles for solving tasks through exchanging and modifying ideas. The conversations and narratives identified by Resnick (1988) that people manage through dynamic peer relationships are practiced over a working lifetime. In the world outside of school, “learning and cognition are fundamentally situated through these usual activities” (Brown, Collins and Duguid, 1989, p. 32). Bell and Cowie, (1997) remark that concepts and procedures become embedded in purposeful processes including cooperative discussion and shared exploration supporting student autonomy in their learning.

Maw and Maw (1964) cited in Arnone and Small, 1995, p. 4) describe a classroom practice of encouraging group behavior that was referred to in their study as being closely linked to student motivation. The development of “knowledge communities” amongst active groups suggests that the attraction for students’ working together resides in the shared knowledge generated by member activity (Hickey and Zuiker, 2005, p. 278). Csikszentmihalyi (1983) uses a description of Flow Theory, drawing attention to student behavior often conspicuous in small groups that highlights the manner displayed when a student is fully engaged in an enjoyable learning task. This occurs when the relationship between curiosity and motivation is exhibited “as a state of intense intrinsic motivation, a merging of action and awareness, highly focused concentration, a sense of potential control, an altered perception of time, a sense of growth and the engagement in an action simply for its own sake” (as cited in Arnone and Small, 1995, p. 7).

In a study by Carr and Claxton (2002) it was noted that amongst individuals working in small groups, behaviors indicated learning dispositions in the development of student goals. It may be that certain dispositions are likewise exhibited towards technology work as students attempt activities in small group situations. Dispositions may be considered as a type of personal attribute identified in the students’ responses to certain situations, (Ibid,

2002) or personal characteristics regarded as recognized behavior types such as being friendly or assuming leadership (Katz, Cacciari, Gibbs and Turner 1998).

A student's disposition towards collaborative discussion or negotiating decisions that may be described from observations during an activity, will be displayed through their persistent actions. Talking about their ideas is important for both socialization and the creative design process. Group dialogue is more than sharing information; it involves group members in the processes of decision-making as communities of learning. Students able to practice making appropriate choices during classroom activities, learn the processes of self-regulation, how to manage their goal achievement behavior. Findings by Boekaerts, de Konning and Vedder (2006) argue that multiple content goals are inherent in students' responses in new learning environments and influence engagement and motivation. Socialization amongst group members while working to solve challenges may contribute to coordinating both their social and academic goals in an enjoyable setting. When students have presented their group solutions to the whole class, there is a forum to describe technology outcomes in group terms rather than individual terms. Urdan and Maehr, (1995), cite a number of other studies such as Dodge, Asher and Parkhurst (1989) and Phelan, Davidson and Cao (1991), when asserting that the convergence of both social and academic goals has been recognized to be beneficial for early adolescent age groups.

Cooperative learning methods have been noted as effective in improving student achievement because that cooperation helps students share ideas, explain their reasoning, and provide assistance to peers as they work together. Meloth and Deering (2007) document the effects of two co-operative conditions on group discussion and meta-cognitive awareness, observing that, "groups are more likely to focus their discussions toward important task content and improve their awareness of learning goals and task dimensions when discussions are directly oriented toward the meta-cognitive features of their cooperative tasks" (p. 164). The benefit to individuals of working in social groups is the opportunity for expression of creativity and reflection (Bruner, 1962). Acknowledgement of

influential social factors in classroom technology activities lends insight for teachers to develop an engaging program design.

Importance of context

Students' motivation to become engaged in learning activities when in unfamiliar classroom environments is an important indication of interest in both the content and social interaction (Hickey & Zuiker, 2005). A context for technology activities maybe promoted by the type of classroom experience initiated by the teacher to encourage students to become involved through a shared experience and to uncover new knowledge. Work undertaken by Fox-Turnbull (2003) on assessment tasks indicated the possibility of a social context embedded in a unit of work allowing students to identify worthwhile connections between what may be real to them and situations they experience subsequently. These contextual connections may assist students to see a relationship between contemporary social trends, and their eventual technological solutions. Authentic learning contexts described by Hennessy and Murphy (1999) and The New Zealand Technology Curriculum (MOE, 1995) support the view of a complementary relationship between the type of context and student outcomes. Likewise, two other studies by Mawson (2003) and, Craig, Gholson and Driscoll (2002), suggest that an authentic social context, may allow students to use a starting strategy that suits their learning style.

The authenticity of a context affects how students personally view the need for becoming engaged in an activity, seeking new knowledge with personal relevance. Brown, Collins & Duguid (1989), suggest that the authenticity of students' learning environments contribute to "indexed representations" increasing efficiency of their responses to class tasks, (p. 37). An authentic learning context creates opportunities for establishing genuine technological need situated in the students' familiar social environment (Gawith, 2003; Ing, 2003). It is important that students view the technology activity as a form of engagement associated with their ownership of that context (Mawson, 2003; Horn, 2007). These authors identify two types of authenticity: a) purposefulness within a personal context, and b) purposefulness within a social context. In research identifying students' work potential, Jenkins, Macfarlane

and Moltzen (2004) emphasize the importance of providing a “culturally meaningful learning environment” (p. 64).

Ing (2003) makes similar reference to the importance of contextual factors for students’ work generating creative responses in situations that inspire personal vision. Hickey and Zuiker (2005) describe the internalizing of students’ motivation in social contexts using McCaslin’s model of “CRL, co-regulated learning” (McCaslin, 2004, p 281). “CRL focuses on the relationships, social supports, opportunities, and emergent interactions that empower the individual to seek new challenges within that scaffolded environment.” (ibid). The importance that context has for learning activities can be realized on multiple levels in how students’ interest is activated.

2.2 Audio-visual

Audio-visual has been a familiar media in many households throughout the westernized world for several generations with easily affordable television and more recently computer appliances. This mode of communication supplements first-hand community accounts with multiple genres such as information for tuition and nature documentary viewed as social entertainment. In the Western world where choice has become a common feature of the free-market, an individual’s interest is closely related to this preferred “communication web” (Kress, 2000, p 143). Our contemporary culture has advanced the mode of visual representation beyond the power of looking-in to understand aspects of our world with reality reproductions. The preferred mode of communication for young persons in recent times has become a visually appealing aesthetic style displayed via an electronic screen frequently enhanced with contemporary music soundtracks. The development of gaming and other interactive audio-visual media is beyond the scope of this study.

The Hollywood touch of post-production manipulation has been credited with heightened visual illusions of a certain ‘if-ness’ (Darley, 2000). A predictive suspense of what-if something happens is relevant for recognizing how viewers’ attention is captured. Audiences familiar with current audio-visual media expect to be entertained viewing a film

having imaginative qualities. The whole theatre experience of large screen, high definition projection and surround sound seduces more than the eyes with the photo-realism and aesthetics borrowed from traditions that began decades ago with the silent movie. In the context of a technology activity an audio-visual extract becomes more than an electronic resource. The film viewed could be seen as an influential artifact presenting a context for activities and stimulus for interaction between students and teacher. The description of an “influential artifact” has been discussed in the research of the Classroom InSiTE Project (Cowie, Moreland, Jones & Ortel-Cass, 2008, p. 45) as something (either tangible or intangible) that supports students in discussing their ideas.

Rich content offers context

When viewing an extract of film media there are multiple experiences of colorful images, language and music through which an audience has the opportunity to make connections with their own sense of identity and a wider view of the world. Comparable to Bruner’s (1991) description of the narrative form, audio-visual media offers a story in the manner of constructing a contemporary reality for viewers with a way of knowing. Darley (2000) describes in the classical cinema setting, a viewer having reduced mobility as they are taken into the world of the story, “the pleasures of this mode of representation are considerable” (p. 48). The film medium by allowing a passive state to occur invites receptive students to take in experiences and ideas potentially informative or helpful (Ings, 2003). The experience has relevance if we recognize the students’ state of flow described by Csikszentmihalyi, (1997) which becomes a type of affective reality. Moore, Burton and Myers (1993) identify audio-visual material, specifically film as a medium that communicates information quickly in a focused manner easily grasped by students. The presentation of information by a familiar medium such as film has two active perceptual modes (auditory and visual) that create an inviting learning experience.

Audio-visual media may be seen as a rich experience for viewers. In his bulletin, Bacon (1972) described this as “filmic power”, an effect that encourages the belief in what has been seen and heard (p. 68). Further, Darley (2000) offers the comments of Marshall

McLuhan (1968) and Jean Baudrillard (1981, 1983) in suggesting that, the purposes of the audio-visual medium has progressed beyond providing interesting information for our reflection to affecting behavioral changes in viewers (p. 59). It is emotionally charged and politicized entertainment, often supplemented by subliminal advertising (insertion of recognizable branded products, eg. Soft drink, car, clothing) directed at prompting audiences to react in particular ways that affect change in consumer behavior. Audiences are exhorted to buy particular goods associated with other desirable traits with which they are familiar.

Studies by Bromley (1996) and Chua (2007) comment on the representations of digital mass media communication and suggest that the mass-media view an audience sees of the world is less a window of what it (the world) looks like than a digital re-creation presented for dramatic effect in film. There are innumerable audio-visual effects shown to eager audiences that shape viewer perceptions. For many children the images of film media are possibly the dominant text form they experience (Darley, 2000). These sources suggest that the use of suitable media may affect students' views through links they make to historical personal experience. Audio-visual extracts potentially offer a form of media suitable to provide information supporting student understanding for each strand in the New Zealand Technology Curriculum.

Chua (2007) documents the technical qualities of film media as having powerfully engaging effects on audiences by building a sense of anticipation. Chua (2007) emphasized the synchronization of narrative voice overlaid with an almost tactile musical soundtrack accompanying enhanced images. This becomes a powerful medium for the viewer. It may seem that the audience is in the driver's seat, viewing a crafted illusion extending their sensual view of reality. Contemporary film has been described as a complex interaction of "soundful images" (ibid, 2007). An aesthetic relationship between sound and image is "fused together to form sound image events" (Ibid, p. 8). The engaging experience of viewing a film extract offers support to classroom technology with a content of embedded meanings for an audience to experience, discuss and refer to during subsequent learning activities.

Media supports learning links

The use of a film extract to introduce a unit of work in the classroom is not a unique approach. A study by Gibbons, Anderson, Smith, Field and Fischer (1986) documents that audio-visual resources have been widely used in many curriculum areas for the advantages this modal delivery of information offers. The benefits of using audio-visual material are varied and may be considered for a range of purposes. Production quality, subject matter and suitability directly influence the benefits compared with the use of other teaching support materials. Mayer, (1989) studied how meaningful information presented directly to all students in a class via an explanative style may positively assist with cognitive processing. The role of film to quickly engage students and involve them in discussion and the pursuit of possibilities for further classroom investigations was also noted by Watts (2007).

The short-term recall of certain images or information has value in prompting discussion amongst student groups. Several sources, (Mayer, 1997; Gibbons, et al 1986; Bacon, 1972) refer to the opportunity with media to demonstrate certain learning processes at work for individual students as they recall certain images and infer possibilities in their work activities. Responses to media, although observable through students' behavior, take place in a complex environment that includes other influences. Forming links between words, images and prior knowledge by selected images connected to existing personal understandings, prompt a students emotional response to take part in a classroom activity. Lave's (1991) idea that learning is recognized as taking place "through legitimate peripheral participation in arranged social practice" (p 64), suggests that viewing appropriate media is likely to be an example of "a cognition plus view" (p 66). The students' views of themselves, (their identity) and knowledge structure, (through which they have an understanding of the world) allow an opportunity for them to become purposefully engaged with a learning activity.

Regarded with interest by consumers worldwide the extent of technological development that has propelled the cinema industry into creating a whole range of digital media, offers a powerful aesthetic reception on various levels for students' perceptual, cognitive, emotional and/or interpretive engagement. The quick presentation of an authentic need in a form of

electronic narrative can stimulate students' imaginations (Mayer, 1997; Darley, 2000; Horn, 2007).

Selecting suitable media

The Technology program goals guide teachers' attention to carefully select appropriate material for screening to student audiences (Mayer, 1997; Gibbons et al, 1986). Criteria for selecting audio-visual media are determined by a number of factors: a) contemporary relevance to the teacher's intended technology scenario to both interest and engage the class (Horn, 2007); b) the students' views of a need for intervention by their possible technological activity; c) relevant censor rating and appropriately safe viewing content for age group and ethical criteria is essential, (established by staff previewing); d) the alignment with students' social goals of self-regulated peer interaction (Boekaerts, DeKoning, & Vedder, 2006).

Appropriate media may stimulate students to respond by taking ownership of an activity and seeking a genuine technological solution. Student ownership represents their unique view of how they could make a difference through a solution produced in the teachers' planned learning activity. Media considered suitable will be easily available through established commercial outlets, most likely seen by students previously and reviewed in print media. The quality of brief selected extracts from suitable media is essential for teaching staff to predict likely scenarios identifying an opportunity for appropriate intervention by design. Any contextual alignment with a technological need resulting from viewers' interpretation of the audio-visual extract facilitates participant engagement as an intended learning outcome.

2.3 GATE: Gifted And Talented Education

It is relevant to consider recent research in GATE (Gifted and Talented Education) in New Zealand because the participants in this study were identified being from this group. Renzuzlli (2004) informs us that it is important to develop programs that foster creativity in

exceptional young people. Lewis (2005) described a framework for encouraging creative responses from students allowing them to move beyond a restrictive type of traditional knowledge-based program, to a collaborative student-centered problem solving approach (Cathcart, 1998). A program offering GATE students multi-level skill caters for a range of individual differences (Moltzen, 2004). The skills identified as essential for these exceptional students are: a resilience when exploring alternative ideas in a challenging activity; viewing ideas in a variety of ways and; having a readiness to look beyond the easy answer and provide insight into how to provide an appropriate approach (Carr & Claxton, 2002; Kaplan, 2007).

Cultural implications

A significant aspect of GATE programs not to be overlooked, as it has importance in both the identification of gifted students and the nature of programmes, is the socio-cultural implication of class organization, discourse and dynamics (Mahuika, 2007). This has been identified in studies examining Maori students demographic under-representation in GATE class groups leading to a cultural reflection on what constitutes giftedness (Bevan-Brown, 1996). Fundamental to GATE programs are “culturally meaningful contexts” promoting knowledge growth complimentary to students’ beliefs, practices and values (Jenkins, Macfarlane & Moltzen, 2004, p.64).

Suitable environment

In identifying an environment for classroom activities consideration goes beyond the physical requirements of material resources and equipment, extending to known benefits of particular teacher pedagogy (Cathcart, 1998; Claxton, 2003; Meloth & Deering, 1994; Mawson, 2003; and Moreland, 2003). Recommendations for providing suitable learning environments for GATE students are described by Maker and Neilson (1995) who suggest possible ways to meet the unique learning needs of GATE students by both teacher pedagogy and classroom management. These are described as:

- Learner-centered

- Management allowed independent of teacher
- Resource rich and complex
- Accepting of creativity with physically and psychologically safe risk taking
- Varied and open grouping
- Access to unfamiliar artifacts, materials, people
- Scheduling flexibility
- Freedom and toleration for mobility
- Space to incubate discoveries

(Ministry of Education, 2000, p. 37).

Although literature on GATE students is recognized for contributing valuable observations on a unique group of students in New Zealand schools, these characteristics may also have benefits in other learning environments.

2.4 Summary

Contemporary approaches to technology education offer learners a blend of practical and theoretical design intervention based on socially responsible global behavior. Educators are able to engage students in technological activities when students see class activities as something worth doing. The New Zealand Technology Curriculum (MOE, 2007), reflects an inclusive approach in which students may explore multiple content goals in a variety of contexts with an authentic human interest. In the three complimentary strands of the curriculum, opportunities embedded for personal expression, economic advantage and recognition of technological social impact, motivate technological literacy in various forms. A cultural perspective is foundation to an inclusive learning environment acknowledging that all students in schools have goals with content that is personally relevant to their engagement.

Attempts at activating students' engagement in technology classes have identified that contexts that students see as relevant are likely to motivate participants in the development of technological literacy (McCaslin, 2004). Research authors recognizing a place for rich

and appropriate audio-visual experiences to stimulate students' imaginations compliments our contemporary digital culture (Chua, 2007; Craig, et al, 2002; Darley, 2000; Gibbons, et al, 1986; Sprau & Keig, 2001; Watts, 2007; Wilson, 2008). An invitation for students to have fun using connections between the content of media they view and opportunities in technology, may arouse curiosity for developing creative design solutions. Appropriate criteria for selecting suitable audio-visual material reside in the educators' professional evaluation of authentic scenarios for suitable class activities that may resonate with students interests.

This may attract attention when managing programs for GATE students by encouraging flexible programmes that allow creative investigation of suitable challenging human problems. The inclusion of student personal views involves the critical questioning of design justification as both a creative and analytical process.

An opportunity for feedback and guidance exists when teachers identify formative knowledge progression in student technology activities. Shared small group experiences have evident links to student motivation and relationship behavior that encourages the demonstration of collaborative work. This goes beyond the restraints of a single subject and opens the way for a curriculum of the future (Kress, 2000). The social constructions students acquire in technology learning activities they see as authentic link historical experiences to those anticipated in the future.

Having reviewed the literature that informs this study the next chapter describes the methodology and data gathering methods adopted and also provides details about the researcher, the approach taken during the teaching sessions and important ethical considerations.

Chapter Three: Research Design

3.1 Context and Participants

3.2 Methodology

3.3 Researcher's background and role

3.4 Data gathering Methods

3.5 Reliability and validity

3.6 Ethical considerations

This chapter describes the research design of the study and begins by describing the context of the study and the participants. Next, the study's chosen methodology is explained and this is followed by description of the researcher's background and role within the research design. Methods of data collection are described in section 3.2 and later explained further in section five. Issues of reliability and validity are discussed in section six. The chapter concludes with discussion of the ethical considerations of the study.

3.1 Context and Participants

This study took place in a technology centre using the workspaces of two adjoining workrooms. The technology centre is a relatively modern, purpose-designed facility with excellent line-of-sight views between rooms and is brightly lit from natural and fluorescent sources. The centre contracts to provide specialist technology programmes for year seven and eight students from contributing schools in the Tauranga District. There are workbenches and tables at comfortable standing height or students may work seated at stools. In the larger of the two workrooms seats are arranged audience style facing a large projection screen serviced by a mobile data projection/sound system unit. The second room is a specialized workroom for hard materials and electronics, separated by glass bi-fold doors. Students approach the rooms from the school grounds via a covered area for bag storage.

Participants for this study have been accessed through an extra-curricula program that I offer each year to Year Six students from two local schools. Historically, I have taken small groups of students for a series of technology enrichment classes in my professional development teacher release time. Students were selected as being gifted and talented, (GATE) by their usual classroom teachers, (seven teachers in all) prior to attending the classes. There is an expectation from the students and their parents that attending the program was a form of enrichment as well as an experience not available in the normal timetable.

This GATE group comprised eight students of evenly mixed gender from one school, plus another group of nine students including five boys and four girls from the second school. The total of seventeen participants aged between ten and eleven years were all willing and enthusiastic to take part in the series of technology classes and understood that their activities were being studied as part of a research project. Although some of the students knew a few of the others from around school, they had not worked together before this program. During each session students displayed a coded identification tag attached to their uniform lapel by clip. All written work was similarly identified by their personal alphanumeric code.

The classroom organization during the technology activities placed students in small groups of four members, (except in one group there were five students in two sessions), with a blend of gender and schools in each. Students were asked to work cooperatively throughout the activities, collaborating to investigate the technology challenges and negotiate through discussion their combined solution. Attempts were made to engage the students' social skills each session through the shared purpose of solving the challenges. The student work was an active collaboration, reinforced by the teacher through formative dialogue promoting cooperative student interaction and frequent attention to class work performance goals.

3.2 Methodology

It is my intention to develop an understanding of how an audio-visual introduction engaged GATE students in this situation. I will look beneath the surface of students' behavior to gain an understanding in what I suspect they know as well as, what they are trying to do (Burns, 2000). In a study of small size, it is appropriate to answer research questions with the participants voice'. There is a need to appreciate honest views on this audio-visual introduction from both the students and the teacher involved via their comments and by subsequent researcher reflection. It is helpful that the participants' actions be examined through a perspective that also acknowledges their intentions.

The research paradigm or perspective adopted in this study is that of qualitative interpretation. A qualitative, interpretive methodology offers the combination of two complimentary styles of educational research. The qualitative paradigm seeks to make sense of particular phenomena by identifying participant behavior embedded in the context in which the research takes place (Burke Johnson and Onwuegbuzie, 2004). Data grounded in the context of the technology classroom that becomes available for comparison, discussion or later analysis has been referred to as thick-descriptions (Geertz, 1973).

The interpretive aspect of the research paradigm involves the exposure of meaning that is extracted from the participant behavior this study records. Interpretation of participant behavior assists understanding of their motivation, personal needs, social responses and how they interact (Bogdan and Biklen, 2003). Evidence obtained by qualitative interpretive method described by Denzin (1970) for presenting detailed and comprehensive character information is similarly described by writers such as Desimone and Le Floch (2004). To understand what has been taking place with the participants, I will be looking for a new set of insights to drop out adding to my understandings of any theories grounded in the data collected (Glaser and Strauss, 1967). Identifiable themes that arise from student comments will be inferred from conversations, specific instances of individual behavior and the nature of their proposed technology outcomes.

Supporting the methodology of the study is a constructivist perspective on learning. Druin and Fast (2002) suggest that students who are offered opportunities to explore and develop pathways to forming their own knowledge will build on prior understandings. Authors from other sources agree on the cumulative benefits as students develop conceptual links with previous experiences (Papert, 1980; Harel and Papert, 1990). Constructive learning activities allow students to progress their understanding supported by progression in conceptual and procedural aspects of their technological knowledge (McCormick, 1997). A hermeneutic view of knowledge partially comprises a socially constructed reality as seen through participants' perspectives that may be reflected in recognizable cultural themes (Cohen, et al 2000 p. 29).

