“Jumping the Fence”—a computer-based educational adventure challenging children to interact with the natural environment through physical exploration and experimentation.

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Abstract

The subject of computer gaming and its associated benefits and problems are of interest to researchers across many different disciplines. The potential benefits of computer games in education, training and entertainment are widely appreciated, but their downside is also equally a matter of concern. Whilst computer games are mostly played for recreational purposes, or to keep the player in suspense, the frequency of game playing and the average duration of the games we now engage in often bring about unintended consequences. On the other hand, not everything about playing computer games is bad. Computer Based Learning (CBL) has great promise as an instructional tool and, whether we like it or not, proficiency with computers has become a key part of the skill set required by modern children and familiarity with interactive technologies is essential for success in contemporary society.

The question that concerned the researcher was: how can we balance the benefits of CBL and computer literacy with the disadvantages of spending large amounts of time in front of a computer? Would it be possible to design a computer based learning game that actually required students to get up from their seats and move around in their nearby environment in order to engage with and advance in the game? In order to answer to these questions, the idea of creating an educational game called Jumping the Fence (JTF) was born.

The problem is, today’s students are highly sophisticated computer users and a lot of the computer based educational material on offer just simply doesn't compete with what these students are used to at home. It is easy to understand why computer game based learning would appeal to the new generation of learners and educators. Commercial and online games can immerse players through deep level engagement, intricate and dynamic structures, high quality visuals and audio and by providing highly rewarding experiences with near instantaneous feedback, but few actually require students to engage in physical activity.

The Jumping the Fence project utilises design-based research as its primary methodology, since this approach allows for the carrying out of both design and testing in the context of
real-life settings (Barab et. al 2005 p.91). Although normally considered to be a methodology primarily associated with educational practice, the iterative nature of design-based educational research aligns directly with the working methods used extensively in both creative arts practice and throughout the design professions. Although a combination of design-based research and situated design models inform the primary methodology, acquiring both quantitative and qualitative data to support the developmental processes is also integral to this project. This is why the exegesis has both a theoretical and a practical component. The theoretical part consists of seven chapters discussing the current literature on topics including computer based instructional design, computer gaming, the side effects stemming from excessive gaming and the positive effects of computer game use. From here the concepts for building an effective learning and teaching game are explored. The next chapters cover the methodology, the design and construction of the game, the observations made during the testing phases and end with a broader discussion on the outcomes of the research project and by finally providing some suggestions for future research. The practical component of the study consists of a prototype computer based game called Jumping the Fence that was used to test the strategies determined as an outcome of the literature review and to explore the creative and technical challenges involved in designing and building such a game.
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Statement of Original Authorship

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Signature: _____________________

Date: _____________________
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Uwe Terton, April 2012.
Chapter 1

Unlike most Australian children, my three sons have grown up without a television in the house. This was a deliberate lifestyle choice made by my wife and I long before they were born. Instead, the boys were encouraged to play outdoors on our bushland block, participate in sports, music and dance and to read, write, paint and draw as much as possible. They did, however, grow up using computers and the Internet and they are—without a doubt—members of that modern tribe that American educator Marc Prensky (2001) called “digital natives”.

A few years ago my middle son, Nils, stayed overnight at his friend’s home, where he and his friend stayed up into the small hours and then most of the next day playing action games on the family’s newly purchased Xbox video game console. When Nils returned home later that day, he looked quite pale and said that he was suffering from nausea and a bad headache. That night, he could not get to sleep and complained extensively about the weird colours he was seeing whenever he closed his eyes and that everything seemed to be spinning around. In the end, he became so distressed by these symptoms that we had to drive him to a late night doctor, where he was subsequently given a sedative. That incident triggered my interest in the effects of computer games on young children and, as any modern parent does, I turned immediately to the Internet to find out whatever might be known about what had happened to Niels. In retrospect, I now realise that the subject of computer gaming and its associated benefits and problems would naturally be of interest to all manner of researchers in any number of disciplines but, at the time, I was quite surprised to learn just how much interest there really was. The potential benefits of computer games in education, training and entertainment were widely appreciated, but their downside was also equally a matter of concern. As we have learned over the centuries, whenever a new technology is developed, its obvious benefits often harbour unforeseen consequences that are not immediately apparent, whilst its use often reveals applications unimaginable at the time of its invention.
After doing preliminary research into the subject and discussing the issue with professional colleagues, friends, my own university students and both high school and primary school teachers, I came to the conclusion that computer based educational games had immense potential as learning tools, but that it was necessary to also encourage children and young adults to leave the computer and spend more time outside being engaged in physical activities. The question was: how could such a balance be achieved? Would it be possible to design a computer based learning game that actually required students to get up from their seats and move around in their nearby environment in order to engage with and advance in the game? In answer to this question, the idea of creating an educational game called Jumping the Fence (JTF) was born. This game would seek to answer just that question.