3.3 Researcher's background and role

As an experienced technology teacher I believe that I have both the recent and relevant experience to conduct this type of research, acting as a human instrument, observing and interpreting the activity. Lincoln and Guba (1985) describe the researcher as human instrument seeing and interacting in a meaningful way with data as it occurs to study relevant details closely. My experience of working in technology education classrooms will inform my ability to collect and interpret the data. Observation of participants during the study activities will provide a window on their learning behaviors.

A compromise for my administration of this study was to take the researcher-observer role. I initially planned to be directly involved with the strategic questioning of students' activities and hands-on with teaching roles. However, in the interests of providing a third perspective to triangulate the findings, I stepped aside to become primarily focused on the role of researcher. It is a more familiar classroom role for me to have direct interaction with students during formative processes when they explore the development of challenge solutions. A colleague, Mrs B. offered to teach the class, effectively creating a third perspective and enhancing the data gathering. As a researcher-observer, I would be able to concentrate on observing classroom activities and ensuring details were recorded accurately.

3.4 Data gathering methods

To understand the students engagement following an audio-visual introduction requires the collection of accurate, quality information employing several instruments. The data collected is intended to build an understanding how students are likely to behave in these technology classroom environments. The students and teacher were briefed prior to the commencement of the technology lessons of what to expect in regard to my methods of observation and recording of the interactions. I had adopted a visible approach throughout each session, to help participants feel relaxed and invited to express their views.

I have chosen approaches for this study that will offer multiple instruments for collecting data allowing comparable perspectives. The tools used to obtain the data were; i) researcher

observation, including field notes ii) interviews with students and the teacher; iii) written material from student worksheets; and iv) camera still and video recordings of classroom activity. It is my intention that having students follow a structured format will contribute a degree of reliability to information collected (Silverman, 1993). Data collected could be reliably described as authentic and recognized as true to context.

i) Observation

Researcher observations were made as I stood discretely back from group tables or circulated throughout the room. There were times when I sat at a side table or at the teacher's desk and wrote notes in my logbook. The collection of data has been completely managed by myself as an instrument for the research to include thick descriptions of student behavior in this context described by Geertz (1973). These observations seek clues to meaningful participant behavior represented from the evidence gathered with an ethnographic perspective. The events of each session were described in the complex social environment where they took place and interpreted later (Bogdan and Biklen, 2003). I took notes in a field notebook, still photographs and video images using three video cameras to collect sound and images, plus a digital audio device to record interviews. The teaching role was managed fully by the teacher, (Mrs B) with my role being only to observe activities and behavior during the class sessions ensuring recording devices operated correctly.

ii) Interviews

Interviews have been chosen to collect participant and teacher data to enable direct accounts to become available for analysis. The research has been designed to qualitatively interpret the voices of those directly participating in the technology activities. In the interviews, participants will be withdrawn in pairs and seated together at a table in the first room where the introduction took place. A sequence of four questions were asked of each pair of students, inviting them to answer in turn while I recorded responses as a type of normal conversation (Bogdan and Biklen, 2003). The questions asked participants to comment on the technology activities and the introduction as they saw it, (Figure 4.1 Appendix). The

purpose being to give them the opportunity of discussing how they considered the “situation from their own point of view” (Cohen, et al, 2005, p. 267). Insights could be gained from this method of collecting data with students slightly removed from the main group, although within sight through the closed bi-folding glass doors, in a quiet relaxed environment. The opportunity for students to interact with the researcher has an added benefit of indirectly confirming informed consent through familiarity with the researcher (ibid).

Selected students participating in the research were interviewed towards the end of each session as the class was cleaning up the workroom. It had been explained to the class that interviews would be taking place each day to gather information about the technology work the students were doing by way of sharing their ideas to assist our understanding of how the program could be improved for the future. The research purpose had been explained to the students prior to commencement and advised of their prerogative to withdraw at any time they felt uncomfortable. At commencement of each student interview it was explained how the interview would be conducted and acknowledgement made of their participation.

Twelve students were interviewed in total for this study, comprising seven girls and five boys, (Table 3.1, Appendix). Selected students were asked questions during each interview with student responses recorded by notes in a workbook, a digital voice recorder and video camera. The interview selection was based on having different pairs of students, one from each school, from same group with no repetition of participants. Five of the interviews were with pairs of students of the same gender who had been working together during the technology session. These students were comfortable in the others’ company having previously worked together during the technology activity. In the last student interview after the third session, students were interviewed from different groups and opposite gender as a consequence of the time constraint. Participant responses were transcribed on separate pages for analysis.

Table 3.1 Interview Schedule

Session One	Session Two	Session Three
1. Red, boys GPS8, TPS3	4. Blue, boys GPS4, TPS2	7. Blue, girls GPS7, TPS7
2. Green, girls GPS6, TPS6	5. Yellow, girls GPS1, TPS5	8. Yellow boy TPS9, Red girl TPS8
3. Teacher	6. Teacher	9. Teacher

Teacher Interviews

The teacher was interviewed with a separate set of questions asked at the end of each session, (Figure 4.2, Appendix). There was opportunity to sit at the same interview table after students had been dismissed, relax for a few moments and reflect on the activity observations for the day. The teacher interviews were recorded in similar style to the students, with notes hand written in research log and by electronic voice recording device. Discussion was candid and this was an important sharing time, considering the students' learning outcomes.

The collecting of participant views is intended to permit rich-descriptions to be brought out for later analysis. I believe that this tool is one suitable way of finding informative answers to the research questions. The time frame for each session was brief and the information freshly obtained from participants. An advantage of this method is the opportunity to obtain detailed data from participants that relax and speak openly.

iii) Written material

The analysis of any written material recording participants' personal ideas, in their own words, generates an opportunity for the researcher to consider information that may not have been verbalized at the time of the activity. There were several opportunities for written material to be accumulated during these sessions. During the initial brainstorming activity at the beginning of each session students were firstly provided with large sheets of blank A3 paper for their groups to record any ideas they considered helpful to the challenge, (Figure 5.1, Appendix). Each student had access to a pencil, eraser, ruler and scissors located in a desk caddy on the table. The members of each group arranged the information how they chose during this activity. Secondly each session, students were provided with a separately prepared work sheet that included a summary of the technology challenge noted and framed areas within which to record their responses (Figure 5.2, Appendix). Worksheets and group brainstorm sheets provided each session each had coded identification noted on them. These

two items were collected at the end of each session for further analysis, remaining in my secure possession until they were returned to the students. The third type article on which the students have recorded information on was a self-evaluation sheet completed only in the last session. Included in this page were frames with starting phrases to prompt students to describe their technology experience, (Figure 5.5, Appendix).

The work sheet framed areas included brief questions to prompt responses to particular aspects such as the main problem, helpful ideas and sketch designs. Participants were reassured that these work sheets would not be marked and would be kept in secure storage. This collection method was not intended to become a questionnaire for numerical analysis. It would not be particularly useful from such a small sample. The written material was intended to obtain authentic insights, inviting participant honesty and directness from the technology experience (Cohen, Manion and Morrison, 2005). These artifacts provide lasting evidence with potential for reflective comment.

iv) Digital still and video camera recordings

The participant activities were recorded each session with the use of a digital still and three video cameras. The still camera was hand-held by the researcher as I moved around the room each session, photographing instances of individual and group work. The video cameras were strategically placed on tripods in separate locations around the workroom, accumulating considerable data for the duration of each session. The management of these cameras meant that I was physically present in the classroom, moving quietly amongst the groups of participants. Frequently, I was asked questions by participants and did likewise of them, each seeking further information. The data from the cameras was later transcribed, verbatim and used in analysis.

3.5 Reliability and validity

Quality control assurance in educational research, is concerned with tools designed to assess data value (Cohen, et al, 2005). These are the tools of validity and reliability with the added feature of triangulation provided by multiple data collection sources. Cross-referencing of

the multiple data sources described in the last section provides a degree of confidence that the classroom activities and outcomes have been reliably interpreted. In other words, the study demonstrates replicability as described by Cohen, Manion and Morrison (2005). I expect similar outcomes could be reliably obtained with another group of students if the same procedures were followed. Reliable findings described in this way contribute to establishing credibility, with the realization that knowledge has been gained through following a consistent practice. The technology introduction and class program was conducted in identical format for each of the three sessions. Thus, it was important when recording observations and interpreting human interactions to ensure the opportunities for participants to present their views of the technology activity without interference from any bias tendencies of the interviewer (Silverman, 1993). A clearly planned structure for the class program and interview questions offers uniform procedures to gather accurate data.

Reliability can be demonstrated by the relationship between what is recorded as data and the events that take place (Bogdan and Biklen, 2003). The same teacher following the planned processes with an audio-visual introduction presented to participants and each interview managed identically for the three sessions is a particular type of reliability. Another type of reliability is supported with the replication of data gathered from this study over the three sessions. The data can be sourced from each session following identical procedures to obtain findings from separate sources of information that may or may not be comparable. The small sample from which the data was collected will only include numerical counts to indicate general tendencies rather than demonstrate statistical reliability.

The concept of validity scrutinizes the integrity of the research process through examining “the honesty, depth, richness and scope of the data achieved, the participants approached, the extent of triangulation and the disinterestedness or objectivity of the researcher” (Cohen, Manion and Morrison, 2000, p. 105). Multiple methods of collecting data have been used to improve the likelihood of validity in the findings.

The general tendencies that are uncovered through this study will be considered by the consistency with which these occur and the concurrent confirmation provided in the accounts from the three parties involved. None of the students were known to the researcher

prior to the sessions, however bias towards those participants displaying higher levels of interest in the activities or being particularly good at articulating ideas was considered potentially an issue. To counter this issue the teacher conducting the sessions was selected for her objective facilitation skill.

The triangulation of data has been achieved by the methods of collecting data from three viewpoints on what occurred during the technology activities. Triangulation in qualitative research is used to establish greater certainty by collecting data from several sources of information. Triangulation addresses potential bias from reliance on a single method of data collection by using an additional means of describing the events (Cohen, et al, 2005). Gathering data from multiple sources provides a more valid description through a convergence of views from multiple viewpoints. There are no guarantees, nor expectations of producing exactly the same data from each session even with identical methods. However, this approach does allow for cross-referencing the findings obtained from a replicated approach complimented by similar procedures. What I expect through investigator triangulation (with more than one observer) and methodological triangulation (using the same method on different occasions) are general tendencies or behavior trends to emerge in the data (Cohen, et al, 2005).

3.6 Ethical considerations

Ethical approval for this research was applied for and approved by the Human Research Ethics Committee of the Centre for Science and Technology Education Research (Table 7.70, Appendix). Participation in the study was entirely voluntary and students and/or their parents could choose not to participate at any time. Although caregiver/parents' permission was obtained for each child to take part in the research, a parent's permission did not obligate the child to take part in the project. A child's participation was entirely voluntary in that no coercion was employed in any way. He or she was free to stop participating at any point, and would experience no negative consequences for withdrawing.

Letters of explanation to the parents/guardians of participants and schools set out the nature

of this research, offering the opportunity to take part in the activities from which data would be collected. Informed written consent was obtained from all parents or guardians of those students taking part as well as the schools involved (Table 7.80 and 7.90, Appendix).

Confidentiality was safeguarded by use of an alpha/numeric coding system substituting students' names and personal details to assure no direct reference will be made to individual participants. Although digital still and video images were recorded of student activities during the program to assist in analysis and interpretation of the project's findings, no images in which students can be identified will be used in the final reporting or publishing of the findings unless specific and separate permission is obtained from the students' caregivers or parents. All information was kept securely in a locked file cupboard and is available only to the class teacher, my supervisor and myself. Digital files will be kept on compact disc, mini digital video recording tape or flash memory cards in a securely locked file cabinet until such time as these are destroyed. Temporary computer files are protected by password and will be deleted once the thesis is written and completed. There is no foreseeable potential harm to participants from taking part in this program. Students were selected to take part in this GATE Technology program as a form of enrichment learning. Participating students will not be assessed (i.e. it will not affect their academic progress within their school) for the work they will be doing during the technology activity each session. There will be no disruption to any other class programs as the research activities will take place in specialist technology work rooms at times that are free from other scheduled classes. In respect of student autonomy, it was made clear to all, that if they felt unhappy about taking part at anytime they could withdraw without consequences.

Arrangements were made for participants to receive information in several forms; i) ongoing verbal feedback during each session, ii) part way through the set of sessions a preliminary feedback statement was made regarding acknowledgement of support and trends noted, iii) an open forum meeting was held at the centre for parents/guardians, principals, teachers and colleagues to share initial findings and contribute comments of interest, and iv) a copy of the final thesis will be provided to each school. Analysis and interpretation of the data gathered during the study will primarily be used in the completion of the researcher's Master of

Education thesis. Findings of the study may also be presented at conferences and/or published in academic journals.

The methodology and data gathering methods used in this study were designed to be suitable for the number and nature of participants in a study of this size. Attempts to find answers for the research questions necessitate accurate interpretation of participant responses reflecting a robust practice that is open to peer-scrutiny. In brief, the research instruments chosen support reliable and valid data collection by the verification of several converging viewpoints. Reassurance that participants and their data have been handled appropriately in regard to confidentiality and security has been a priority.

Having described the research design, methodology and data gathering methods adopted, the next chapter describes the setting, processes and procedures of the three classroom sessions.

Chapter Four: The Research Context

4.1 Setting of study

4.2 Classroom organization

4.3 Teaching sequence

4.4 Audio visual introductions

This chapter describes the environment in which this research was conducted as well as the sequence of events. The chapter begins by describing the setting in which the study took place and then goes on to explain the classroom organization. Next, the teaching sequence is explained and there is a brief summary of the selected audio-visual extracts that were screened at the introduction for each session.

4.1 Setting of study

General situation

The study took place at the Tauranga Technology Centre, located at the Tauranga Primary School campus 31 Fifth Avenue, Tauranga. Staff at this facility provide specialist technology classes to intermediate age students from client schools in the Tauranga district. Students that usually attend the centre are bused in the morning for full-day classes that extend through to the afternoon. The program these students take part in follows the New Zealand Technology Curriculum in the most recent form (Ministry of Education, 2008).

Physical setting

The study took place in two adjoining rooms of the Tauranga Technology Centre. The rooms are specially designed for intermediate aged student technology classes. The first room, the larger of the two with high ceiling, was the room where the students were greeted for briefing each session, viewed the film extract, took part in interviews and were debriefed at departure time. This room had data projection with large screen facilities and attached surround sound speakers. Seating was by individual plastic-backed chairs set in rows, cinema style facing the screen. The environment was spacious, comfortable and central to adjoining facilities.

The second room, for hard materials was adjacent to the first with folding glass panel doors dividing the workspace. The hard materials room was arranged with worktables and stools for each student where the greater portion of time was spent, tables were arranged with

seating in four separate groups. The worktables are at a leaning height, allowing ease of written or construction work either standing or seated on the high stools. Two sides of this room were furnished with wall-side benches for tool work with electric scroll saws, soldering irons and small drill presses.

There was an area of display on two walls for associated visual images and general signage, a large whiteboard and sink wash-up area. The room was well lit by natural lighting from windows and overhead fluorescents. Participants had access to a nearby toilet block and an outside drinking fountain as and when needed. Student bags were left on hooks outside the main entrance. The general appearance of the rooms created interest to students from the colorful displays of posters plus other informative material and numerous artifacts of new or old forms of technology. Some of the artifacts on display were examples of student work from year seven and eight technology classes.

4.2 Classroom organization

The classroom organization during the technology activities placed participants in small groups of four members, (except in one group there were five students in two sessions), with a blend of gender and schools in each. During each session students displayed a coded identification tag attached to their uniform lapel by clip. All written work was similarly identified by their personal alphanumeric code. Participants were asked to work cooperatively throughout the activities, collaborating to investigate the technology challenges and negotiate through discussion their combined solution. Although some of the participants knew others from around school, they had not worked together before this program. Peer relations varied from those with some previous school contact to newly introduced and enthusiastic, to irritating. Attempts were made to encourage participant social skills each session through the shared purpose of solving the challenges. The participants' work was an active collaboration, reinforced by the teacher through formative dialogue promoting cooperative interaction and frequent attention to activity performance goals.

My administration of this study was to take the researcher-observer role. In this way, I would concentrate on observing participant behavior and ensuring details were recorded accurately. A teaching colleague, (Mrs B) offered to manage the participant activity, facilitating in the teacher role, effectively enhancing the qualitative content by providing a third perspective to triangulate the findings.

4.3 Teaching sequence

The teacher conducted each of the three sessions in an identical style following the steps set out in the program. All teaching was managed by (Mrs B), the teacher following the timing of the sessions described below.

The students were greeted at the entrance with their classroom teacher and welcomed to the Technology Centre each session on arrival. Notices and other instructions were explained at this time to formalize the commencement of the session. Pre-session briefings introduced staff to students and acknowledged the contributions they (students) bring to our activities from previous experiences. General program outline, safety guidelines and refreshment breaks are explained at that time. Once seated, audience-style facing a large screen in the assembly room, students had an overview of the technology challenge described and were invited to observe a brief film extract for the purposes of identifying anything that may assist with solving the challenge described at that time for the session activity. The introduction experience for students had dominating sound effects and a dramatic visual display. Each session students were reminded that the film presented the narrators' ideas and they had to decide the value or accuracy of the content for themselves.

The film material used for this research was sourced from the documentary '*An Inconvenient Truth*,' (Bender & David, 2006). The film is rated PG and contains general news style presentations of scientific phenomena, interspersed with actual archival footage of world climatic events. The pace of dialogue is relaxed, as the narrator reflects on his personal youth experiences, current professional and political responsibilities presenting this material to worldwide audiences. This film has been used previously with introductions for

technology classes of Year Seven and Eight students, during Term One 2008 to support a similar Climate Survival program.

The film extract was viewed on a large (1.5 x 2.0 meter) screen via data projector and surround sound system. In each of the introductions, an extract was selected to match content closely with the type of survival technology challenge participants would be working on: Session One, A Warmer World; Session Two, A Wetter World; and Session Three, A Windy World. Instructions given to the class each session by teacher managing the lesson was to consider viewing content to assist identify the technology challenge and generate group solutions. Identical questions were asked each session to prompt participant attention considering climatic conditions and identify potential solutions that might assist people survive. The first question asked by the teacher each session was worded:

1. *“What would it be like living in a _____ world?”*

(Session One: *“A warmer world”*; Session Two: *“A wetter world”*; Session Three *“A windy world”*),?”

The second question asked by the teacher each session was:

2. *“What are the survival needs that you can identify from the climate changes that bring more _____?”* (Session One: *“warmth”*; Session Two: *“water”*; Session Three: *“wind”*).

The topic of Climate Survival had been selected to allow students the opportunity to work with relevant material of contemporary interest in the wider community featured in recent news media coverage. There have been publicized responses in the news media identifying genuinely recognizable technological needs that would be suitable for students this age to consider. The perceptions of this subject are controversial at times with interest from established community groups. Therefore, differing points of view have been nationally discussed and a variety of information widely circulated in the media that many students could be aware of. The topic has the potential to attract a wide range of technological

solutions closely associated with factors that could affect life forms and life styles in crucially important ways that students could accept as authentic.

Unit planning of this program included two Technology Curriculum Achievement Objectives identified as 6b and 6d, New Zealand Technology Curriculum (Ministry of Education, 2005). Achievement Objective 6b was written as; The students will investigate technology solutions to meet the survival needs of a changing world, and Achievement Objective 6d as; The students will identify, record and evaluate their technological solutions with reasoning. The achievement objectives were kept to brief statements of what it was expected students could possibly achieve in the available time.

Session sequence and approximate times:

1. 9:30 Students welcomed to the Tauranga Technology Centre by staff, as this is their first visit to our purpose built facility. Acknowledgement of their valued participation in our research program to find or understand improved ways of teaching and learning technology topics. Declaration of confidentiality and right of refusal to take part at any stage that they might feel uncomfortable about this lesson.
2. Introduction to staff; Mr T Smith, (Researcher); Mrs B, (Teacher) and Mrs G, (Technician), that will be working with them during the three lessons. Essential administration details explained such as where toilets are located, fire exits, assembly points, first aid guidelines and general responsibilities whilst here. Students issued coded identification tags.
3. 9:35 Teacher, Mrs B then took control of class to explain organizational information regarding formation into class groups, sequence of events during lessons, worksheets, materials and equipment available for their use. Protocols for learning about new processes to ensure every person's safety is maintained and the equipment undamaged. Mention was also made that I would be circulating the room observing, taking notes and asking questions of students.
4. Teacher introduced topic and seated students in cinema-style arrangement to view an audio-visual film extract of approximately three minutes from the film, *An Inconvenient Truth* (Bender and David, 2006). In each of the three sessions, a short

section appropriate to the challenge activity was shown. Teachers' preamble prior to screening commented on possibilities from viewing the content; including scientific information, other peoples opinions and some scientific explanations for natural weather phenomena. The film also asked viewers to consider possible answers to survival questions for humans and other species on earth.

5. 9:45 Students were then directed to form into small class groups of four persons and move to stools at worktables for the next phase of discussing ideas and making their technology solution plans.
6. Students were asked to consider the topic as a technology challenge to investigate what things; artifacts, processes or systems might meet the survival needs of people at risk from the type of weather considered as climate change by some scientists.
7. 9:50 Teacher coordinated a whole class discussion, encouraging all ideas offered by students to be recorded on large blank sheets of A3 paper as a brainstorm, at each table.
8. 9:55 Small groups were then asked to talk amongst members about the ideas they are interested in or might consider possibilities for associated problems and their solutions, recording ideas on worksheets and sketching of what those ideas might look like.
9. Participants were observed throughout the sessions by myself, as a participant researcher, filmed by static positioned video, digital still cameras and voice recorded during individual conferencing as I moved around the room. I also took notes in a field workbook for later reference.
10. 10:00 Teacher distributed Discovery Kits for each group to inspect in the next phase of designing and constructing their technology solutions for 'climate survival'. The kits comprised a selection of battery-powered items, hard and soft materials that students arranged for construction of their ideas, (see list of materials). General stationary tools were available on the desks for each group such as; pencils, erasers, ruler, scissors, sellotape, gluesticks and bluetack. Suggestions to identify items discuss and consider possible use the materials might have for construction purposes were made by the teacher. The kit materials were briefly set-aside to reflect on their ideas and possible designs.

11. Participants were then asked to quietly record possible problems and solution ideas on their individual worksheets. This was intended as a time for reflection and prediction.
12. The groups were directed to develop a negotiated group solution through discussion and construction using the materials available from the Discovery Kit. Specific instruction was given in the use of certain hand tools. Participants were asked to think about the features or qualities desired for the solutions and the reasons for such. The term attributes has been used to describe the features of a solution. The teacher circulated amongst the groups encouraging, offering formative assessment comments and asking for reflective and predictive type explanations from students.
13. 10:15 Participants were asked to pause with the construction activity and take turns presenting their group solutions with explanations to the class. Questions have been invited from the audience for a solution performance comment.
14. As a summary form of assessment, in the latter part of the third session participants were asked to evaluate their group solutions for this topic challenge according to the underlying expectations of the stated achievement objectives. Directed to select pre-phrased comments that correspond to a rubric for one of three levels of activity, participants selected one rubric for each of the two Achievement Objectives and offered a blank space to comment on their activity. Rubrics have been structured at three levels; Spectator; Apprentice; and Expert. The blank spaces arranged in a similar three level structure. Candid replies will be encouraged from the students in responding to questions in worksheets.
15. Participants were offered several minutes to make any verbal comments they might consider sharing with the class at this time. Completed items may be taken home and unfinished articles stored until the next class.
16. 10:25 When class cleaning up the workroom two pairs of two participants were separately withdrawn to sit at a table next door, through closed glass doors to be asked interview questions about their work. (Figure 4.1, Appendix)
17. De-brief and interviewing of teacher took place at the end of each session by researcher asking set questions. (Figure 4.2, Appendix).
18. 10:35 Interval break time for staff and participants.

Note: this sequence is indicative of the first Session for these participants. In subsequent Sessions Two and Three, Procedures 1 and 2 will not be repeated. The additional time available will be utilized for extending the challenge activity development time by five minutes.

The technology challenge activities invited participants to attempt a range of open-ended tasks requiring a deliberate effort. There were frequent opportunities for researcher and teacher to identify characteristic highlights associated with: the nature of participant exploration with items available to use; sketch possible designs; investigating the processes used to alter or combine materials in different ways; construct and de-construct models. Student responses are not a certainty in any classroom environment, although from the type of behavior a teacher observes, interpretation might be made regarding the nature of students' interaction. In the classroom, student observation is the basis for formative assessment interaction that could be initiated by teachers scaffolding students to the next level of competence (Moreland, 2003). This opportunity for participants to work in an unfamiliar and visually stimulating environment at the Tauranga Technology Centre with tools and a supply of resources, visibly motivating. Any items constructed were available to be taken home at the sessions end.

Technology Session Intentions: to conduct three separate technology sessions of one-hour duration with a class of year six GATE students.

Topic: Climate Survival “everyone seems to be talking about changes in the weather these days creating survival situations for people in different communities”.

Student Achievement Objectives: technology curriculum goals for this topic were:

- A. Students will investigate technology solutions to meet the survival needs of a changing world.
- B. Students will identify, record and evaluate their technological solutions with reasoning.

4.4 Audio Visual Introductions

At the beginning of each session the audio-visual introductions summarized below were played to the class.

Session One

Technology Challenge Activity: ‘A Warmer World?’

Students viewed an extract of the film from 42:00 to 45:00, comprising the latter part of *Chapter Sixteen; The Arctic* and the initial part of *Chapter Seventeen; The Ocean Conveyor*. This extract displayed clear images of polar ice fields and the recent effects on permafrost layers to roads, buildings and other structures from warmer than usual climate conditions. Graphics simulating ocean and wind currents in relation to solar heating illustrated the conveyor belt nature of the world's heat transfer. There is an animated display of a polar bear having to swim long distances- an occurring consequence of reduced pack ice presenting viewers with direct effects of a warmer world. The important scientific concept from this film extract is related to solar heating of the world's oceans, melting ice and the associated heat convection transfer altering environmental conditions.

Session Two

Technology Challenge Activity: ‘A Wetter World?’

Students viewed an extract of the film from 52:00 to 52:40, being *Chapter Twenty: Antarctica*. Impressive images are displayed of the ice fields in Antarctica and Greenland identifying evidence of surface melt water. The dramatic effects of warmer temperatures are shown in the increased frequency of unstable ice shelves slipping into the sea. A distinction between sea ice and land-based ice is graphically demonstrated with ice cubes and two glasses of water. One glass has ice cubes in the water the second glass has ice cubes added causing it to overflow. The consequences of rising sea levels are shown by flooding to the homes of Pacific island peoples subsequently evacuated to New Zealand. The fundamental scientific concept of volume as ice displaces water introduced to the oceans from melting land-based ice fields of Antarctica and Greenland could likely result in a rise to sea levels

around the world. Vast communities of people living in coastal areas might expect a wetter world.

Session Three

Technology Challenge Activity: ‘A Windy World?’

Students viewed an extract of the film from 28:50 to 31:30 from *Chapter Twelve: Hurricanes*. Historical descriptions of recent hurricanes, tornados, and typhoons are described according to relative wind velocity and the damage caused to communities. The property loss and human death toll resulting from the 2005 Hurricane Katrina in the United States is graphically illustrated. Personal accounts from victims reveal the extent of human suffering that has taken place as a consequence of high winds. Satellite images of windstorms and cloud formations associated with these specific climatic conditions indicate the characteristic features that produce catastrophic effects. The weather concept of meteorological significance from this section of film is stated as the relationship between warm water temperatures and wind velocity in that warmer oceans tend to lead to stronger storms from recent experiences.

This chapter has described the research environment for the study, explaining how data was obtained in the setting at the Technology Centre. I have identified who was involved and the roles held by the participants. The next chapter presents the findings from each of the three classroom sessions.

Chapter Five: The Classroom Sessions

5.1 Session Introduction

5.2 Session One Challenge: “A warmer world”

5.3 Session Two Challenge: “A wetter world”

5.4 Session Three Challenge: “A windy world”

The previous chapter described where and how the study took place and established the research context. This chapter presents the data collected during the three teaching sessions. The perspectives of participants have been considered from their responses during and after the activities and examined to reveal what themes emerge.

5.1 Session Introduction

The first session began with introductions to staff plus essential safety and procedural guidelines explained to all participants prior to commencement of the activities. The technology room was an unfamiliar environment for these students requiring the wearing of covered footwear, ensuring long hair is tied back and identifying evacuation procedures such as fire exits. Research processes were clearly explained and questions answered. To maintain confidentiality all participants were issued with a coded nametag for lapels, worksheets and interview transcripts to be used in each of the three sessions. Each group had color-coded resource containers corresponding to the coded lapel labels worn, stocked with matching materials and equipment.

The film extract took between three and four minutes of viewing time for the introduction of each session. Each day the events of the one-hour sessions were video filmed from three separately located cameras and later transcribed for analysis. Participants were seated in rows theatre-style during film viewing. A verbal response was invited several minutes later after participants relocated to the adjoining workroom in small group brainstorming discussions. It was expected working relationships would form as group members attempted to achieve a negotiated technology solution in the one-hour available each session. All participants had identical opportunities to become constructively involved in processes of design resourced to construct a model of their combined ideas. Each session allowed a brief time for each group to recap and share their models with the class.

The teacher, (B), facilitating the sessions, followed the planned series of activities from: film introduction, on to individual and group brainstorming (this included problems perceived

from the film as well as possible solutions); discussion of potential solution ideas for the challenge; construction of functional model solutions; recapping with presentation to whole class of group solution; through to an self-evaluation of model suitability. There was no prior assessment to ascertain what knowledge participants had about the program topic.

5.2 Session One Climate Challenge: “A warmer world”

Participants quietly took in their surroundings for the first time in this unfamiliar environment, working with new staff and unknown colleagues, As one group, the audience intently focused on the large projection screen quietly viewing the film introduction. Directly after viewing the film extract, participants moved to an adjoining workroom where they were seated at small tables in the arranged groups. Group behavior was subdued and hesitant to begin with as participants became familiar with other members and ideas were shared. As they were getting to know other members in the group, students discussed things of interest outside the immediate topic task.

The teacher described the interaction as follows:

“Ah, they were initially quiet. Unfamiliar with each other I think would be why. Then they were quite verbal, talking and got more involved, discussing a lot of what they had seen in the film”

“Oh, um I noticed the different groups’ ideas they discussed, yep, they were writing things down on the big paper.” (Interview 3, Session One)

The Session One brainstorm ideas were recorded for Session One by groups on large paper sheets indicated brief survival solutions related to the problem of living in a warmer world. Ideas radiated outwards from a central cloud with Warmer World printed within the shape on all pages as per the teachers’ instructions. Linking of ideas was evident on some pages, with minimal explanation given in only four instances. Brainstorming produced a total of thirty-one ideas from the four groups. Sub-grouping these ideas; six ideas referred to the film extract, nineteen ideas identified problems associated with a warmer world, and six

ideas noted possible solutions to the climate challenge (Figure 5.1, Appendix). Some of these group ideas were shared with the whole class as the teacher asked for contributions from each group before moving on to the next phase.

The students' responses indicated that they recognized a genuine technological need. Strongly voiced participant views displayed empathy with other people and animals. In the Session One introduction a computer model simulation was included with narration to illustrate how warming ocean currents have reduced the floating pack ice followed by an animation displaying effects on polar bears resting during hunts. Participants commented that this was a problem because polar bears were dying and as a species were possibly facing extinction. The solutions proposed from a number of groups were aimed at re-cooling the polar region by inventive means, or re-locating polar bears.

The following are representative comments identifying technological needs:

“Um, to me it was kinda of practically polar bears and had no where to live and yea, drowning.” (TPS3) (Student Interview # 1, Session One).

“Um, I liked the bit about the polar bear, like how if they don't have ice they'll drown”, (GPS6) (Student Interview #2, Session One).

There was empathy recognized by the teacher in these comments:

*“There was the problem with polar bears a fair bit that concerned a few.”
(Teacher Interview #3, Session One).*

At this time the groups were each given an identical plastic storage bin containing a selection of materials suitable to construct functional models as a means of translating ideas into three-dimensional objects. These were referred to as Discovery Kits during the sessions and included a range of items for participants to construct a model of their ideas requiring minimal tool skills. Items included were; cardboard, string, blu-tac, tape, plastic sheet, soft wire, straws, assorted pieces of thin plywood and sticks of wood dowelling. The teacher gave clear instructions to inspect the materials; identify what was available; and consider how these might be used to represent their ideas for solving the challenge. It was explained that participants should work together as teams, sharing materials and discussing their ideas

to produce the best solution possible in the available time during that session. Groups enthusiastically investigated the items contained in the kits holding-up, passing around to others, twisting, stretching, spinning, flicking and drumming playfully. Participants moved closer together, huddling around the bins displaying increased verbal interaction describing, naming and suggesting possible uses. Handling items helped participants to consider possible designs and stimulated group discussion of what they could use in their solutions. A discovery phase is integral to this type of technology program prompting investigative or experimental exploration.

Instructions were then given to place items back into the bins for several minutes allowing time to record ideas individually on worksheets. Researcher and Teacher circulated around the room, observing students sketching and making notes of their ideas. Responses recorded on individual worksheets displayed what was considered “the main problem with a warmer world”. The classroom was quiet during this phase of the program as participants sat and carefully sketched or made notes, concentrating on their worksheets with only whispered conversation. Fourteen participants recorded personal comments interpreting possible survival consequences to communities from a warmer climate (Table 3.3, Appendix). Participants were also asked to record their individual brainstorming ideas in response to the challenge and a total of twenty-four ideas were noted (Table 3.4, Appendix).

A copy of a participant worksheet displays ideas considered for Session One with sketching of a possible technology solution is displayed below.

95

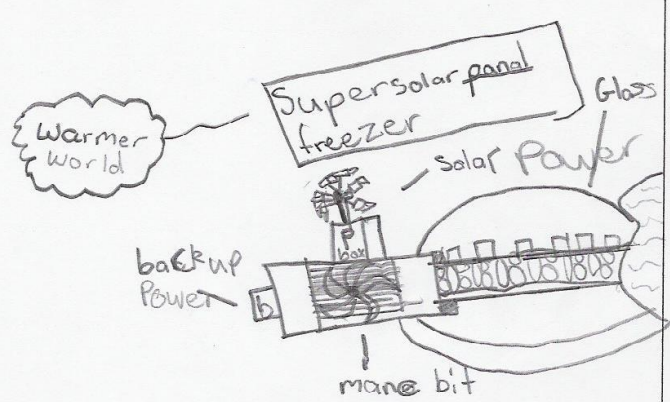
TS
 Student Code 605 5
 Date 15 04 08

Warmer CLimate Survival!

1. What would it be like living in a warmer world?

What are the survival needs that you can identify from climate changes when things feel warmer? What effect will this have on our food and drinking requirements in order to survive? Design and evaluate prototype things to help with our survival considering that some items we have now may not be available in the future.

Brainstorm all your ideas



What do you think is the main problem with a warmer world?
The main problem is the heat will kill

Figure 5.2 Student Worksheet Session One

The teacher gave the groups instructions to then attempt assembly of a model of their combined ideas into a solution that each group considered would best provide a survival solution for the challenge. It was noticeable amongst the groups how deliberate the effort

was to carefully consider what they might use. Individuals were hesitant to express their ideas and perhaps anticipating this, the teacher made encouraging comments to prompt feedback from individuals. Dialogue gradually increased amongst individuals and relations warmed through increased conversation when participants suggested possible uses for various materials and gave reasons to explain their ideas. Group talk, made mention of the fatal consequences of extreme climatic conditions.

“Animals will die because of the heat” (GPS8) “Trees die so there will be less oxygen. Because there will be no rain and the plants that we get fruit and vegetables from will die most times if the sun is too hot. If we don’t get enough cool air, it’s too hot for them and they will just die” (TPS5)

Circulating amongst the groups, a noticeable feature of the dialogue was the continuous questioning of what specific things could be used for and the shared answering as the group models evolved into a design that had been progressively developed through consensus. A copy of transcribed conversation highlighted small group interaction as participants worked with materials combining design attributes of their solution ideas. In this discussion Blue Group were making their model of a device to transport fresh water.

“We could use these for, and then have those bits.” (GPS4)

“It might float. Okay, but the other parts could attach for,” (GPS6)

“If you had that standing. What about the box?” TPS6)

“There’s nothing wrong with rope.” (GPS4)

“It might be in the wrong place.” (TPS6)

“Maybe with a bit of blue-tac. Probably. What’s something that could make it waterproof?” (TPS1)

“Just let me show you. Let me show you.” (TPS6)

“It’s nearly attached to it.” (GPS4)

“We’ve got to have some more.” (GPS4)

“What are you using?” (TPS7)

“That’s only going to hold it in place.” (GPS4)

“It’s got to go through there and then tie it.” (TPS7)

“Can you get some more blue-tac?” (GPS4)

(Transcription from Camera Two, Session One)

Each of the groups managed to begin with a set of ideas that they slowly adapted by selecting or rejecting to pursue the construction of a negotiated model item. The range of design and construction skills varied from competent to reluctant, but each group cooperated to enable things to progress to the point where a representative from each group could recap and present to the whole class an overview of their collaborative solution. This process had taken approximately twenty minutes, during which time conversation amongst the students in each group became more animated as gesturing accompanied an increased noise level.

In the final fifteen minutes of the session, each group presented their model solutions to the class with a brief description. A lead person, often assisted by another student with confident verbal skills had emerged from each group during the earlier activities. This person was prepared to stand up and describe the assembled solution. Models had been quickly put together using materials available (plastic sheeting, cardboard, thin pieces of plywood, Perspex, etc) using temporary fastenings such as: sellotape, blu-tac, string, wire or hot glue. Model designs displayed improvisations used to illustrate design or construction details from discussion.

A consistent theme that emerged from the participants’ discussions was a concern for polar bears plight as a consequence of melting pack ice in the northern polar region. The teacher felt there were indications of students’ prior knowledge in the areas of: global survival implications for humans, plants and animals; water recycling; pollution and energy. The tendency for lateral thinking, referred to as thinking *“outside the square”* (Teacher H, Session One Interview transcript) was observed in the group discussions.

Issues identified by students within discussions and recorded on group worksheets included the following:

1. A perceived relationship between water and life forms (animal, human and plant) and that loss of water due to heat may lead to death
2. A warmer world is related to sun effects
3. Ocean water levels will increase from rising polar temperatures and melting ice
4. Food production will be affected by increased temperatures
5. Water quality will be affected by temperature increases
6. Uncomfortable living for life forms in a hotter environment on earth

All group solutions related to the audio-visual introduction by suggesting cooling devices (Table 3.5, Appendix). Water issues and ocean warming were presented as potential climatic conditions that could impact on human and other species survival in the introduction content. Groups constructed technological solutions to meet the session challenge describing the particular needs they saw for their design.

Interview comments

At the end of the session, as the class tidied the workroom two separate interviews each session were held at a table through closed glass doors in a room adjacent to the workroom, where the film introduction had earlier taken place. During the interview, students were asked if the film had helped develop their ideas.

Yea, because it just gave us lots of ideas and helped us to think and well if that's what the sun is doing and how could we use the sun for our solution",
(GPS6, Interview # One Session One).

The recall of images led participants to mention how they felt about animals affected by climate changes.

“Um, I liked the bit about the polar bear, like how if they don’t have ice they’ll drown, (GPS6). Um, I liked the part about the sun. The sun is melting the ice, (TPS6).

The teacher made comments in Session One Interview that confirmed that the introduction offered interesting information for participant discussion. She remarked that the scientific nature of participant solutions related to what they saw as survival problems.

“Students, students were actually looking outside the square, coming up with ways to replace the ice that was melting. Different solutions to do that. In the film the narrator discussed about the global nature of the problem and some students actually put that into their solution. You could see some ideas about that in the sketches.” (Teacher Interview Session One).

5.3 Session Two Climate Challenge: “A wetter world”

The second session was conducted over the identical one-hour time frame, commencing at 9:30 am when participants were greeted and welcomed into the first room to sit theatre style for the film introduction. The film introduction was viewed without distracting information and presented the differences between land and sea ice with regard to the effects this has on ocean or sea levels. Scenes of Greenland and Antarctic ice fields were shown explaining the phenomenon of moulins as well as documentary footage of Pacific Islands affected by rising sea levels. A simple demonstration of water volume displaced by adding an ice cube to a glass of water was compared to the changes to continents with existing ice fields after these slide into the water. This graphically demonstrated a possible climate change on coastal habitats with an increase in ocean levels being the likely result. The audience was silent in their seats during this time apart from one exclamation of “*Wow*”, (GPS8). Audience behavior was similar to that in Session One, of intently listening to the sound track and being visually focused on the film images.

A significant coincidence occurred the previous evening of relevance to this session. The teacher and I both commented that we had experienced first hand what it might be like living in a wetter world. There had been a thunderstorm with considerable flash flooding locally that students would have also experienced. The participants were invited to recount their experiences of that same weather the day before.

“When we came home last night the water in the drains and the curb bit the water was flowing and the car was wet”, (TPS5

“Down from our street the water was that high”, (TPS4) student held hand up approximately waist high.

“When I was driving back from school along Welcome Bay Road where the hill is, the water was all flooding and they had to like the drains were going like that” (TPS1) Participant gesturing with open hand waving up and down as whole arm movement.

“Yesterday when I came to school the drains were overflowing the gutters” (TPS3).

“Just yesterday when we went to pick up my brother from Tauranga Intermediate, that little estuary there, the water was practically over the mangroves” (GPS8, Transcript Camera One Session Two).

This was an interesting coincidence, reinforcing the view of technological need for climate survival solutions with a first-hand experience. The Technology Teacher, (H) asked the class to consider what it would be like living in a wetter world, then proceeded to remind them to share their ideas in group discussion.

The teacher explained that Session Two would be similar to the previous session activity, with a slightly different challenge. The timing for work processes, recapping group activity and the presentation of solutions followed similarly phased schedules from Session One. The challenge scenario ‘*A wetter world*’ was then read aloud to the class, by the teacher. The small groups commenced to discuss the challenge of a ‘wetter world’ identifying the main problems and planning possible solutions. Ideas were recorded on large blank A3 sheets of

paper at each table. Ideas radiated outwards from a central cloud with Wet World printed within the shape on all pages. The teacher allowed opportunities to explore ideas, develop understandings and evaluate any ideas they shared. Interacting within the peer groups, students practiced skills of explaining ideas and opinions, respectfully listening to others and able to respond constructively (Cathcart, 1998). There were individually unique styles displayed when peers interacted to discuss, consider or combine ideas during the brainstorm phases, and when working together on construction of models. Frequent instances of humor and laughter accompanied the more serious or strenuous endeavors.

The students worked actively together in their small groups and engaged in designing or developing an integral aspect of the challenge solution. Discussion amongst students was an essential aspect of each session. Students discussed things of interest outside the immediate topic task and when a new student joined the Yellow Group, relationships formed initially in Session One altered. An original member displayed attention-seeking behavior by making nonsensical noises, waving and throwing small items around to annoy others in that group. Unfortunately, this occurred several times, when the group was discussing detailed features of a prototype design. This participant coincidentally increased his errant behavior when others in the group ignored him, which may have been a strategy for gaining acceptance or participation.

A change in Yellow group personality dynamics occurred when the fifth member joined in Session Two and Three, bringing leadership skills. The performance goals of the Yellow group lifted in complexity and the spokesperson appeared to manage contributions from members to overlook the less productive member. Aware of this change to group performance, the teacher asked formative questions for inclusive peer contributions. By directing forward-looking feedback the teacher attempted to activate participant motivation for learning (Sullo, 2007).

Yellow group made adjustments to accommodate an additional member, (TPS9) who had not taken part in Session One raising their number to five. It had been apparent earlier, that

amongst members of this group personal dynamics displayed instances of irritation. Aware of comments that might impede co-operative interaction the teacher had adopted a questioning strategy to direct involvement from all members towards a negotiated development. The fifth member contributed a calm leadership influence, assisting with formative aspects, progressing individual ideas towards an adopted group design for the prototype model.

Similar to the previous day, participants were invited to share group brainstorm ideas with the whole class prior to inspecting the contents of the Discovery Kit. Confidence to offer ideas verbally and conversation amongst students was noticeably increased in Session Two. Brainstorm ideas discussed by student groups indicated a number of imaginative solutions related directly to the topic of having to live in a wetter world. The ideas displayed technological features in the type and style of development with deeper reasoning and supportive explanations from the Session One efforts.

A total of twenty-nine ideas were recorded on the large papers from all four groups (Table 3.2, Appendix). The introduction to Session Two told the story of people from Kiribati, a Pacific island being relocated to New Zealand due to flooding from the rising sea levels which students responded to by designing both floating and underwater homes.

Summarizing both perceptions of the challenge and group solution by the comment:

“Cause most of the houses will be under water. With this you will be able to basically have a house that floats. So if it rises, your house then it will go up with it” (GPS4) (Transcript Camera One, Session Two).

Participants were quick checking out all the materials to be found in the Discovery Kits, commenting on several different items from Day One. They curiously removed each piece, describing and naming those they recognized or asking for names of others. Items were closely viewed, turned over in hands and quickly passed around the group. This ritual similarly took place at each of the four groups in an excited style. It was noticeable that at various times the participants sat or stood, leaning over the tables listening to softly spoken

comments from peers and intermittently speaking responses. Discussion was active with many individuals talking at the same time, identifying items available and what they might be used for. Expressions were animated by participants transposing ideas onto different materials with explanations of how these could be used for construction of the Day Two solution. The volume of conversation was loud and comments carried tones of insistence. At the Red group table, conversation transcribed from the video recording illustrated behavior when students constructed model features for a device to vacuum water to an aircraft transporter and remove to another location.

“How can we make a plane or something out of that?” (GPS2)

“Yea, and then we could fold it like this” (GPS8) student then demonstrates his idea.

“Do you think we could use these? It’s plastic pieces” (TPS3)

“We could make you know it’s like a thing that sucks up water. A nature thing, with a tube, like this” (GPS2) student holds material up to show others what she intended for a feature on the group model.

The teacher complimented the class, *“The ideas I am hearing are fantastic. I can see we’ve got some inventors in this classroom, this is fantastic guys!”*

In further encouragement the teacher said, *“There are some different things in your container. Are you going to use them in your solution?”* (Teacher (H), Transcription Camera Two, Session Two).

Participants’ behavior was active handling items in the discovery kits, viewing the components and moving quickly on to the next item. The items were then returned to the kits and brainstorm ideas and sketch plans recorded on individual worksheets. It was quiet during this recording time and any conversation amongst students was whispered.

Comparison of ideas and sketching was noticeable by students looking over others’ worksheets before going back to their own records. Individuals acted physically comfortable moving into other participants’ workspace during this time. A sample of a Session Two participant worksheet is displayed below.

R9

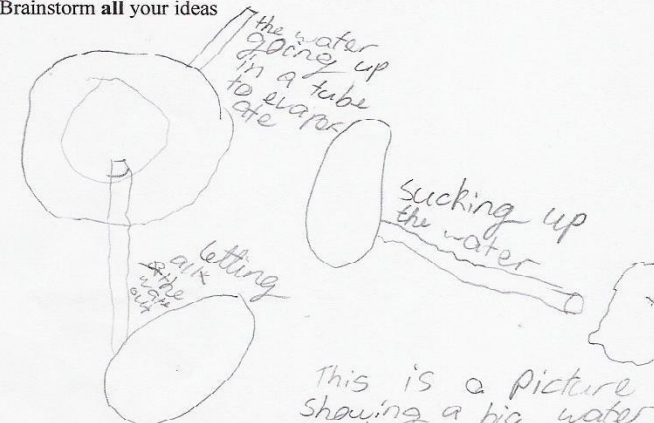
TS
 Student Code E9 TPS 8
 Date _____

Wet CLimate Survival

2. What would it be like living in a wetter world?

What are the survival needs that you can identify from the climate changes that bring more **rainfall** each month?
 What might happen if there is too little rain or perhaps too much rainfall?
 Design and evaluate prototype products to help our survival in the future.

Brainstorm all your ideas



This is a picture showing a big water cleaner sucking up the water and letting it out in a big tube and then there is a big pipe sucking it up for it to evaporate in to the sky

What do you think is the main problem with a wetter world? *that lots of people will die and lots of animals will drown*

Figure 5.3 Student Worksheet Session Two

The teacher specifically asked the groups to concentrate more on sketching their ideas for Session Two, to get more of their ideas down. Fourteen worksheets from the seventeen

participants recorded responses to the Main Problem for this session challenge (Table 3.3, Appendix). It was noticeable that several worksheets presented complex diagrams with arrows, labels and explanatory notes. Participants looked over to their peers' pages to see what others were planning. Inspecting worksheets later, it was noticeable that there were three times as many ideas recorded in Session Two, (47) than in Session One, (15) and almost as many in Session Three, (43). The ideas displayed numerous design qualities associated with the film introduction, but possibly enriched by an experience of the local storm, and technology activity (Table 3.4, Appendix).

A noticeable trend from participants' ideas in this session was an increased number of possible solutions for the survival challenge as compared with those generated in Session One. There were also indications of an increase in the quality of explanations for possible solutions discussed in Session Two compared with the previous session. Comments from the teacher interview substantiated the increased verbal interaction amongst students during this session:

“I did notice today, more than yesterday, there was more discussion coming when it came to the brainstorming like lets just talk about it for a minute then off they went. There was noticeably more discussion, but that could be put down to the fact that they actually knew more students and were more comfortable to start with. So there was less of that hesitation awkward moment. But I moved around the room and there was little, less instigation than I had yesterday to get them moving because the ideas were just fact. Today I let them go longer than yesterday and actually I had to say that’s enough now let’s move to the next thing.” (Teacher MHB, Interview # Six Session Two).

There were a number of creative ideas displayed by group discussion such as retractable walkways between floating homes, rocket tankers, and holes in the sea. General interaction amongst the groups was suggestive of recent peer familiarity, an increase in acceptance for group routines with the shared purpose of the technology challenge and the interruptions

from my presence. The monitoring of video cameras and regular photographing of the activity remained occasionally distracting for several students.

The teacher gave the instruction for participants to assemble a model of combined ideas that each group considered would best provide a survival solution for the session challenge. Individual initiative and differentiated roles were more noticeable amongst the groups in Session Two. Delegation of particular tasks within the groups and collaboration seemed strong between same gender pairs. The non-verbal collaboration observed between individuals in two groups, (Blue and Red groups especially) during particularly hurried construction involved the use of alternate hands, assembling model components. Leadership within the small groups was more pronounced, especially in the decision-making and spokesperson roles in this session. The sense of urgency to complete models had become a priority for the groups, even though there was no overt mention of competition within the discussions. Intense concentration took place as Red Group worked through design features to develop their solution, taxing the patience of some individuals as construction arrangements were negotiated, debating material qualities for design suitability of a model that would pump water into a type of reservoir to overcome flooding.

“This piece here goes up like this and do we have any rope? Below it so the water can flow out.” (GPS8)

“Will it be strong enough to catch it all? Maybe it has this part here” (TPS3)

“And catch it here” (GPS2)

“No that’s not right because, look this part here is solid and this is hollow, see” (TPS8)

“Yea that can be done, I’ll tape it up” (GPS8)

“Put the piece in here” (GPS2)

“It’s meant to be seen, so all the water it just fills it up here” (TPS3)

“We missed some parts here, the water will,” (GPS8)

“I don’t know, it will stand there, a little bit, just slice a bit here. So it fits better” (GPS8)

“The pump in there and how we gonna do this?” (TPS3) (Transcript Camera Two, Session Two).

The energy and application in the Session Two, model construction was considerable. Activities had been planned to be open-ended and as participants became aware of further possibilities for the models, efforts were directed at exploring various material combinations or alternatives. An initial means of attachment replaced by a modified design or additional fastenings during the developments. Shapes were considered, reconsidered and changed to suit ideas reflected on through trial and error or recalled experience. There was a high level of experimentation with different material combinations amongst the groups.

The activity displayed a significant increase in all aspects from the previous session with higher sound levels and numerically more ideas generated in both group situations and by individuals. The demonstration using ice cubes in a glass of water was understood as a physical concept that participants identified as a problem from displaced continental ice presented in the film introduction. All four groups made reference to rising ocean water levels in their technology solutions (Table 3.5, Appendix). Several groups designed underwater dome homes as part of underwater cities and in one group floating homes were joined by retractable walkways. The proposed solutions offered technological means of living above or under the worlds’ oceans, incorporating water purification or breathing systems.

Students made choices for their work in a procedural context to discover suitable materials and collaborate on processes useful to realize solution designs. It was an ongoing process of investigating exploratory choices, evaluating the outcomes and repeating steps to complete items indicated in this conversation.

“Put it on the side. I’m going to put it on this side.” (GPS6) *“Oh, look what he’s making.”* (TPS6) *“Use this and this”* (GPS6) *“Yea”* (TPS1) *“Make this glass thing”* (GPS4) *“I’ll hold this and put your part on”* (TPS6) *“Anyway, the whales won’t get it”* (TPS1) *“Blue tac. Could you use another to hold*

it?” (GPS4) “Uh, just stand it back up” (GPS6) “Oh, where’s the cord?” (TPS1) “So hold it and fit the sticks on here so,” (TPS6), (Camera Two, Session One).

Manipulation of materials provided in the discovery kits in this recording by Green Group, shows collaboration in the participant dialogue during development for model design features with glimpses of their reasoning to justify design decisions. On closer inspection it appeared some participants were involved in trialing their ideas and receiving feedback from peers in the small groups, making modifications to refine prototype developments. The opportunity to learn from mistakes and successes became a dynamic process, as discussion prompted individual reflection to evaluate the design suitability of model construction. Creativity and imagination are involved when students explore the possibilities for realizing their ideas in physical form (Hill, 1998).

As students described how their models should be built there were comments explaining what different features would do to solve the climate survival challenge. This reasoning process contributed to forming views on the group design brief including model details in each session. Consider this example from Yellow group, as scientific reasoning, (TPS5) combined with decisions regarded the importance of physical designs during the model construction involved participants in ongoing evaluation, (TPS9) of how certain parts of their design would eventually work. The design being constructed here was for a large-scale pumping of surface water into the earth core to evaporate at high temperatures similar to processes naturally occurring by the atmospheric water cycle. Disruptive comment repeatedly made during this discussion by a member (TPS4), without any explanation as to how his idea might work in the model.

*“We’re trying to have this part move up when the water goes” (TPS9)
“Force field, force field” (TPS4) “It could go like this. That’s the hole”
(TPS9) “There will be a cycle then. Use that” (TPS5) “Okay” (GPS3) “It
would speed up the evaporation cycle” (TPS5) “Then the water will go in, so*

it will be a cycle. The water would be up in the air”(TPS9) “The water we will need it, will go up the pipe at the same time as the evaporation, so it would be balanced” (TPS5)

“Yea well. Would that be better?” (TPS9) (Transcript Camera Three, Session Two)

The technology challenges were accepted in earnest by participants with an understanding of the responsibility for making choices in their work. An opportunity to make design or construction choices also offered individuals input to contribute in a manner complimentary to group goals. Although part of a GATE class, the unique character of each participant was evident by their individual behavior as they worked with peers towards self-set goals and having fun whilst learning (Glasser, 1990).

Issues identified by students both within discussions and recorded on group worksheets included the following:

7. People will drown from increased water levels
8. Ice will come down from polar regions when it melts
9. Tidal waves will flood coastal areas
10. Animals and plants will die from too much and dirty water
11. Droughts from no rain
12. Extra drinking water available
13. Water cycle will be affected
14. Food supplies will be flooded
15. People will live on houseboats

In the latter minutes of the session a spokesperson from each group presented to the class a model for their combined survival solution with accompanying explanation. In turns, a spokesperson or pair described what they had designed and how it might assist solving the climate challenge. The audience listened quietly, acknowledging by way of congratulatory applause after each presentation. The transcription from the class presentation by Green

Group reflected the results of determined collaboration amongst four members, explaining purpose in model design, (TPS1). The solution design is claimed to solve the climate survival problem, of a wetter world, introduced in the film extract in two ways, (GPS5).

“Our one is an underwater dome and we’ve got these little ones around the bucket and then we’ve got. So you can see in. Cut them so you can go. This is a dome city where you can live and it would have a pipe to the surface for oxygen” (TPS1) “Um there would be platforms on the top on barrels on the top. Rockets would land and take water up to space and put it back up there because it can’t fit in the world. With gravity it wouldn’t fall down. So it wouldn’t overtake the countries. I’ve got two things with the rocket something that could use it as an evacuation rocket. It solved two problems” (GPS5) (Transcription Camera Two, Session Two).

Descriptions of the solutions including complex technological concepts with purposeful function were explained economically by a spokesperson on behalf of each group. Examples of student ideas included; floating homes linked by walkways; integrated plant and animal life-supporting underwater dome homes; large-scale sub-terrain water evaporators; and rocket water tankers transporting surplus water and people to outer space. Critical examination of these solutions was beyond the scope of this study and the teachers’ comment was made: *“That we will have to look into that idea a bit further to find out more.”*

Interview comments

In the Interviews, an increased level of reasoning can be seen by the comment in response to the questions. At this time two separate interviews were carried out with two participants from each of two groups.

In response to the question: *“What ideas did you talk about with other people in your group?”* (Figure 4.1, Appendix) two students have described the consequences for agriculture from climate changes that might cause water shortages.

“We talked about how the crops and plants that we need to eat are dying will die if they drown, (GPS1) Um that the animals like cows that we have meat from for a balanced diet and if we don’t have the animals then and also selling them if you’re a farmer makes you money and that makes your world go round and secondly we talked about if there is not enough water then we will die and we will have more droughts and too much water we will have tidal waves and floods,” (TPS5, Student Interview # Five Session Two).

Participant responses to the introduction indicated they found interesting information that prompted their thinking. There was recognition of big ideas involving scientific concepts associated with the global nature of climate.

In the interviews after each session, one of the questions all participants were asked: **“Did the film help with any of your ideas?”** (Figure 4.1, Appendix) to describe their impressions from the introduction. The repetition of an affirmative reply could be an indication of student positive agreement with the question that the film used for the introduction in their view helped in some way with brainstorm ideas. During the interviews pauses gave relaxed opportunity for students to say what, or nothing of what they may have been thinking.

“Yea, sort of stuff to make you think about things”, (GPS4) “Probably, it was interesting and yea”, (TPS2) (Student Interview # Four, Session Two). “Yes”, (GPS1) “Yea”, (TPS5) “yes it was interesting”, (GPS1) “some of the bits were a bit big some of the words were a bit big and as we are only year sixes we haven’t come across those words before,” (TPS5) “Yes”, (GPS1) “Yea, that’s what helped them, me understand the text and um, what he was saying easier” (TPS5) (Student Interview # Five, Session Two).

In pairs, dialogue was relaxed and flowed smoothly between interviewees who were familiar from the collaborative experience of the session. An interview was held with the teacher

after the participants had been dismissed that confirmed a number of my observations. The teacher reflected that parts of participants' work related to the earlier film introduction:

“Well they picked up largely on that the increased volume of water. Which there were other things in the movie also being emphasized. But they seemed to hone in on that. What they have thought is the fact that they because the extra volume of water, I felt that, may have come out of ideas connecting with the fact that there were big caverns.” (Teacher (H), Interview # Six, Session Two).

In a group situation the constructive comments and procedural choices comprised the accumulated understanding that led to a successful group outcome. Teacher comments during the interview in Session Two, gave an insight into the Blue groups' challenge solution.

“So the solution that one of the groups picked up on was the floating house idea that they started off with a street. You know houses just around here so if it flooded they could rise and then go down. Okay so then that went to there could be houses around the world. But they “said there’s already houseboats there now how are these different?” But you live on them all the time. That’s why that electrical thing was underneath for water circulation. I think they thought all year living as a permanent. And did you see that they came up with walkways that would when houses got closer together a bridge would walkway would develop so you could actually get to the next house. That was really interesting that it would just, it would be something a distance like this that it would actually. When they got closer an imaginary walkway would go there. You could use it to go to the next house. So I imagine the same thing it would retract when they moved away. So I thought that was quite amazing.” (Teacher Interview # 6, Session Two).

In the teacher's interview, a comment was made to confirm participants had reacted to the perceived survival need presented in the introduction.

“Many of them chose the fact that the water would rise and they were associating their solutions to do with that. Either a floating house that would move as the water rose or building an underground city. Because there was going to be more water and less land.”
(Teacher Interview 6, Session Two).

The teacher had recognized a connection between the participants' responses and images seen in the film of moulins. These images were of caverns in continental ice fields caused by melt water flowing through the layers of ice which passes out to sea under the ice mass. The effect of this extra melt water flowing into the sea was described by the narrator as making the change in ocean levels noticeable in coastal countries. Film images discussed by participants in this session were found in their inferences and two of their design solutions. Firstly, floating houses connected by walkways, and secondly, the suggestion that a giant hole through the ocean to the earth's core could allow water to flow down where it would be evaporated by high temperatures. Further explanations of both solutions were supported by participant descriptions of how these group designs could work.

5.4 Session Three Climate Challenge: “A windy world”

The third session was conducted as the previous sessions beginning at 9:30 am with greeting and entry to the first room for the film introduction. Participants were enthusiastic, some laughing and making conversation amongst the group about a range of topics, including what they were going to make that day. It appeared overall that the groups were more familiar and comfortable with peers this session. The film introduction screened for a similar length of time, approximately three to four minutes from the title used in previous sessions. This particular extract presented a scientific description and historical examples of hurricanes with detailed satellite images of cloud formations that led to windstorms. The destruction and death toll resulting from the 2005 Hurricane Katrina in the United States of

America included news footage and was supported by the personal accounts of eyewitnesses.

The weather concept of meteorological significance explained by animated modeling displayed the relationship between warm ocean temperatures and wind velocity as a phenomenon that often leads to storms with tragic consequences in certain locations. The content of this extract was recognized as having links closely related to survival technology needs from the two previous challenges. The survival challenge on Session Three, *'A Windy World'*, presented aspects of the previous two challenges with the warming effects on the ocean generating strong winds plus the resulting rise of ocean levels from the storm as seen during Katrina causing widespread flood damage.

Participants followed identical procedures for the small group brainstorming of related ideas through discussion and recording all ideas on blank sheets of A3 paper at the tables. Discussion was animated amongst the groups with instances of loud comments, gesturing by way of arm movement and noticeable criticism of peer comments. Occasionally impatience was displayed from group members determined to continue with physical activity constructing models. Negotiating each step of design and construction required patient application in collaboration with other group members. It was noticeable from analysis of the papers that there was a large increase in the number of ideas recorded, references made to the film and the type of problems identified between Sessions One, (31) and Two, (29) with Session Three, (50) (Table 3.3, Appendix).

One particular student explained she had cousins living in the region at the time of the Hurricane Katrina tragedy. The realization of genuine survival needs for this type of weather produced a number of innovative solutions. Participants appeared to be motivated by a real concern for others' welfare.

"Yea um, well we talked about the houses, yea sinking into the ground so that it they wouldn't get destroyed if they saw a hurricane. Um and we talked

about the winds power and things it could do and some of the solutions,”
(TPS7) (Student Interview # 7, Session Three).

“It showed what it looked like after the hurricane, (TPS9) Hurricane Katrina, because my cousins got hit by that in Florida. And I, um, I heard about it. I heard about that and their house got wrecked, (TPS8) (Student Interview #8, Session Three).

“What I saw was I think that quite a few of them had compassion for the situation from the destruction that winds bring.” (Teacher Interview #9, Session Three).

The significance of identifying authentic needs for justification of participant ideas and actions cannot be underestimated as powerful motivators. This was how they saw it and the film images were discussed frequently during the session. The contribution that affective emotions whether from concern for fellow humans, polar bears or the environment were closely related to personal views voiced in participant discussion.

Following the planned routine of the technology sessions, students inspected the contents of the Discovery Kits, replenished with some additional materials different from previous sessions. Additional materials included a plastic bucket color-coded to match each group designation, four one meter pieces of plastic hose, hose clips, selection of cable ties and assorted pieces of rubber foam. The students' responses when viewing the Discovery Kits had progressively changed. There was anticipation to see new content that might fulfill their intended design or construction purpose. Conversation and rapid searching through the kits indicated participants had an expectation for resources to support their design ideas. In each group there were one or two students that adopted the role of closely scrutinizing materials available in the kit. These members often gave directions to others for potential uses of each item. As participants handled the materials it became noticeable that with familiarity of items used previously, the exploratory manipulations appeared as play. The movement or activity with various items seemed exaggerated and irritating to peers, (Yellow Group). This was in contrast to earlier sessions, when the handling of materials was cautious or tentative,

as students had patiently contemplated various possibilities. A sample participant worksheet from Session Three is presented below.

*use

TS
 Student Code AM GPS 2
 Date 17 4 08

Windy Climate Survival!

3. What would it be like living in a windy world?

What are the survival needs that you can identify from climate changes that create very **windy** weather? What effects will stronger winds have on our living and working conditions? Could this wind be helpful in any way that the community might benefit from? Design and evaluate prototype products to help our survival in the future.

Brainstorm all your ideas

wind turbines to power city inside dome.

giant dome made out of

perspex holding from inside by their will.

door to the outside world

carbondioxide holes to let carbondioxide out

oxygen holes to let oxygen in.

city inside dome

the cooler power plant

recular radiators to project a second air mass above to protect earth from hurricanes etc

What do you think is the **main problem with a windy world?**

1

Figure 5.4 Student Worksheet Session Three

When instructed to replace items back into the Discovery Kits and address worksheet planning, (unlike earlier sessions) it appeared that several items remained out on the tables. Participants were intent with their sketching and making notes. The appearance of individual sketch designs was less precise, and notes supported ideas with some detailed explanations. Responses recorded on individual worksheets for Session Three, asked to identify the main problem with a windy world was indicated on only one worksheet from the total of seventeen participants (Table 3.3, Appendix). The absence of data collected from this section is a contrast to that produced by participants in other sections. The total recordings of individual brainstorm ideas were forty-one, on worksheets from the seventeen participants (Table 3.4, Appendix).

It was noted how active and involved participants were discussing and constructing their survival solutions. Despite being reminded by the teacher to complete this section of their worksheet it was overlooked in the busy endeavor of hands-on with the materials, a significant attraction for this class. Their solution sketches focused on meeting a particular survival function, whether that was to divert, shelter from or generate power from wind. Group activity in Session Three could be described as dynamic. Continuously seeking to try out design ideas, participants handled materials and discussed construction options attempting to create a solution for the challenge. Although there were obvious attempts to build functional model devices, specific operating systems were enthusiastically described in conjunction with actual artifacts the groups had constructed.

The nature of participant interaction commented on by the teacher and participants themselves identified specific collaborative dynamics with each technology challenge. The concentrated inquiry style program socialized participants through the shared processes of developing goals iteratively self-evaluating their progression. The efficacy of this approach combines fun with intrinsic learning motivations of students wanting to work alongside peers (Sullo, 2007). Here is an example of Red Group resolving a design concern over which idea was more suitable and how it would function.

“My idea is a wall that goes into the ground. Still there is a kind of bar things that makes the wind go through it to make it calmer. Then it would have four walls. It’s practically my idea. That’s huge, Atlantic ocean huge, colossal. Practically, it could go with my idea and it could come out of the top. And what about a tornado? You could have one around each, anyway, around your town.” (GPS8) “It could have a fan on it to suck it up” (TPS3)

“It did have something like that too”, turns over her work page looking at other side, “Mine was a big sucker” (GPS2) “We could go with your guys’ idea. A humungus idea powered by a nuclear power plant.” (GPS8)

“I had the idea of like a door gate that makes the wind go through it” (TPS8)

“In the dome the wind goes over” (GPS8) “It could be an extra” (TPS3)

“Well a tornado fan in the air, and then comes down so what protection does her idea have from on the top?” (GPS8) “Yea but this doesn’t really stop the air, it sort of goes through” (GPS8) “Well what should we make?” (TPS3)

“It could be a really big thing, with slits in it that the wind rushes through” (GPS8) interpreting an earlier idea from TPS8. “If we cut this in half then that piece could be the base. But what will we make it from? This?” (GPS2)

(Transcript Camera One, Session Three).

In each session, participants were asked to attempt a series of steps encouraging them to work closely together. The brainstorming discussion, shared description of planning ideas, negotiated goal setting and producing a group prototype model. There were fundamental tasks that required students to record their responses, steps that involved sketching, and noting ideas for reflective evaluation aimed at consolidating understandings. However, these steps were invitations rather than demands, asked, not insisted upon. The participants were not coached on how to answer any challenges during the activities. The teacher circulated in class sessions asking strategic questions, frequently providing formative feedback to build group understandings through cooperative group interaction.

A quotation that was characteristic of dialogue, in Session Three indicates the complexity of design detail participants considered in their discussion supporting model suitability for technology purpose, to solve the climate survival challenge.

“Well this is just a bucket to represent the ground and this is a sensor if there is any hurricanes or strong winds it starts beeping. This is the oxygen tube so if hurricanes come. Strong winds blow rubbish it might catch on the tube and stop the wind coming in and you can clear it after the hurricane is over. And, and the underground house, the tube will get rid of the smell. There will be a fireplace to cook and it will have toilets and stuff underground and beds and stuff” Student holds up the groups’ model showing class. *“There will be a fireplace underground. This is the chimney. It will be like a tunnel. This is the hallway. This is the kitchen. There will be an oxygen thing. It will generate power by fire and by batteries. It will help us and there will be water in it.”* (TPS5) (Transcript Camera One, Session Three).

There were requests for additional materials to the items available in Discovery Kits when participants explored opportunities to expand upon their original designs when constructing models. It became noticeable that individuals were reaching a skill level of their practical capability beyond which they were unable to safely manage the fabrication of integrated design ideas. Students had no prior experience with electric drills or saws, soldering irons and sequential fastening processes that required increased confidence and limited risk-taking. There were instruction and demonstrations provided to all, however the choice for each individual if an items would be used. The participants discussed a number of complex ideas to solve the challenges for which they had limited means to produce in the time available.

Issues identified by students both within discussions and recorded on group worksheets included the following:

16. High winds bring big waves
17. High winds could blow leaves away

18. High winds could generate electrical power
19. A gate or dome-shaped home could deflect wind
20. Living underground would be safer

Ideas presented on previous days were partially combined with new ideas for the Session Three survival solution. All four groups presented models to the class that identified protection from the wind as the critical design feature in their solutions. To construct representative models and express these ideas required technical skill such as cutting wood or acrylic sheet, soldering wires in making an electrical circuit and effecting strong joins in various hard or soft materials. These competencies were to become the tasks for subsequent sessions, extending individual capabilities with further instruction.

Interview comments

In interviews carried out with two students from two different groups the students recalled graphic images displayed in the film introduction that had caught their attention. Comments from participants confirmed that informative details had related to personal experience and provided a scientific model for understanding particular forms of weather. Mention was made that the introduction provided a reference for groups to guide the development of specific features in technology solutions. In the interviews after each session, one of the questions participants were asked, described their early impressions:

“Did the film help with any of your ideas?”

“Yes, (GPS7) Yea it was, it just sets the scene, it sets the scene really well and kind of gives you an idea of what your meant to be doing, (TPS7) Yea”, (GPS7) (Interview # Seven, Session Three)

“Um well, it was useful showing, showing the, how it moved. How the hurricane moved to different countries. It kept moving around, (TPS9) Um, it

interested me in how there was something like five tornadoes in 2004 in one country”, (TPS8) (Student Interview # Eight, Session Three).

There was an interview held with the teacher to record her observations of this third session. In the following comments, the teacher describes the influence of the audio-visual introduction on participant responses to the technology needs viewed in the film extract. In both instances, participants had recognized the need for protection from the powerful winds shown in the film and suggested survival solutions to communities. The latter part of the teachers’ comment refers to an alternative approach from group members considering the electrical power generation possibilities from the wind.

“A girl in green group, her initial reaction was that I saw that linked directly to the video and the high winds a solution was pulling the house down under the ground and having some sort of warning system where the house went down under the ground and the high winds over the top.”

“The other girl in yellow group, suddenly her idea was as a solution, once again it was quite an impact for the kids to see that tornadoes and hurricanes go through, okay really in New Zealand we don’t have, it gave them some information and telling them about high winds. I thought her idea, her solution was fantastic in that her idea was not about harnessing the energy, but her idea was of a gate coming up out of the earth.” (Teacher Interview # Nine, Session Three).

In the last session as part of their self-assessment, participants were asked to complete a brief evaluation sheet (Figure 5.5, Appendix). On the sheet there were a number of frames with part sentences scaffolding participant replies to how they might have planned their technology solutions plus two questions asking where their ideas came from and what they discovered. There was also a frame to display several thumb size photographic prints of participants at work or displaying an item constructed in the sessions. The teacher explained

answers would not be marked and the evaluation questions referred to all three sessions. As part of a low risk approach to the technology program, participant responses were intended to encourage further participation.

Participant's evaluative comments in the final session reflected what happens when students manage a central role in the technology process. Participants were asked to respond to an incomplete statement that read:

“This term I have planned my technology solutions by _____ and _____ to _____.”

The evaluation worksheet was designed for participants to have the opportunity for meta-level reflection on the three sessions. The insights from student comments as to how they viewed the activities demonstrated collaborative tendencies reinforcing social relationship considerations.

“Drawing and designing, working with my friend Adam”, (TPS3)

“Listening to my team mates”, (TPS7)

“Working as a team, sharing ideas, team-mates”. (TPS9)

“Drawing sketches of them on paper, working with my friend Louis, make my solutions work effectively”. (GPS8).

A brief summary was tallied to show from all participant comments recorded:

“My ideas sometimes come from _____”:

- Technology artifacts indicated in 2 comments
- Film content referred to by 8 comments
- My head, or brain from 9 comments
- Other people attributed for 9 comments

“I have discovered working on this challenge _____”:

- Information from film in 6 comments
- Technology related in 11 comments
- Thinking related skills in 5 comments
- Social interaction in 5 comments

In this study the participants readily commented on their ideas when asked, recalling details of the introduction and their group experience. It is of interest that participant responses to the prompts on the evaluation sheet acknowledge the contribution from other participants or group social interaction. There were two students that made no comment to either of these two questions; five instances from both questions where students made only one remark, but all others contained multiple comments noting their thoughts about working with others.

Throughout this chapter I have described the technology processes and the participant responses revealed during activities in each of the three sessions in which they were invited to take part. Participant views, identified underlying issues displayed by their comments each session, responding to authentic technological needs in introduction content. Survival needs for clean air and water, safe shelter and food supplies that communities required were supported by their design inferences. The reasoning that produced a dome shaped home identified this shape for the protection from high winds in Session Three. A linked network of floating houseboat structures was the design response to rising floodwater by a group in Session Two. In Session One, a cooling system was proposed by group members to overcome heat effects of a hotter world, assisting animals, plants and people to survive. The participant groups modeled solutions to resolve each of the three challenges they saw for climate survival. I will explore themes from these findings in greater detail with the analysis presented in Chapter Six.

Chapter Six: Analysis answering the research questions

6.1 Understanding participant behavior

6.2 Engagement in the technology activity

6.3 Collaboration amongst participants

6.4 Student views

This chapter explores through analysis and discussion the themes that emerged over three sessions with this GATE class. The participant responses in producing group technological solutions offer answers to the research questions set earlier.

6.1 Understanding participant behavior

Students taking part in specialist technology classes routinely arrive cold from contributing schools after a bus trip to the host environment that is different from their usual classroom. The task of creating interest in the technology topic includes the expectation of productive learning activity. At the beginning of a usual classroom activity the teacher may share a narrative account or offer relevant information. Students' interest and subsequent engagement in a technology topic is integral to the extent of their performance. In this study by having students view a short extract of specially chosen film, the introduction provides an objective start to the technology program, irrespective of individual background or prior experience.

The technology activity is like someone searching for clues during a treasure hunt with proximity to finding the treasure trove described as warm and further away cold. The students in a technology class at commencement are cold to both finding the clues and recognizing potential treasure troves or solutions to their challenge. The warming-up occurs as students become involved in the activities and respond with ideas, comments and physical attempts to construct model solutions for the original challenge. Sustaining application in unfamiliar technology activities with cold students can be a brief endeavor. A student's warmth reflects to what extent a student displays commitment or interest towards the activity. The findings suggest that the introduction is instrumental to this affect on students, who demonstrate by their comments and behavior that they have bought-in to the program. Students seem willing to accept technology challenges they see as authentic, becoming engaged in constructive activity with peers.

How effective is the introduction as a way to warm students for a technology activity? The extent that an introduction generates interest in a specific technology activity is one

reasonable indication. Students that become interested in a technology activity make a conspicuous commitment by pursuing involvement in the activity when they see a genuine need. The effectiveness of the introduction for a technology teacher can also be seen in how well the challenge is taken-up and sustained through class processes. A further indication of students warmed by the introduction is the reduction of off-task behavior, an added benefit from creating strong interest and engagement in the technology activities. Technology sessions where film is used to introduce activities resonates with what Treadwell (2008) refers to as the teacher seeking motivational leverage from an event with dramatic wonder.

The introduction is designed to invite student participation in open-ended technology activities that allow students the opportunity to develop a range of solutions. When a student persists with technology development beyond the first attempt, choices may be discussed and trialed. To view technology challenges as open for further changes or refinement, contrasts with a closed activity that has only one acceptable result. Classroom activities that encourage individual creativity are complimentary to diverse student behavior by exploring a range of choices with materials. Students brainstorm all ideas related to the challenge, pausing to reflect on possible problems and evaluate designs by trial construction of models. The learning journey to develop original answers to technology challenges for all students, and especially GATE students with unique abilities, highlights the need to view ideas in ways perhaps not considered previously (Kaplan, 2007). Teachers accepting students' creative abilities in a low stakes environment may guide them to discover materials, processes or systems they could use safely (Dickey, 2005). The stakes are considered low when consequences for design or construction errors are accepted as valued learning moments.

Understanding the circumstances conducive to student engagement and small group collaborative activity necessitates an examination of program design. Open-ended activities encourage individual student ownership of challenge solutions as they explore a range of creative responses. Design work is viewed in broad terms initially as students collect ideas and discuss seemingly unrelated events to investigate what could be perceived as the main problem and a potential solution to the technology challenge. The posing of a solution to the

challenge does not end the activity. Further refinements to the students' solution will be produced through trial evaluation and modification. The processes of discussing ideas add value to the topic sometimes bringing into the discussion a sense of humor or imagination allowing alternative perspectives to emerge. These flippant digressions occur as students, briefly visualize what if, and eliminate or select desirable features in their work allowing for the possibility of serendipity, the unexpected to occur (Treadwell, 2008).

If students develop low-stakes associations between the main problem and a technological solution, design reasoning that reconciles important issues is helpful later for evaluating results claimed to solve the challenge. I am suggesting that the inclusion of false ideas in the early stages of technology brainstorming could allow individual creativity to flourish as curiosity and individual choices are experienced without negative consequences for getting a wrong answer. Participants became quickly engaged with activities that offer opportunities to work in these ways. They were prepared to identify the main problems with each particular climate challenge, collect unique ideas for a design solution, and persist with unfamiliar classroom work routines.

6.2 Engagement in the technology activity

In the beginning of this study the first research question asked was:

Does the audio-visual approach used in this study quickly engage students with the technology activities?

It should be declared that there were no timing mechanisms used to accurately record the actual elapsed times between participants viewing the introduction and becoming engaged in the technology activities. However, what can be described is that in each of the three sessions, participants responded verbally and physically with no delays or reluctance to become involved in the arranged activities. In the technology workroom, safety was an important consideration and construction activities in the latter part of each session involved careful instructions.

There are four aspects of participant behavior observed in each of the three sessions that confirm how the engagement in technology activities took place quickly. Firstly, an initial response from viewing the film extract was seen by establishing a common starting point, as the same audio-visual experience for all. The concentrated audio-visual experience provided identical information for all participants. Content screened in each introduction presented information via production of soundful-images, as complimentary media professionally blended with a paced sound track to interest the audience (Chua, 2007, p. 12). A shared experience anchored the program from that point by the powerful presentation of combined audio and visual content. Participants displayed motivation to immediately take part in their group discussions following the introduction and promptly became involved in the technology activities. Participants talked about the film content immediately screening ceased.

The commitment of this class to engage with each challenge indicated a collective experience that shared links to a common starting point. In the teachers' words:

"I was most surprised about the group that planned to rebuild the Arctic it was interesting to see about the ice caps and everything. It seemed to be an even starting point for them all." (Teacher Interview # Three, Session One).

As participants worked together the shared starting point established possibility-thinking for participants to exercise their creative solutions to the challenge with original ideas Craft (2000 cited in Watts, 2007, p. 103). Student interaction discussion and animated negotiation involving use of materials and decision-making for material resources dramatically increased each session. This coincided with increased familiarity amongst peers and individual comfort in the workroom environment.

A second aspect of the quick engagement was how participants' progressive technological focus from general ideas to specific solution details steadily introduced a sense of urgency. As students selected or rejected ideas, formative feedback from self, peers and teacher guided choices for designs or materials. Directed to discuss and record ideas in steps towards producing solutions for climate survival challenges participants were urged to work

towards a group goal. The teachers' strategy to direct general responses in the group brainstorm generated ideas associated with the challenge statement and the introduction, (Figure 5.1, Appendix). The teacher asked the class at the commencement of each session;

“What are the survival needs you can identify from climate changes when the world gets warmer, (wetter, windy)?”

“What could be some of the challenges if the world gets warmer?”

Brainstorm ideas to help people or animals. Write down your ideas as problems and solutions.” (Transcript from Camera Two, Session One)

After brief discussion, participants were asked to identify what they considered the main problem with the climate challenge, (Table 3.3, Appendix). Following another spell of discussion, individual reflections were recorded on worksheets of possible ways to solve the challenge, (Table 3.4, Appendix). Specific solutions were then negotiated amongst group members for a preferred technology solution to the climate challenge, (Table 3.5, Appendix). The student interaction displayed an ability to transfer conceptual understanding of what constituted the survival problem faced by affected people or animals in the film, into a suitable technological design solution. This type of behavior has been referred to in studies elsewhere (Skinner & Belmont; Stefanou, Perencevich, DiCintio, & Turner, 2004). At each step, justification for and explanation of ideas were offered or asked for by both teacher and participants. The effect of the iterative design, idea selection, evaluation of solution, became a cyclical process during each session, bringing class interaction closer together with a sense of urgency to develop models and present their model as a solution to the class.

The nature of participants' quick involvement in the technology activities presents the third aspect of engagement. Expectations existed amongst participants to make comments about their thoughts as much as to handle materials and tools and build something in the technology workroom. The low-stakes activities contributed to a lenient formative environment, in which all students could participate. Dickey (2005) describes the ideal environment for learning as providing a motivational impact on students' behavior demonstrated by the nature of their participation in decision-making and subsequent events of self-regulation when manipulating various materials.

Inviting participants to join in the brainstorm activity to discuss all their ideas encouraged a variety of responses to the challenges. Discovery Kits that included a selection of materials were keenly sought by participants to handle and use for construction of models. Materials were made available for each group that could be used and kept for activities by cutting and joining together. The participants became involved in handling materials, sharing their design ideas as non-judged feedback, further increasing their engagement (through a reduction in participation resistance), and removing the perceived consequences of making mistakes (risk aversion). This behavior displayed characteristics of forming group design briefs. Participants discussed what materials suited their model purposes, how this could work as a solution for the challenge and reasons to persuade others when it was presented.

Behavior of special interest was how the participants became involved and continued with unfamiliar problem solving in the activities. As participants became interested in the processes of model development the involvement escalated further and drew group members closer. In effect, their engagement with the activities and unexpected events that subsequently evolved displayed urgency. Engagement refers to the quality of the physical involvement and apparent commitment during learning activities (Connell & Wellborn, 1991; Skinner & Belmont, 1993 cited in Johnson, 2008, p. 3).

The evidence of student engagement during these technology activities was illustrated by their participation and persistence (Finn, 1993; Ladd & Birch, 1997). Although the study group was small in number all participants willingly took part in each session, persisting in the technology activities with focused intent. The fourth aspect of the quick engagement was participants' belief in the value of their work being for the benefit of other humans, animals and the environment. Recognition of critical information in the film extracts presented genuine technology needs for the topic on climate survival. The participants were encouraged to discuss and record their ideas from information presented in the film introduction indicating issues that could be addressed with potential solutions each session. The film extract presented participants' with an apparent social need for which they might design a suitable technological solution. The extent of participant engagement was

demonstrated in discussions by frequent comments linking main problems and the technological features of group solution designs.

Participants' appreciation of a technological need was a form of engagement that created a contemporary learning context from the shared experience. This relates to the first aspect of quick engagement, described earlier as establishing a common starting point from the shared experience. Engaging images were viewed in each of the three introductions of catastrophic damage to communities and large-scale destruction from climate events. On those occasions participant empathy was noticeable from emotive comments. These instances were recorded by:

- In Session One, the polar bears plight from melting ice fields in a warmer world
- In Session Two, the rising oceans had caused people from Kiribati to relocate to New Zealand
- In Session Three, Hurricane Katrina left widespread destruction and loss of life

Empathy noted by participants towards people or animals suggests a personal experience had taken place from watching the introduction. Participants collectively stated that climate survival was a serious business through their inferential reasoning linking certain events with consequences (Brown, 1994). Historical studies suggest that the visual aspects of media has a dominant effect on young people's cognitive processing in depicting actions, assisting formation of inferences and narrative conventions (Gibbons, Anderson, Smith, Field and Fischer, 1986).

Engagement was quick following the introduction warming students to the technology activities each session. Their interest had been heightened by the eminent threat to survival from the effects of climate events presented in each film extract. Only insignificant peripheral distractions were observed at this time, other than those attributed to researcher movements. A closer examination of the participant comments in transcripts of interviews revealed the nature of close engagement with the activities.

6.3 Collaboration amongst participants

The second research question that I have considered in this study is:

Will the shared audio-visual introduction encourage students to work together?

The purpose of this question has been to examine beneath the obvious procedural practices of the classroom and seek out the dynamics of student interaction related to an event early in the technology session. The skills of working alone on a task are somewhat different from those required in a small group, endeavoring to negotiate consensus on solution design through peer compromise and tentative assertions. I will answer this question by looking at key procedural features of the sessions regarding; the program type; the teachers' role; and nature of peer relations.

In these three similar technology sessions, the program followed was similar to the daily practice at the Tauranga Technology Centre, with slightly older year seven and eight students. It has been established practice to use an audio-visual introduction for the affect stated earlier of: warming-up students to attempt a technology challenge and provide them with interesting information in an auditory and visually interesting manner. It is anticipated for most students the audio-visual content will identify a technological need and evoke a reaction with concern (possibly empathy) for something or someone. Introductions open to interpretation may also stimulate student persistence to strive for goals of their own setting if they are permitted to work in ways that more naturally suit their gregarious inclinations. Asking participants strategic questions sought to establish reflective questioning and discussion routines. This practice may advance participants' understanding of events that are relevant in the context of each unique classroom situation.

Technology processes were managed in a cyclical fashion during each session, as ideas were trialed in discussion, cooperatively evaluated by students, and occasionally altered after further discussion if group members agreed. The iterative nature of working from initial technology challenge to an eventual solution could be described as interrupted development provoking a sense of urgency. Class routines modeled by the teacher, interrupted group

work at formative moments. At these times the class was asked to reflect, share the ideas they were working on and recap with supporting reasons. Dialogue exposed participant's ideas with links back to the information originating in the introduction. Participant ideas displayed reasoned prediction as the basis of negotiated model development progressed from general ideas to specific.

A range of practical skills were taught on a need to know basis which revealed further possibilities for extending solution complexity. It could be argued that bringing participants into a central position for decision-making in the classroom had a positive effect on how they managed the activities to achieve goals of their own design. Demonstrations and managed assistance to learn or to safely trial construction practices were integral to technology development each session. At times, participants displayed discomfort with unfamiliar directions or unexpected outcomes from the use of tools and equipment. Formative comments from the teacher, and probing questions led to feeding-forward participant anticipation of steps in construction or self-evaluation of work.

An increased level of interaction amongst group members was recorded coinciding with the familiarity of program routines and peer relations. A net result from this behavior was displayed by the higher number of ideas recorded on worksheets for these two sessions. Participant responses over the three sessions indicated increased familiarity with program schedules in Sessions Two and Three. In (Table 3.4, Appendix), there are tallies of students' ideas noted in categories they were asked to record on individual worksheets: ideas about problems related to the session challenge; and ideas identified as possible solutions. A third category notes the number of ideas making reference to the introduction film extract. This data indicates that participants recorded more ideas when they were most active together.

Trends in data from Table 3.4 indicated (Appendix):

- Greatest number of separate ideas recorded in Session Two (55)
- Reference to film introduction highest in Session Three (12)
- There were approximately three times more Challenge Solutions noted in both Sessions' Two, (47) and Three, (43) than in Session One, (15).

In a traditional classroom the teacher will instruct the class to design and construct a device or system to meet the assigned brief through a linear approach, achieving intended goals that are easily assessed. This style of learning offers respective roles for teacher and student based on the assumption teacher knows best to expedite arriving at the technology answer to a problem. Contrasting to the teachers' role in this study as a facilitator, organizing the activities, managing the timing of work sequences, asking strategic questions and providing formative performance feedback. Participants have shared in co-ownership of the design and construction phases by their planning choices. It was made clear there were multiple possibilities to complete the challenges and that prior knowledge and experience had value for explaining possible solutions. The nature of participant work collaboration often appeared as a style of think-tank, reinforced by the teacher through formative dialogue to promote cooperative goals. Critical thinking was also encouraged to reflect on group outcomes. Learning supported through group interaction from manipulating materials and mediating feedback has been identified for insights into students' activity (Hennessy & Murphy, 1999). Group interaction was a consistent feature of participant activity in each session.

An inclusive approach taken by the teacher during each of the three sessions, supported widespread participant interest in each technology activity. Initially viewing the introduction, to discussing their ideas in small groups was an interactive process connected by strategic questioning. Activity that includes the provision for selected questioning described by Harpaz (2005) may allow students opportunities to create their own understanding and realize the goal of managing an active role in this learning. Participants in this study were invited to discover their ideas about the main problems and brainstorm possible survival solutions for each session challenge. The notion of a challenge also conveys the understanding of an invitation, in what can be done about this problem? Shrand (2008) mentions the first essential step for motivating students occurs by creating opportunities for widespread participation in subsequent activities.

The teacher facilitated generic questions during these brief reflective pauses at intervals of approximately eight to ten minutes. Participants were supported by the teacher practiced in

the approach of making clear links between design intention and later construction (Fleer, 2000; Moreland, 2003). At no time did the teacher judge the quality of participant's ideas or their proposed solutions. All comments were accorded a neutral acknowledgement, usually followed by a question prompting participant reflection or leading to further activity.

This GATE class had been selected from two separate schools and within seven different classes in total. The likelihood of students having worked together previously was minimal and therefore it could be assumed an open potential for new relationships existed. Put together in small groups, new relationships formed through a common purpose to solve the technology challenges. Although considered pre-adolescent, social interaction amongst some individuals in the groups displayed an interest in forming new relationships, which extended to topics beyond technology and is regarded in several sources as a normal part of socialization (Johnson, 2008; Phelan, Yu and Davidson, 1994).

The formation of peer relations may benefit students' motivation through their opportunities for collaborative learning activities (Stiller and Ryan, 1992). Interaction amongst participants evolved from quiet, tentative cooperation in Session One to boisterous animated activity in Session Three. The behavior evolved as a shared experience through participants actively engaging in purposeful discussion, while negotiating as they made decisions to investigate solutions to the topic challenges. A wide range of behavior was observed in each group, at times: listening and laughing, criticizing and complimenting peers during activities. The enthusiastic involvement in the technology activities produced increased familiarity with opportunities and resources available over each successive session. Individual participants were exposed to peer comment and criticism at frequent stages in the technology activities requiring personal resilience on numerous occasions. The increase of ideas in Session Two and Three generated further comment from peers (Table 3.4, Appendix).

An iterative cycle of review and analysis in the technology program was a noticeable factor in participants becoming self-monitoring and self-regulating learners (Broadfoot, 1996; Gipps, 2001). This behavior could be regarded as evidence of participant's deliberate

intention to work in a community of learners (Brown, 1994). The dynamic activity displayed participant willingness to work closely alongside peers to develop a group model solution. Further demonstration of student collaboration was the acceptance of shared leadership in both construction work attempted alongside peers and when sharing group plans, a prevalent theme in these sessions. There was sustained participant interest in co-development of their technology solutions by individual concentration and enjoyment in the activity. Conversations indicated participants shared engagement in higher levels of reasoning as they made decisions about solutions (Johnson, 2008).

At times there were displays of alternating construction input on a shared model, nonverbally interacting as they placed materials in an informally organized sequence. Group model solutions were developed in terms of how the proposal could be displayed. Each group quickly constructed a functional model using the available materials and processes. Inter-group contact was minimal, but students were aware of the progress made by other groups.

A positive side effect was the generosity shown towards peers with verbal support and respect for ideas without any put-downs (negative personal criticism). Participants worked together in their small groups, co-operating to reach consensus on design or assembly of models. This was noticeable when understandings evolved, students' learnt from each other's different expertise, interest and goals. Discussion became helpful as a form of externalized thinking (Brown, 1994) an open benefit to peer understanding. The verbal exchanges for the development of design utility extended personal vocabulary and supported individual prediction for next steps. The introduction could be recognized as pivotal in the formative development of meaningful participant collaboration.

6.4 Student views

The third research question I have set out to answer:

What influence does the audio-visual introduction have on students' views of and responses to the technology learning activity?

This question may be answered best by considering from the accumulated findings the staged activities participants were guided through. Earlier in the findings, themes have emerged when participants' views were invited during their engagement in the technology activities. Students were asked what problems they could identify presented in the introductions; ideas about what could be done about improving situations; and to explain their ideas with reasons. In Session Two, a comment recorded on one participants' worksheet indicated that the problem with a wetter world had consequences:

“Too much water would drown us or our planet! Too little water would make droughts and we would die of thirst!”

(TPS5, Session Two).

Participants have been directed by the teacher and through small group collaboration from general possibilities initially, refining ideas through discussion and reflection of suitability, into more specific solutions for sharing with the class. The actions of planning and trialing materials may lead to development of reasoned choices, when designing solutions to the climatic survival challenges when agreement and support is needed from group peers.

Participant views yield insights described as grounded in the actual events that took place over the three sessions (Glasser and Strauss, 1997). In the various sources of data, recordings of how they saw it indicated participants' summative response to their technology activity. Views were shared of the technology learning activity; amongst participants; between participants and the teacher; and from the participants to the researcher. Exposed to powerful images in the film extracts depicting climatic threats to lives and lifestyles invited viewer responses as general comments. A routine process of understanding the experience, combined participants' personal reasoning with the new information and led them to form inferences about technology problems for the climate survival challenge. Group discussion constantly shared links between problems participants identified from the introduction as reasons used to explain requirements in their design briefs. Comments from a member of Yellow Group:

“Animal transfers because there would be no land for animals in Antarctica to live and they would be swimming all the time and drown.”

Umm, we would have to make a water cooling device.” (GPS3, Session One).

This student indicates a view of concern (empathy), for animals in the Antarctic expecting tragic consequences from reduced ice floes, suggesting the idea of a device to cool water and presumably create more ice.

In this program participants were not told what to think nor given simple questions with direct yes/no answers. Individual or group views were challenged by strategic questioning related to genuine technological needs (human, plant, animal or some other focus) for the participants’ interpretation. When participants viewed the film introduction any realization of obvious climatic survival problems occurred by individual interpretation from viewing images and processing auditory information. Viewing the film extract may or may not be contributory to participant views inferring the type of solution suitable to resolve survival needs. Machin (2007) identifies the impact of using film, directing educators to appreciate the ‘modality’ of this medium our culture has become inextricably associated with. The data suggests that assisting students to identify genuine technological needs through the use of contemporary film extracts is part foundation to forming a view on an issue. This quote from Machin (2007) identifies aspects of the introduction that supported technology activity when participants became engaged in developing a solution.

“Harnessing of visual resources to communicate coherent messages, moods, styles and values is the case in all visual communication that we see in the mass media,” (Machin, 2007 p. viii).

If the introduction triggers recognition of a technological need, will this be sufficient for the audience to have a personal response, and form a view they put forward to solve the activity challenge? We live in a world of digital media communication contributing to understandings that support our views of everyday events. Investigations into this media are likely to reveal complex interactions taking place on multiple levels in the reality we have come to know (Chua, 2007). Wonder and awe was displayed in students’ facial expressions. Their comments demonstrated a connection amongst the students and teacher with a shared emotional experience to the images and information presented in the film extract (Treadwell,

2008). A comment from the final evaluation in Session Three from a member of Green Group indicated an understanding that climate survival was having effects on animals:

“The global warming is so bad of the last three years. That polar bears are having to swim a lot to find ice.” (TPS1, Session Three).

When students work in the classroom community, there could be an implicit role in audience behavior displaying consideration for how others may see it. A regard for personal emotions and feelings was displayed during small group collaboration as participants looked for coherence, certain qualities for the material, reasonable explanations and an attempt to clarify ideas (Brown, 1994). Directing participants to work together in small groups made available opportunities to form and express views about the activities in each session. All ideas were discussed openly, often with laughter, frequently in competing conversations as the merits of ideas shared and debated. Through repeated discussion and selection of ideas, an ongoing development of student technological literacy has benefited through individuals' expression of how a proposal could function. The benefits amongst peers exposed to the process of externalized thinking, (comparing and predicting) is helpful through the growth of shared understandings (Brown, 1994).

There was an apparent change in students' technological capability with interest progressively shifting from theoretical to more practical experimentation in the three sessions. Model constructions appeared tentative and incomplete in Session One when compared with Sessions Two and Three. The use of equipment displayed a growth in participant's confidence and willingness to become adventurous through experimentation and peer guidance. A frustration amongst several male members of the class became noticeable in the third session with the gap between their expectations and capability for completing solutions they had designed. Year Six students with no prior experience in specialized technology workrooms, but those with advanced design ideas, demonstrated open enthusiasm to learn construction skills that might lead to further development.

There were two scheduled times set aside during each session for students to bring out and share all their ideas about the challenge. The first opportunity was directly after the initial

small group brainstorming, each session when all general ideas that could be considered of interest were discussed from recordings on the large blank sheets of paper. An example of initial ideas being shared was from Red Group in Session One:

“What’s it about?” (GPS8) “Put something down.” (GPS2) “They don’t just need sun, they need rain or they will shrivel up and die. Umm, animals die because of heat. If trees die less oxygen. Mostly, plants or animals that we get our vegetables from. Most trees, if It’s too hot, they will dry out and die. And not enough cool air just die. It will get too hot for them” (TPS5)

The second opportunity was more specific towards the latter part of each session, after groups had developed their functional model. These solutions were shared by way of a class presentation with students explaining the intention for their model and reasons for particular attributes of their design brief. There was keen student interest during these times with polite regard displayed towards other participants’ work. The model constructed by members of Blue Group was explained to the class as:

“We made a fun type of thing that goes on the borders of all types of countries and it generates electricity and stands here when a tornado comes. In extreme winds we just turn it on. It generates electricity and blows wind away.” (TPS5, Session Three).

The types of solutions, groups presented to the class at the end of each challenge activity are summarized in Table 3.5 (Appendix).

Group Solutions

- The solutions that were presented by the four student groups, all indicated a direct response to the main problem of each challenge identified by participants in the initial film introduction
- The design for alternative human and animal habitats were proposed by the majority of solutions in Sessions’ Two (3) and Session Three (3), but not in Session One.

- The complexity of solutions with comments from students, referring to the introduction and including reasons for model designs, increased in Sessions Two and Three.

In the closing minutes of the third session, participants were directed to reflect on their technology activities over all the sessions and record comments on a separate worksheet as a self-evaluation. Encouraged to think about their technology work and express views in several formats there were opportunities to select and organize ideas, materials and systems for developing a solution to the challenges. These emerged as representations of participant views within the data. Animated descriptions of ideas they were thinking about and examples of those ideas in the group models constructed.

Meaningful learning occurs in many situations and perhaps best when active discussion and information rich material is visually available. Systematic connections may eventuate contiguously within a low-risk problem-solving style of program (Mayer, 1997). What appeared to have a commonality each session was the way participants engaged with the technology activities when prompted to think about what they had attempted at both a functional and a meta-level. The comments from Yellow Group in Session Two, identify details of both a design brief and the views that led to this model development:

“This is our design and it is like a hole in the ground to make the water level go down a bit so it’s not too high. And this is the crust of the earth. This is the water. (GPS1) “Okay um, the red material is the crust of the earth. This here is the water. The sun is a planet evaporating it and this is a pipe where all the rest of the water goes down the pipe and the hole where it will evaporate again so it will be like a cycle to lower the seal level and reduce pollution.” (TPS9, Session Two)

Participation in the sequential phases of this program allowed group members to progressively collaborate with peers by choosing what they would work on. Identifying items needed for solving each challenge effectively brought them together in small groups, cooperating through negotiation and apportioning the available materials from the Discovery

Kits. It was an evolving process as they questioned peer designs and their own developments, evaluating suitability in reasoned explanations. Participant's engagement took form displaying a persistent pattern of making considered choices during the three sessions. Choices made in the social context by peer interaction, established cooperative relations with technological viewpoints, discussed while negotiating their construction goal. Offering a view and listening to others' views was openly encouraged at regular stages as participants progressed through the technology processes in developing group solutions.

The effectiveness of group choices became a matter for individual members to evaluate in discussion and reflection times during the recap or presentation phases. There were members who spoke out loudly of their technology concerns or asked questions seeking informative answers. Other members remained silent and appeared prepared to watch and wait for further feedback from trialing models, carefully considering a reply. Factors contributing to participants' views were possibly more personal and related to an empathetic response to graphic images and interesting narration presented in the introduction. Participant prior knowledge, individual past experiences, understandings constructed during program processes could have been exposed during these times.

Although understanding participant engagement in technology activity may seem complex and not always apparent to the observer, the dialogue provides valuable clues in this situation. It was the thinking behind decisions engaging participants' determination to produce a functional model. When Red Group presented their model to the class care is taken to explain how it could solve the challenge to survive a windy climate:

"Well this is a fence, but it wouldn't be made out of wood in real life, but this here. Well, it's a fence and it stops wind coming through and protects things. Stops it from being hard so when the wind goes through it is soft. This will be dug deep underground so when the wind goes through it won't knock it over. This is an underground dome made out of Perspex, represented by the ice cream container, with fans on the outside to get in oxygen and to get out carbon dioxide and to protect from things like tornadoes." (GPS8, Session Three).

An explanation of their survival system identified any critical thinking about the activities when participants considered their own thoughts by organized explanations at a meta-level (Rodriguez-Talavera, 2001). Looking forward to the next step in doing something better, participants have repeatedly sought to make changes by thinking about what they have been trying to accomplish (Kimbell, Stables and Green, 1996). Cognitive choices, about the challenges were complex and less readily identified from the students' processes of thinking about what or why they were doing certain things. Through their inferences, stated or written conclusions regarding the problems for the topic of climate survival, we get a glimpse of how they reasoned that these challenges were a serious business (Brown, 1994).

There were examples of meaningful scientific information being recalled by participants in this study as mental models when:

- Ocean heat transfer from cold to warm temperatures as an ocean conveyor belt
- Water volume displacement from continental melt ice raising ocean levels demonstrated as ice cubes in a glass of water
- Surface water temperatures generating strong onshore winds in Atlantic shown in swirling patterns viewed by satellite

The contribution these film images had on participant views was identified from their discussion and justification of features in the solution models. Today in a world of increasingly sophisticated electronic entertainment and widespread media availability, audiences experience complex combinations of image and sound that shape our perceptions of what is real (Chua, 2007). It is possible that the information presented in the introduction may have influenced descriptions of solutions from a conceptual viewpoint. Introduction film content detail supported explanations of creative designs recognized in the shared descriptions. Students described large holes in the ocean to pour extra flood water down to evaporate away (Yellow Group, Session One) and another idea involved sending excess water to space in a rocket (Green Group, Session One).

Discussion throughout this section included observations from both teacher and the researcher to understand the significance to technology learning by the use of selected audio-visual material. The comments recorded from participant dialogue are indicative of

the type of responses that occur in situations where the complex interplay of a rich sensory environment is programmed for group activity to facilitate individual initiative. The analysis of findings in this study may resonate with classroom events that are familiar to the wider educational community. These shared pedagogical understandings support formative benefits to student learning in a technology context of the type described here. Research into understanding tools for engagement in classroom learning activity has rapidly evolved in a technological context where opportunities may exist.

The GATE participants were socially engaged in the technology challenges as they quickly developed functional models representing genuine climate survival solutions in their views. The readings listed in the reference section provide further evidence that student learning may be beneficially affected through the strategic use of audio-visual extracts. Educators have long recognized the powerful effects of auditory and visual resources contributing to enhanced student learning. Audio-visual media combines two powerful forms of communication in the classroom, presenting the technology moment to a receptive audience, supporting realization of authentic needs and acting as the cornerstone for technology programmes.

In the next chapter I will offer a series of suggestions for technology units managed in this way. It has become apparent there are further research opportunities to investigate regarding the use of audio-visual in technology. Student familiarity with the use of electronic audio-visual media, made attractive by the increased availability of portable devices and high interest interactive online websites, as views are increasingly shared.

Chapter Seven: Discussion

7.1 Discussion of findings

7.2 Conclusions

7.3 Suggestions for further research

This chapter reflects on the study's findings. In the discussion of findings, understandings that have emerged in the data to answer the research questions take into account the participants' responses and teacher comments. The implications for doing technology classes in this way are considered and suggestions for further research are also given.

7.1 Discussion of findings

This study set out to develop understandings from the activities of a small group of year six GATE students when a technology topic is introduced using an audio-visual extract. These participants began a series of three technology sessions by viewing a specially selected film segment. The findings suggest there are links between their initial experiences and students' motivation and interest in class activities. The quick engagement effects of film have also been noted in a study seeking ways to enhance the teaching of literacy (Watts, 2007).

Participants' responses to the technological challenges following the audio-visual introductions show detailed ideas with reasoned inferences, such as theoretical scientific explanations or generalizations on social behavior, expressing how participants thought about the survival challenges. There were instances of emotional motivation indicating participant empathy with people or other animals affected by the climate conditions shown in the films. It became apparent that the prompt engagement occurred on a variety of levels including emotional, social, historical and structural, similar to instances recorded in another study by Fleer (2000) where students were involved in forming design briefs to address a technology challenge.

“The visual is used to create a compelling sense of what is the nature of social reality” (Iedema, 2003, p. XIV).

This quote identifies the potential value of particular events at commencement of a technology class when the teacher will focus student attention by an opening statement or present an artifact for discussion before moving to an activity. How important is this time for arranging subsequent student technology activity? The teacher will have considered the

effect of a statement or chosen artifact as being of critical importance to set the scene. The opening scene may quickly connect students existing understandings with compelling recognition of new opportunity. Student activity arranged by an approach that more closely resembles technology work as it occurs in commercial reality, poses a challenge situated in a culturally meaningful context (Jenkins, et al, 2004).

When participants accepted the invitation to take part in the class it was a personal choice and they were made aware the stakes or consequences were low for any ideas or models. Work being neither scored nor wrong answers criticized, has been found to enhance participant motivation (Dickey, 2005). Individuals' engagement and their persistence to complete activities was noted when teacher feedback is supportive of participant responses by being open-ended (Chua, 2007) and non-judgmental (Johnson, 2008). The opportunity to work in a technology room offered participants a chance to make something with materials and equipment. When they identified the technology needs for climate survival from the audio-visual introduction experience they began the process of forming a design brief as part of their work goals.

The introductions each session triggered personal responses to real life situations, other people, and animals. Participants speaking with emotion identified designs for things that could assist those affected. A sense of wonder or awe about the problem was followed by a belief they could make a difference with design ideas. Participants' prompt and persistent attempts with each technology activity indicated a form of modal leverage (Treadwell, 2008) from the high interest audio-visual content. The analogy of a cornerstone in the construction of a building is accurate when considering the physical leverage of an audio-visual introduction to support students through building their technological knowledge.

Quick engagement

Researcher observations and comments from the teacher indicated that students exhibited genuine interest in the content of the technology challenge each session. Participant responses following the audio-visual introduction demonstrated prompt discussion and

physical activity. This was described in the narrative accounts of Chapter Four, when participants began each session by sharing the viewing of the film extract. Participants responded directly by generating numerous ideas, both verbal and written through personal responses and interactive group discussion. The shared experience quickly activated participant curiosity and provided a reference point for their creative musings described by Bruner (1962) as benefiting learners' predictive skill. Film media is recognized as familiar (Kress, 2000) as it appeals to students by offering images and sounds, satisfying a need for information about our world (Darley, 2000). Contemporary culture transmits information that students are exposed to through using audio-visual devices in a range of social practices. Understanding how quickly the introduction engages students identifies media as contributing to the underlying development of social knowledge structures (Bacon, 1972; Gibbons et al, 1986; Lave, 1991; Mayer, 1997).

Recognition that introductory experiences may be influential on students' behavior is comparable to the description found in a recent study that suggests particular artifacts may affect students' productive responses in class situations (Cowie, et al, 2008). Film media can also be considered as artifacts that affect students' engagement in class activities through the affects in has had on students participating in this study. Students walked into the technology rooms cold to the activities and peer relations, to warm to the challenges shortly after the introduction. The data indicates that participants in the study promptly identified authentic survival needs after the introduction (Table 3.2, Appendix).

Apart from the film other influences on participants noted in the findings that might have led to quick engagement, were the expectation of handling different materials from group Discovery Kits. In the second and third sessions, participants eagerly inspected the kits seeking out items to use in model construction. Participants were routinely asked by the teacher to replace items after initially inspecting the kits while planning and recording ideas on individual worksheets. These instructions were followed closely in Sessions One and Two, but not in Session Three. It is possible that participants were fully occupied with model construction and resisted instructions to stop and record sketches and planning notes. Other studies reviewed refer to the interest students find in having fun while exploring

resources (Prather, 2000; Huizinga, 1955; Provenzo, 1991). This behavior is understandable for students in technology classes aware of the time constraints on completing constructions of their products and involved with design choices for group solutions.

Collaboration

The second research question set out to understand how the shared audio-visual introduction might encourage students to work together. The teacher arranged participants into small groups to facilitate logistical and management outcomes that seem to work well in technology rooms, comparable to real workplace practices (Brown, et al, 1989). Accepting there existed mutual unfamiliarity amongst all participants, including the teacher, keen interest was displayed towards the social aspects of working collaboratively to solve the survival challenge each session. The description of learning dispositions towards small group work from Carr and Claxton (2002) is reinforced in these findings when participants blend social and technology interests in working on their model solutions (Meloth and Deering, 2007).

Regardless of individual differences, students recognized a commonality in the introduction that encouraged collaborative working relations in physical and verbal ways. Emerging adolescents allowed opportunities for fun and humor experience technology activities with a student-centered focus. Participants' performance displayed a commitment to genuinely contribute viable solutions for the climate survival challenges in a range of styles: individual, small group and whole class. On an individual level, participants were reserved, but in small groups most were insistent on designing solutions that would effectively assist those most affected by the threatening climate. In front of the whole class it appeared each session that certain individuals consistently put themselves forward to speak on behalf of the group about their design brief and model solution. The comparison of participants' model product or model system performance was referenced to the film introduction in discussion with their peers and their written records. Initially unfamiliar participants from the two schools formed active friendships through interactive behavior and shared experiences.

The benefit to participants of working together has been recognized as a powerful dynamic observed in the cooperative nature of participant interaction each session. A group that performs through co-ownership of design ideas beyond the point where individual interest may lapse begins to act as a community of learners (Brown, 1994; Hennessy, 1993). Arranging groups of four and five produced a peer forum for introducing ideas, sharing critical discussion and promoting reflective feedback through negotiation in the pursuit of agreed group solutions. The blending of social and academic goals from the collaborative nature of brainstorming problems, offering potential solutions to each challenge and critiquing others' ideas fostered a work ethic of interdependence based on mutual support. A study by Boekaerts, et al, (2006) suggests that multiple content goals are influential to student engagement allowing for individual differences and encouraging student involvement considered effective for optimizing work performance.

Peer collaboration was evident in frequent occasions of encouragement, shared ideas, negotiated resource choices, critical feedback and polite respect displayed as participants worked together. A benefit of increased participant familiarity became evident in Sessions Two and Three with the increased number of ideas that the students generated in these sessions reflecting trends noted in other research (Shrand, 2008). Displays of co-responsibility indicated that a sense of identity forming within the groups affected individual students on a personal level (Brown, 1994). The acts of working together became an iterative feedback cycle of discussion, design, construction, trial and evaluation, involving participants supporting each other to achieve a shared goal. The observation of an unexpected event that occurred in both Session Two and Three was the alternating participant construction techniques of two pairs of boys that worked for several minutes on the negotiated model, (Blue Group and Green Group). In each occasion there were no spoken directions, only hand movements arranging materials on the centrally positioned model. I suspected there was an intuitive understanding between the pairs of participants regarding the group design brief based on earlier discussion. The audio-visual introduction established via the powerful film experience an authentic context for the participants to approach the climate survival needs at the start of each session. Participants responded by

working together to design and construct a model of a technological solution on which they could agree.

Contribution to learning

When teaching technology in the limited time of a sixty-minute class period, opportunities to arrange for learning to occur is determined by critical factors. Factors such as; how we interest students; what responsibilities students have to manage development of their creative technology solutions when making appropriate design choices to address the group brief. The opportunity for progressing student learning that complements their personal view or individual style was created by the audio-visual stimulus. Discussion in previous chapters identified themes related to the effect of audio-visual media with advantages also found in other curriculum areas (Gibbons, et al, 1986). The experience had formative aspects for participants that set a foundation for their subsequent activity. What followed the introduction was significant, in that all parts of the program combined, created an overall effect greater than the sum of individual parts (Hipkins, 2008; Delandshere, 2002).

If an introduction kindles curiosity that sustains multiple learning processes, students are able to follow in ways that may be accommodating of their individual diversity (Alton-Lee, 2003) and find a compatible learning style (Mawson, 2003; Craig, et al 2002). Although the introduction was only one part of the technology program in the study, the introduction provided an authentic context for guiding participant design briefs. Participants were encouraged to put forward design suggestions, ask questions to both evaluate ideas and test model solutions for suitability. Reviews from literature substantiating student engagement behaviors and the relationship with an authentic context are noted earlier (Brown, et al, 1989; Gawith, 2003; Ing, 2003). Student discussion was formative to developing their understanding during activity phases of the negotiated design brief.

The study included activities that were open-ended for participants to attempt each challenge as they saw it, and share design ideas with their peers. The class acceptance of participants' ideas in a low-stakes environment was openly inclusive of divergent views. Participants

began each session with a wide sweeping collection of fuzzy possibilities, working gradually through discussion, construction and evaluation, towards refining those ideas that suited the need participants identified for the challenge (Bassey, 2001). By asking questions and suggesting ideas, participants progressively developed their design briefs and models from the general to specific, exchanging meta-level communications (Stefanou, et al, 2004; Skinner and Belmont, 1993) and evaluating group solutions using their meta-level reasoning (Rodriguez-Talavera, 2001) as development of conceptual understanding evolved.

How important is it to get the correct answer for technology work? Modeling patience or tolerance by the teacher, may allow creativity and innovation to emerge from the unexpected ideas or mistakes that occur in the course of usual class events. It may be of greater value, that students are involved in a range of technology processes, rather than finding the one right answer. The happenchance or serendipity of ideas in technology activities, accepts unexpected work outcomes where students explore creative solutions to a challenge (Treadwell, 2008). When students are involved with group technology activity opportunities, developing skills of observation and evaluation, indicate the nature of peer relations (Stiller and Ryan, 1992). Feedback contributes a reflective plan-develop-evaluation cycle moving students towards their technology goals and forming connections between processes in activities (Moreland, 2003). The organizational processes during each session contributed to the formative development of individual technological competencies considered relevant to different participant learning needs.

Systematically asking questions, to consider the merits of idea suitability and fitness of construction details, has led participants to make reasoned inferences as a basis for design decisions (Harpaz, 2005). It was unexpected to observe in participants' model solutions the combination of both structural view of plans and a social description of how the finished design would be used in the future. Complex details were suggested for water recycling in underground or underwater dome habitats to accommodate large numbers of people. Relevant understandings of the original research questions readily fall-out from the events in each session as themes are afforded credibility by both consistency and frequency that these occur (Cohen, et al, 2005).

Participants were consistently emphatic in interviews when they declared benefits they recognized from the film introduction. Reasons given to support these comments referred to empathy for other people or animals, social information content regarding community needs and how they explained the solution design in scientific or climate terms. The personal development of technological literacy has been described in psychological terms as a state of flow, when students learn to think, fully involved in overcoming challenges in life (Csikszentmihaly, 1997). These experiences contribute to the ongoing development to students' points of view on issues they consider important.

That participants responded in different ways reflects how they saw the climate survival problems and what, in their estimation, might constitute a viable solution. It remains an enduring human interest to seek out information for something seen as important.

Participants articulated views regarding: emotive descriptions of the damage caused or threats posed by climate events, design styles for proposed solutions, the construction choices for different material resources, group roles, and predictions evaluating product performance to meet the discussed challenges. Students observing the film extract gained information and later recalling details of the experience when contributing.

To put the original research questions into perspective it is appropriate to balance findings with the possibility that participants were already sufficiently informed on the survival topic to make well-considered contributions. Views expressed by participants may reveal understandings formed as a result of the introduction or by considering that any existing views held were prompted by the introduction and group interaction. Distinctions between the sources of participant understanding have not been mapped in this study and the question of whether this alters the outcome of engaging participants is unproductive in this situation. These GATE participants demonstrated articulate verbal design exchanges with their technology brief development using meta-level language (Fleer, 2000) describing model functions, (eg. water cooling, polar bear relocation, air purification systems, wind deflection/generation).

It seems clear that participants sustained their motivation for this technology program due to the affects of a high interest, informative audio-visual introduction and the opportunity to work on this in small social groups. It was helpful that the introduction offered participants interesting information to provoke views on the climate survival topic. The teacher's approach actively invited participants to consider their views and exercise choices at developmental stages in their work, sharing with the class explanations recapping solution progress and reflecting on design briefs. Views expressed, recognized there were certain technological needs for those communities affected by climate as considered by group activity that eventually led to productive outcomes.

7.2 Conclusions

The conclusions gained from this study are I believe, intuitively understood by many educators. That is, when the learning environment presents a sensory-rich experience for students they become quickly engaged and connect with peers in subsequent activity (Chua, 2007; Machin, 2007). The introduction presented an invitation for students to form a personal design brief in context, recognized as interesting opportunities to become creative structurally and involved socially.

In brief the audio-visual introduction to a technology activity has:

- Quickly engaged GATE students in unfamiliar technology activities, motivating their interest and effort to complete challenges,
- Stimulated collaborative group work with an authentic context to which they related conceptually and emotionally by seeking a design solution,
- Formed a reference point for design and material choices students expressed during an iterative technology process of developing their preferred challenge solution.

GATE students have contributed rich data from their articulate discussion and broad range of design ideas that promptly followed the introductions each session. As participants in this study they demonstrated accurate interpretation of instructions and focused concentration in developing design ideas to a brief negotiated with peers. The audio-visual introduction was a

motivating factor for these students working with unfamiliar co-participants in an unfamiliar environment on the climate survival challenges. Emphatic responses from inviting participants to give the challenge a go carried implications of having fun. The approach has worked in circumstances when there is limited time to engage students and when the students' technological potential is unknown. The teacher's role of class facilitator, asking formative questions and instigating developmental steps progressed students' critical design or structural decisions. Aware of the constraints on technological development, students' behavior displayed a range of self-management skills that sustained their engagement to persevere with successful completion of the challenge, particularly in an unfamiliar environment (Boekaerts, et al, 2006).

The social attraction for naturally gregarious young people to work together on technology tasks was reinforced by the shared introduction experience providing a conversation topic. Students worked together in small groups amongst peers encouraged by opportunities for individual initiative, specific role responsibility, practice for personal skills of negotiation and learning compromise in design brief or construction decision-making. Although it may be that sometimes groups temporarily mask low levels of effort from those members less willing to take risks by contributing ideas. This is often how real workplaces function by arranging workers into small groups to stimulate the problem solving of design briefs and apportion workloads fairly.

The introductions activated participants' imagination recognized by individual viewpoints, when ideas or decisions were shared and developed amongst group members. Participants consistently made reference to the introductory film extract in their comments describing group models. Audio-visual offered an authentic context of those communities affected by extreme climate conditions that was common to all students at commencement of the technology activity. This content affected students' emotions and thoughts towards other people or animals to which they referred later when evaluating their group design solutions.

Technology has been described as intervention through design (MOE, 2007) with the possibility of offering inventive students opportunities to make a difference to situations of

real need through the design of a new product or system. Moments of meta-level learning occurred when peers questioned others on design details or merged observation skills with candid predictions for the next steps. Sources indicate that when students have the opportunity to make choices that affect their own learning in a positive way they will accept ownership and responsibility for the outcomes (Brown, 1994; Cathcart, 1998). The inferential reasoning that emerged during the iterative design processes furthered individual technological literacy. Participants comfortable with these opportunities for thinking about their own learning were actively resourceful in using their initiative and imagination by expressing meta-communications (Cathcart, 1998). Technology challenge activities are ideally suited to the forms of individual research, inquiry or collaborative group investigative programs for GATE students at this level.

Audio-visual resources have been used routinely for enriching classroom environments for generations of students (Gibbons, et al, 1986). In the teachers' selection criteria there are requirements for features in a film extract to potentially direct students' understanding towards curriculum and personal knowledge goals. Indicators that I have identified for suitable film extracts include:

- Sufficient action and dialogue to activate curiosity to discover more
- Controversial and contemporary topic to stimulate meaningful class discussion
- Connects to audience age appropriate prior experiences
- Contains embedded values exposed through investigation
- Scaffolds open-ended conceptual understandings
- Suggestive of varied technological solution designs

There are many film titles available as program support material that a casual search inspecting a video library or surfing the Internet will identify a selection on a wide range of topics. Identifying a suitable film extract for a school age audience, requires strategic selection to identify genuine technological issues, situated in an authentic context that are sufficiently contemporary to attract student attention. Understanding how selected audio-visual engages students quickly and collaboratively offers technology educators the opportunity to use an easily accessible resource in the classroom.

7.3 Suggestions for further research

In recent years the increased availability of digital audio-visual devices has led to the supply media of high interest media that students are familiar with and skillfully use. Sophisticated electronic devices, (eg. mobile telephones, computer and gaming devices, portable music players) offer features for the creative manipulation of audio-visual for work and leisure within easy reach of many people. The portability and low cost has enabled device and inter-operator interactivity plus rapidity of storage and retrieval with a range of equipment offering a digital context for education uses (Jukes, Mc Cain and Crockett, 2010).

Research into students' views of how they see the procedural or structural performance aspects of learning activities, could re-define student-teacher partnerships in knowledge communities (Hickey and Zuiker, 2005; Jukes et al, 2010). Inviting students' to formulate design briefs in response to authentic contexts where access is not practical or desirable enable a blend of engaging social and academic goals through directed questioning. The phenomenon of student directed audio-visual creates further opportunities for individual choice in selection and presentation of original material. What motivates students today underpins issues of self-efficacy and the relationship between learners engagement in unfamiliar technology challenges. This is fundamental to planning future programs for all curricula but especially technology.

Investigating the compatibility of audio-visual media and the 'contiguity effects' between image and text Mayer (1997) identified in his studies is an area of potential interest for instructional purposes. The filming of specific events to evaluate formative stages in a learners' problem solving competency has merit for investigate any benefits from incorporating audio-visual content to facilitate student discovery phases could have a place in future technology programs. Identifying discovery triggers for learner progression in the classroom to assist scaffold learner competencies through video capture of evidential images during demonstration or confirmation of when these are most likely to occur. A student reflecting on key stages during sequential processes of trialing products or systems

demonstrates indicators of understanding as a basis for later evaluation and modification before final presentation of a design.

In the area of evaluation the use for audio-visual provides for the traditional accountability goals and opportunities for research investigating the power of this medium with individual details able to be closely and accurately observed. Athletes have used this approach for decades to evaluate competition and refine strategic performance techniques. Evaluation underpins the essential foundations of education instigated by teacher or learner.

Contributing to collaborative student engagement through the facilitation of grassroots video, “networks will fuel rapid growth among learners” (Horizon Report, 2008, p. 4).

Effecting quick student engagement by presenting displays of selected media may improve the development of technology literacy assisting life-long learners.

Appendix

Appendix A. Table 3.1 Interview schedule

Appendix B. Table 3.2 Initial group idea brainstorm referring to film

Appendix C. Table 3.3 Comparison of participant views on the ‘main problem’

Appendix D. Table 3.4 Comparison of individual student brainstorm ideas

Appendix E. Table 3.5 Group solutions presented to class

Appendix F. Figure 4.1 Student interview questions

Appendix G. Figure 4.2 Teacher interview questions

Appendix H. Figure 5.1 Group large worksheet sample

Appendix I. Figure 5.2 Student worksheet Session One

Appendix J. Figure 5.3 Student worksheet Session Two

Appendix K. Figure 5.4 Student worksheet Session Three

Appendix L. Figure 5.5 Student self-evaluation worksheet

Appendix M. Figure 7.0 Research approval and conditions

Appendix N. Figure 7.1 Participant parental consent form and letter of information

Appendix O. Figure 7.2 School consent form

Appendix A. Table 3.1 Interview schedule

Day One	Day Two	Day Three
1. Red, boys GPS8, TPS3	4. Blue, boys GPS4, TPS2	7. Blue, girls GPS7, TPS7
2. Green, girls GPS6, TPS6 TPS8	5. Yellow, girls GPS1, TPS5	8. Yellow boy TPS9, Red girl
3. Teacher	6. Teacher	9. Teacher

Appendix B. Table 3.2 Initial group idea brainstorm referring to film

Session One	Session Two	Session Three
<ul style="list-style-type: none"> • Total of 31 ideas were recorded on four sheets of blank A3 paper by four groups • Reference to film introduction made by 6 ideas • Identified problems with '<i>warmer world</i>' challenge by 19 ideas • Possible solutions to survival challenge detailed by 6 ideas 	<ul style="list-style-type: none"> • Total of 29 ideas were recorded on four sheets of blank A3 paper by four groups • Reference to film introduction made by 9 ideas • Identified problems with '<i>wetter world</i>' challenge by 19 ideas • Possible solutions to survival challenge detailed by 2 ideas 	<ul style="list-style-type: none"> • Total of 50 ideas were recorded on sheets of blank A3 paper by four groups • Reference to film introduction made by 36 ideas • Identified problems with '<i>a windy world</i>' challenge by 39 ideas • Possible solutions to survival challenge detailed in 8 ideas

Appendix C. Table 3.3 Comparison of participant views on the ‘main problem’

Session One	Session Two	Session Three
<ul style="list-style-type: none">• Total of fourteen students recorded their comments from sixteen participating• 5 ideas make reference to film• 9 ideas were interpreted in climate survival problems• 6 ideas identified that combined multiple problems in challenge	<ul style="list-style-type: none">• Total of fourteen students recorded their comments from seventeen participating• 12 ideas make reference to film• 6 ideas were interpreted in climate survival problems• 5 ideas identified that combined multiple problems in challenge	<ul style="list-style-type: none">• One comment was recorded from the seventeen participants• 1 idea made reference to film content• 0 ideas interpreted climate survival problems• 0 ideas identified combined multiple problems in the challenge

Appendix D. Table 3.4 Comparison of individual student brainstorm ideas

Session One	Session Two	Session Three
<ul style="list-style-type: none"> • From sixteen worksheets there were a total of 24 separate ideas • Reference to film introduction was evident from 8 ideas • Problems identified with ‘warmer world’ challenge by 7 ideas • Solutions possible to solve the survival challenge in 15 ideas 	<ul style="list-style-type: none"> • From seventeen worksheets there were a total of 55 separate ideas • Reference to film introduction was evident from 5 ideas • Problems Identified with ‘wetter world’ challenge by 10 ideas • Possible solutions to solve the survival challenge in 47 ideas 	<ul style="list-style-type: none"> • From seventeen worksheets there were a total of 41 separate ideas • Reference to film introduction was apparent from 12 ideas • Problems Identified with ‘wetter world’ challenge by 15 ideas • Possible solutions to solve the survival challenge in 43 ideas

Appendix E. Table 3.5 Group solutions presented to class

Session One	Session Two	Session Three
<ul style="list-style-type: none"> • All four groups suggested cooling features in their solution • 3 solutions described use of ice and water in cooling function for world oceans and polar regions • 3 solutions identified electrical power as essential to operate device/system • 3 solutions described water filtration for overcoming pollution • 1 solution detailed the use of solar power 	<ul style="list-style-type: none"> • All four groups identified increased water levels from climate conditions in their solutions • 2 solutions suggested living underground • 2 groups offered solutions to remove excess water from earths' ocean levels • 1 solution described a hole in the ocean to earths' core as a way to evaporate excess water • 1 solution proposed transporting excess water by space rocket • 1 solution design provided for floating raft-style homes 	<ul style="list-style-type: none"> • All four groups identified protection from wind in solutions devised • 3 solutions proposed generating electrical power from wind energy • 2 solution designs described use of fan • 3 solutions included underground homes to shelter from wind • 2 solutions included integrated means for essential living needs • 2 solutions had devices for diverting the high wind • 1 group mentioned risk from flooding

Appendix F. Figure 4.1 Students Interview Questions

These questions were asked of two students approximately two hours after the introduction while seated at a separate table from the rest of class working in the adjoining room. It was explained that the interview was being recorded. The students had their worksheets on table before them when I asked the following questions. A pause was allowed between each response.

1. What did you see or hear in the introduction that was of interest for you?
2. Describe anything in the film you felt might be useful for your technology challenge.
3. What ideas did you talk about with other people in your group?
4. Do you think the film helped with your ideas? Please describe how?

Appendix G. Figure 4.2 Teacher interview questions

The questions listed below were asked of the teacher (Mrs B.) after each session, repeating the process in similar style after the teaching was completed. Seated at the interview table both questions and answers were recorded electronically.

1. What seemed to interest students from the A/V introduction that you could identify from their behavior?
2. What ideas did the students discuss that you recognized were from the A/V introduction?
3. Describe any observations or conversations amongst students that might indicate personal understanding with a character or situation in the A/V introduction.
4. Could you identify any students that created a solution for the technology challenge offering information connecting their work to the initial introduction? If so, can you recall what they actually did or said?

Appendix H. Figure 5.1 Group large worksheet sample

Record all your group brainstorm ideas on this sheet:

Challenge:
A _____ world

Appendix I. Figure 5.2 Student worksheet Session One

TS Student Code _____ Date _____	<h1>Warmer CLimate Survival</h1>
<p>1. What would it be like living in a warmer world?</p> <p><i>What are the survival needs that you can identify from climate changes when things feel warmer? What effect will this have on our food and drinking requirements in order to survive? Design and evaluate prototype things to help with our survival considering that some items we have now may not be available in the future.</i></p>	
<p>Brainstorm all your ideas</p> <div></div>	
<p>What do you think is the main problem with a warmer world?</p> <div></div>	

Appendix J. Figure 5.3 Student worksheet Session Two

<small>TS</small>	
Student Code _____	
Date _____	
<h1>Wet CLimate Survival</h1>	
2. What would it be like living in a wetter world?	
What are the survival needs that you can identify from the climate changes that bring more rainfall each month? What might happen if there is too little rain or perhaps too much rainfall? Design and evaluate prototype products to help our survival in the future.	
Brainstorm all your ideas	
What do you think is the main problem with a wetter world?	

Appendix K. Figure 5.4 Student worksheet Session Three

TS Student Code _____ Date _____	<h1>Windy CLimate Surviva</h1>
<p>3. What would it be like living in a windy world?</p> <p>What are the survival needs that you can identify from climate changes that create very windy weather? What effects will stronger winds have on our living and working conditions? Could this wind be helpful in any way that the community might benefit from? Design and evaluate prototype products to help our survival in the future.</p>	
<p>Brainstorm all your ideas</p> <div></div>	
<p>What do you think is the main problem with a windy world?</p> <div></div>	

1

Term One 2008 GATE Student Code _____ Date _____														
<h1 style="margin: 0;">Climate Survival</h1>														
Student Evaluation for this topic														
<i>Reflect ... I managed the special roles of _____, _____, _____ in my group.</i>														
<p>Our Group <i>designed and developed</i> these products;</p> <p>These were my technology solutions</p> <p>I have DISCOVERED these things...</p> <p>for Surviving Climate changes ???</p>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;"> Term One Challenge The weather has changed to become more unpredictable with temperatures, rainfall, winds and survival is challenged. What different products and systems will people need to safely survive in the future? </div> <div style="border: 1px solid black; height: 100px; margin-bottom: 5px;"></div> <div style="border: 1px solid black; padding: 5px;"> This Assessment Information shows which level I have chosen for my technology work this term. My comments are in three spaces below, one from each column to explain how I solved the challenges. </div> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <tr> <td style="width: 33%; padding: 5px; vertical-align: top;"> Achievement Objective 6b My Planning and the type of Attributes used NZ TC2007 </td> <td style="width: 33%; padding: 5px; vertical-align: top;"> Achievement Objective 6d My evaluation details and reasons NZTC 2007 </td> <td style="width: 33%; padding: 5px; vertical-align: top;"> My comment is printed below for details of my work on this technology topic </td> </tr> </table> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <tr> <td style="width: 33%; padding: 5px; vertical-align: top;"> As a Spectator I can follow some instructions and with help develop a plan for my _____ _____ </td> <td style="width: 33%; padding: 5px; vertical-align: top;"> As a Spectator I am beginning to evaluate my _____ _____ product with help from others. </td> <td style="width: 33%;"></td> </tr> </table> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <tr> <td style="width: 33%; padding: 5px; vertical-align: top;"> As an Apprentice I can work with others or by myself to plan a product using Attributes for my _____ _____ </td> <td style="width: 33%; padding: 5px; vertical-align: top;"> As an Apprentice I can evaluate my _____ solution and offer reasons for changes to improve </td> <td style="width: 33%;"></td> </tr> </table> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <tr> <td style="width: 33%; padding: 5px; vertical-align: top;"> As an Expert I can plan my own solution in detail including some higher Attributes for my _____ _____ </td> <td style="width: 33%; padding: 5px; vertical-align: top;"> As an Expert I can share _____ details of my evaluation ideas for _____ _____ </td> <td style="width: 33%;"></td> </tr> </table>		Achievement Objective 6b My Planning and the type of Attributes used NZ TC2007	Achievement Objective 6d My evaluation details and reasons NZTC 2007	My comment is printed below for details of my work on this technology topic	As a Spectator I can follow some instructions and with help develop a plan for my _____ _____	As a Spectator I am beginning to evaluate my _____ _____ product with help from others.		As an Apprentice I can work with others or by myself to plan a product using Attributes for my _____ _____	As an Apprentice I can evaluate my _____ solution and offer reasons for changes to improve		As an Expert I can plan my own solution in detail including some higher Attributes for my _____ _____	As an Expert I can share _____ details of my evaluation ideas for _____ _____	
Achievement Objective 6b My Planning and the type of Attributes used NZ TC2007	Achievement Objective 6d My evaluation details and reasons NZTC 2007	My comment is printed below for details of my work on this technology topic												
As a Spectator I can follow some instructions and with help develop a plan for my _____ _____	As a Spectator I am beginning to evaluate my _____ _____ product with help from others.													
As an Apprentice I can work with others or by myself to plan a product using Attributes for my _____ _____	As an Apprentice I can evaluate my _____ solution and offer reasons for changes to improve													
As an Expert I can plan my own solution in detail including some higher Attributes for my _____ _____	As an Expert I can share _____ details of my evaluation ideas for _____ _____													

Appendix M. Figure 7.0 Research approval and conditions

The University of Waikato

Application for Ethics Approval

Human Research Ethics Committee

1 Title of Project

Understanding the impact of an audio/visual introduction on students attempting a technology activity

2 Researcher(s) and Contact Details

a Name of applicant

Thomas Smith

b Program of study (if applicable)

MEd

c Course number (if applicable)

STER594

d Department/Centre/Unit

CSTER

e Contact Address

Tauranga Primary School Technology Centre, 31 Fifth Avenue, Tauranga 3021

f Phone number

07 5786222

g Qualifications

Bachelor of Social Science, University of Waikato 1981

h Other personnel (Doctoral Supervisors)

Mike Forret

3 Research Procedures

a Procedure for recruitment of participants and obtaining informed consent

The technology teacher involved in the project, Heather Bonk, a colleague at the Tauranga Technology Centre who is interested in taking part in the study.

Student participants will be accessed through an extra-curricular GATE (Gifted And Talented Education) program that I offer to a small group of invited students each year at the Tauranga Technology Centre. Students are selected by classroom teachers from the year six level at Green Park School and Tauranga Primary. Students are aged between nine and eleven years of age. There will be sixteen students in the class.

Letters of explanation to the parents/guardians and schools will set out the nature of this research, offering the opportunity to take part in the activities from which data will be collected. Informed written consent will be obtained from all parents/guardians of those students taking part and the school administrations of each.

Copies of consent forms are attached.

b Procedures in which research participants will be involved

Students will be involved in completing open-ended written responses in worksheet form as part of the usual GATE Technology program at the Tauranga Technology Centre which will be taught by another technology teacher, Mrs Heather Bonk. This data will be coded for analysis later.

During the program, students will also be involved in informal interviews with myself as researcher/participant. Interviews will be audio recorded and digital still and video recordings of classroom activities will also be made.

The class teacher will also be interviewed at the end of the teaching sessions.

c Procedures for handling information and materials produced in the course of the research

Interview audio recordings will be transcribed and coded. In interview transcripts, field notes and student worksheets a coding system will be used that protects all participants from identification and ensures their anonymity. The data collected in the course of this project will be seen only by myself, the class teacher, Mrs Heather Bonk, and my supervisor Dr Michael Forret and will be used only for the purposes of completing this masters thesis. No video images of students will be made public in any way. All digital and paper records and transcripts will be securely kept in a locked storage room at the Tauranga Technology Centre for a period of two years and then destroyed. Digital files will be kept on compact disc, mini digital video tapes or flash memory cards in a securely locked file cabinet until destroyed. Temporary computer files which are password protected will be deleted fully once the thesis is written and completed.

4 Ethical Concerns

a Access to participants

Access to participants will be by consent from parents/guardians and the Principals and Board of Trustees from each school. These students do not have routine contact with the technology programs I currently run. Previously there have been technology classes hosted by the Tauranga Technology Centre and staff on an informally timetabled arrangement. These students are selected by their usual classroom teachers as candidates for GATE extension to normal class activities.

b Informed consent

Detailed information about the research will be provided in a covering letter to all parties involved (students, parents/guardians, principals, boards of trustees) and informed consent obtained by way of a signed consent form authorizing the students to take part in the research activities. Copies attached.

c Confidentiality

Confidentiality will be safeguarded by use of an alpha/numeric coding system substituting students' name and personal details to assure no direct reference will be made to individual participants.

Although still and video images will be recorded of student activities during the program to assist in analysis and interpretation of the project's findings, no images in which students can be identified will be used in the final reporting or publishing of the findings unless specific and separate permission is obtained from the students' parents/guardians.

All information will be kept securely in a locked file cupboard and will be available only to the class teacher, myself and my supervisor.

Digital files will be kept on compact disc, mini digital video tapes or flash memory cards in a securely locked file cabinet until such time as these are destroyed. Temporary computer files which are password protected will be deleted fully once the thesis is written and completed.

d Potential harm to participants

There is no foreseeable potential harm to participants from taking part in this program as these students are to be selected to take part in this GATE Technology program as a form of enhanced learning.

Participating students will not be assessed (i.e. it will not affect their academic progress within their school) for the work they will be taking part in for the technology challenges. There will be no disruption to any other class programs as the research activities will take part in specialist technology work rooms at times that are free from other scheduled classes.

e Participants right to decline

Participation in the research is entirely voluntary and students and/or their parents may choose not to participate at any time. Although parents' permission will be obtained for a child to be invited to be part of the research, the parent's permission does not obligate the child to take part in the project. The child's participation is entirely voluntary in that no coercion will be employed in any way. He or she will be free to stop participating at any point, and will experience no negative consequences for withdrawing.

f Arrangements for participants to receive information

Arrangements for participants to receive information will be in several forms; i) ongoing verbal feedback during each session, ii) part way through the set of sessions there will be a preliminary statement regarding acknowledgement of support and trends noted, iii) an open forum meeting at the centre for parents/guardians, principals, teachers and colleagues to share initial findings and contribute comments of interest, and iv) a copy of the final thesis will be provided to each school.

g Use of information

Analysis and interpretation of the data gathered during the study will primarily be used in the completion of the researcher's masters thesis. Findings of the study may also be presented at conferences and/or published in academic journals.

h Conflicts of interest

No foreseeable conflicts of interest exist for participants and there is no form of assessment to students or their work. This research will not affect any other work undertaken during their usual class programs.

i Other ethical concerns relevant to the research

No.

j Procedure for resolution of disputes

Procedure for the resolution of disputes will be to refer concerned parties to the research supervisors at the university. Contact details for the supervisors will be noted on all material related to this study.

If you have any questions or desire further information, please contact me via the details given above or you could also contact my Waikato

University supervisor:

Dr Mike Forret,

Phone: 07 8384481

Email: mforret@waikato.ac.nz

CSTER

Private Bag 3105

University of Waikato

Hamilton

5 Ethical Statement

The project will follow the University of Waikato Human Research Ethics Regulations 2000 and the ethical guidelines of the NZARE and include the following. Informed consent of participants will be obtained, without coercion. Exploitation (or perception of exploitation) of researcher-participant relationship will be prevented. Privacy and confidentiality will be respected. The participant will own the raw material collected, and their requests regarding the material will be honored. Participation in the research will not impact academically on the participants.

6 Legal Issues

a Copyright

Copyright will be determined as per University of Waikato copyright regulations.

b Ownership of materials produced

Ownership of materials produced will be as is usual with research in that the raw material of this study shall remain the property of the participants and the interpretations of that data to be the property of the researcher.

c Any other legal issues relevant to the research

No other legal issues which are relevant to the research are foreseeable.

7 Place in which the research will be conducted

Tauranga Technology Centre, 31 Fifth Avenue, Tauranga,

8 Has this application in whole or part previously been declined approval by another ethics committee?

No

9 For research to be undertaken at other facilities under the control of another ethics committee, has an application also been made to that committee?

n/a

10 Is any of this work being used in a thesis to be submitted for a degree at the University of Waikato? Please specify.

This study will comprise the body of data to be submitted as a thesis for a Masters of Education with the Centre for Science and Technology Education Research, University of Waikato.

11 Further conditions

In the event of this application being approved, the undersigned agrees to inform the Human Research Ethics Committee of any change subsequently proposed.

12 Applicant Request for Approval of Ethics Application

Signed by the Applicant

Date

Signed by the Supervisor

Date

Signed by the Chairperson/Director

Date

The ethics application is approved/requires further work

Signed on behalf of the Committee

(Chairperson of the Committee)

Date

Research Design Proposal

Research Objective

This research seeks to investigate the use of audio-visual material as a means of introducing technology challenge activities to intermediate students. The central theme of this study is to identify what the impacts are of using an audio-visual introduction, in the form of a selected film segment, on students' learning responses during technology activities.

Research Goals

The objective of this research is to better understand how to introduce technology challenge activities to students in ways that promote their interest and engagement with the task.

Research Methodology

A qualitative, interpretive methodology will be employed based on gathering data from classroom observations, interviews with students and the class teacher, student worksheets and digital still and video recordings of class activities. Gathering data in this variety of ways will allow triangulation of findings and enhance the reliability and validity of the study's findings.

Significance of Research

One of the challenges faced by technology teachers is how, within the limited time available, to quickly establish authentic contexts for learning technology that interest students and motivate them to engage with a problem. This study aims to shed light on how audio-visual material might be effectively used to meet this challenge.

Timeline

February 2008	Submit thesis proposal
March	Revise thesis application
April	Submit application for Ethics approval Obtain informed consent from participants, schools Conduct Technology sessions for research data gathering
May- June	Process, transcribe and analyze data Continue literature reviews
July- September	Section writing, produce drafts
October	Editing thesis, literature review continues
November	Submit thesis.

Appendix N. Figure 7.1 Letter to Prospective Participants

Thomas W. Smith,
118 Anderley Avenue,
Omokoroa RD 2
Ph: 07 5482483 or 021 2509868
Email: tom.deb@clear.net.nz

Date:

Understanding the impacts of an audio visual introduction on students attempting a technology activity

Dear Parents / Caregivers,

My name is Tom Smith and I am a Senior Technology teacher at the Tauranga Technology Centre. I am also studying towards a Master of Education degree at Waikato University. As part of this study I am completing a four-paper research thesis called *Understanding the impacts of an audio visual introduction on students attempting a technology activity*. This letter invites you to give permission for your child to take part in this research.

The purpose of the research

The central theme of this study is to identify what the impacts are of using an audio-visual introduction, in the form of a selected film segment, on students' learning responses during technology activities. The objective of this research is to better understand how to introduce technology challenge activities to students in ways that promote their interest and engagement with the task.

Findings from this research will support the development of the Technology Centre's teaching programs.

What the research involves

The research will involve students attending the Tauranga Technology Centre's GATE (Gifted And Talented Education) Program. The usual GATE technology program will run as normal and during the program data will be gathered from students' open-ended written responses in worksheets; from my informal interviews with students during the program; and from digital still and video recordings of classroom activities.

Participation is voluntary

Participation in the research is entirely voluntary and you or your child may, at any time, choose not to participate. Although we are seeking your permission for your child to be part of our research, your permission does not obligate your child to take part in the project. Your child's participation is entirely voluntary. He or she will be free to stop participating at any point, and will experience no negative consequences for withdrawing.

Who will see the information and how will it be used?

The raw data collected in the course of this project will be seen only by myself, the class teacher - Mrs Heather Bonk - and my University of Waikato supervisor Dr Michael Forret and will be used only for the purposes of completing this masters thesis. No video images of students will be made public in any way.

Students' anonymity will be safeguarded by use of codes or pseudonyms substituting student names and personal details to assure no direct reference is made to individual participants. Digital files will be kept on compact disc, mini digital video tapes or flash memory cards in a securely locked file cabinet until such time as these are destroyed. Temporary computer files which are password protected will be deleted fully once the thesis is written and completed

A copy of the final thesis will be provided to each school involved in the project and the results of this research may be presented at conferences or published in education journals, but none of the participants, nor the schools involved, will be identified.

Who owns the information?

The students will own their worksheets and the raw data they provide during the research. Tom Smith (the researcher) will own the final research report and any associated papers written about the research.

Who can I contact to find out more?

If you have any questions or desire further information, please contact me via the details given above or

you could also contact my Waikato University supervisor:

Dr Mike Forret,

Phone: 07 8384481

Email: mforret@waikato.ac.nz

CSTER

Private Bag 3105

University of Waikato

Hamilton

Yours sincerely

Tom Smith

The University of Waikato

CSTER Centre for Science and Technology Education Research

Understanding the impacts of an audio visual introduction on students attempting a technology activity

Participant Consent Form

This form should be read in conjunction with the attached "Letter for Prospective Participants."

I understand that participation in this research project will involve the following:

- 1 My child will be involved in a study, Understanding the impacts of an audio visual introduction on students attempting a technology activity
- 2 Data gathered for this project will not be made available to any third party and will be subject to the provisions of the New Zealand Privacy Act (1993)
- 3 My child will not be identified in any way other than a code number or pseudonym in data records or reports of the research findings
- 4 My child's participation in this project will not in any way affect their academic progress
- 5 My child / I may withdraw from parts of this study at any stage or withdraw from the project completely
- 6 If I have any concerns about my child's participation in this research project I may approach the researcher (Tom Smith), the study supervisor (Mike Forret) or the Director of the Centre for Science & Technology Education Research.

I give permission for my child
to be a participant in the research project *Understanding the impacts of an audio visual introduction on students attempting a technology activity*.

Parents Name:
(printed)

Signed:

Date

Appendix O. Figure 7.2 School Research Consent Form

Letter to Board of Trustees

Thomas W. Smith,
118 Anderley Avenue,
Omokoroa RD 2
Ph: 07 5482483 or 021 2509868
Email: tom.deb@clear.net.nz

Date:

Understanding the impacts of an audio visual introduction on students attempting a technology activity

Dear Chairperson,

My name is Tom Smith and I am a Senior Technology teacher at the Tauranga Technology Centre. I am also studying towards a Master of Education degree at Waikato University. As part of this study I am completing a four-paper research thesis called *Understanding the impacts of an audio visual introduction on students attempting a technology activity*.

The purpose of the research

The central theme of this study is to identify what the impacts are of using an audio-visual introduction, in the form of a selected film segment, on students' learning responses during technology activities. The objective of this research is to better understand how we may engage students to think about and respond with personal interest and motivation to technology challenge activities.

Findings from this research will support the development of the Technology Centre's teaching programs.

What the research involves

The research will involve students attending the Tauranga Technology Centre's GATE (Gifted And Talented Education) Program. The usual GATE technology program will run as normal and during the program data will be gathered from students' open-ended written responses in worksheets; from my informal interviews with students during the program; and from digital still and video recordings of classroom activities.

Participation is voluntary

Participation in the research is entirely voluntary and students and/or their parents may choose not to participate at any time. Although we are seeking parents' permission for the child to be invited to be part of our research, the parent's permission does not obligate the child to take part in the project. The child's participation is entirely voluntary. He or she will be free to stop participating at any point, and will experience no negative consequences for stopping.

Who will see the information and how will it be used?

The raw data collected in the course of this project will be seen only by myself, the class teacher - Mrs Heather Bonk - and my University of Waikato supervisor Dr Michael Forret and will be used only for the purposes of completing this masters thesis. No video images of students will be made public in any way.

Students' anonymity will be safeguarded by use of codes or pseudonyms substituting student names and personal details to assure no direct reference is made to individual participants. Digital files will be kept on compact disc, mini digital video tapes or flash memory cards in a securely locked file cabinet until such time as these are destroyed. Temporary computer files which are password protected will be deleted fully once the thesis is written and completed.

A copy of the final thesis will be provided to each school involved in the project and the results of this research may be presented at conferences or published in education journals, but none of the participating, nor the schools involved, will be identified.

Who owns the information?

The students will own their worksheets and the raw data they provide during the research. Tom Smith (the researcher) will own the final research report and any associated papers written about the research.

Who can I contact to find out more?

If you have any questions or desire further information, please contact me via the details given above or

you could also contact my Waikato University supervisor:

Dr Mike Forret,

Phone: 07 8384481

Email: mforret@waikato.ac.nz

CSTER

Private Bag 3105

University of Waikato

Hamilton

Yours sincerely

Tom Smith

The University of Waikato

CSTER
Centre for Science and Technology Education Research

Understanding the impacts of an audio visual introduction on students attempting a technology activity

Board of Trustees Consent Form

This form should be read in conjunction with the attached “Letter to Board of Trustees.”

I understand that participation in this research project will involve the following:

- 1 Students taking part in the Tauranga Technology Centre’s GATE Program will be involved in a study, *Understanding the impacts of an audio visual introduction on students attempting a technology activity*.
- 2 Students in the GATE Program will complete worksheets and take part in interviews during the normal course of the program.
- 3 Data gathered for this project will not be made available to any third party and will be subject to the provisions of the New Zealand Privacy Act (1993)
- 4 Students will not be identified in any way other than a code number or pseudonym in data records or reports of the research findings
- 5 Students participation in this project will not in any way affect their academic progress
- 6 Students/parents can withdraw from parts of this study at any stage or withdraw from the project completely
- 7 If I have any concerns about students participation in this research project I may approach the researcher (Tom Smith), the study supervisor (Mike Forret) or the Director of the Centre for Science & Technology Education Research

On behalf of the Board of Trustees, I give permission for Tom Smith (researcher/) to conduct the research outlined in the attached *Letter to Board of Trustees*.

**Board of Trustees
Representative
Name: (printed)**

.....

Signature:

.....

Date

.....

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