As the literature shows, many of today’s children, teenagers and adults are regularly engaged in playing highly complex, interactive computer games—both online and off-line—using a multiplicity of different devices ranging from desktop computers and dedicated games consoles to increasingly sophisticated handheld devices such as tablet computers and smart phones. If there is one thing that (in the author’s opinion) has defined the first decade of this century, it must be the growth, speed and almost universal acceptance of the Internet as a pivotal focus for almost every imaginable human activity. Whilst the Internet is still inaccessible to millions of people, its overall influence on global affairs and its ability to provide almost instantaneous connectivity to masses of people has not only shaped the political, economic and sociological structures of the world, it has changed forever the way we see ourselves as individuals. For most of us in Australia at the start of the 21st century, Internet access was restricted to a fixed, low bandwidth dial-up connection. However, during the first decade of the “noughties” ever faster download speeds, more widespread connectivity via wireless communication, the growth of broadband and fibre optic cable systems and an ever expanding number of users, databases, resources and commercial applications has meant that the restrictions of time, location and distance have almost ceased to be a factor in our daily communications and commercial and social activities.

Whilst computer games are mostly played for recreational purposes, or to keep the player in suspense, the frequency of game playing and the average duration of the games we now engage in often bring about unintended consequences. Several problems arise with extensive long term gaming in young people, including reduced engagement in physical activities, which can cause obesity (Hesketh, Wake, Graham and Waters 2007 pp.1-8), exposure to violence and the promotion of stereotypes (Aldrich 2006), postural deformities (Subrahmanyam, Kraut, Greenfield and Gross 2000 pp.123-140) increased levels of aggression (Von Feilitzen and Carlsson 1998 pp.45-54, Gentile, Muniba and Anderson 2007 pp.1-82), seizures (Funatsuka, Fujita, Shirakawa, Ogumi and Osawa 2001 pp.1185-1197) social isolation and a reduction in communication skills when engaging with real people.
On the other hand, not everything about playing computer games is bad. Whether we like it or not, proficiency with computers has become a key part of the skill set required by modern children and familiarity with interactive technologies is now considered essential for success in contemporary society. There has also been a large number of studies undertaken that emphasise the positive effects that video and computer games can have for young computer game players. Positive outcomes include such diverse benefits as enhancing fine motor skills, developing visual acuity, developing three dimensional spatial skills and providing training in logical thinking. Amongst other things, computer games are also an excellent vehicle for introducing children to computers and computer technology (Subrahmanyam, Kraut, Greenfield and Gross 2000 p.2), they provide powerful educational and training tools (Behrman 2000 p.128), they may be used therapeutically as tools for treating phobias and behavioural disorders (Knight 2003) and they can help develop problem solving skills in a real time environment (Prensky 2001 p.14). Serious games and digital game-based learning are now widely acknowledged in the literature as an effective method of teaching children via computer games. The problem is, today's students are highly sophisticated computer users and a lot of the computer based educational material on offer just simply doesn't compete with what these students are used to at home.

Because of the impact my son's experience had made on me, I decided that the target audience for Jumping the Fence should be 8 to 12 year old primary school children, because it is the life experiences that occur at this age that are most likely to be remembered in adulthood. It was my idea that creating positive associations with nature might result in a special relationship between the children and the natural environment, which would develop more responsibility within the young and later adults to help preserve the natural environment. Also, children of this age group are well and truly examples of Prensky's Digital Natives (rather than what he calls Digital Immigrants) because they have grown up fully immersed in digital technology:

- Digital Natives are used to receiving information really fast. They like to parallel process and multi-task. They prefer their graphics before their text rather than the opposite. They prefer random access (like hypertext). They function best when networked. They thrive on instant gratification and frequent rewards. They prefer games to "serious" work (Prensky 2001 p.2).

According to Prensky, one result of this total immersion in digital technology is that the present generation of students actually think and process information differently from older generations (the Digital Immigrants) who have come to the technology later in life (Prensky 2001 p.1).

It is easy to understand why computer game based learning would appeal to the new
generation of learners. Commercial and online games can immerse players through deep level engagement, intricate and dynamic structures, high quality visuals and audio and by providing highly rewarding experiences with near instantaneous feedback. According to Foreman (2003) “games expose players to deeply engaging, visually dynamic, rapidly paced and highly gratifying pictorial experiences that make almost any sort of conventional schoolwork (especially when mediated by a lecture or text) seem boring by comparison” (Foreman 2003 p.15). We know all too well that computer games have the potential to instruct students about what they should learn and then assess and test that knowledge in a quick and efficient manner, as well as providing instantaneous feedback—and that this is one of the problems real life teachers experience everyday—the delay between assessment taking place and the marking and feedback on that assessment before being returned to the students. In game based learning and computer games, assessment of learning may not seem like assessment and is instantaneous—a player may pass to a higher level or be required to go through a maze again, pass a test, or repeat combat with a level “boss” before progressing. Whatever the outcome, the student knows immediately how well they have done.

A learning game is basically “a set of activities (special ways of acting and interacting so as to produce and use knowledge) and experiences (special ways of seeing, valuing, and being in the world)” according to Wastiau, Kearney and Van den Berghe (2009 p.15). This is why computer based learning games are an ideal learning and teaching tool that can be used to teach different skills from a wide variety of disciplines, ranging from intellectual pursuits such as mathematics, language and science to physical skills such as flight simulation, driver training and even surgical techniques. However, well designed game elements—such as well planned narration, clear goals, rules, rewards, multisensory cues and a high level of interactivity—are essential if the student is to arrive at the proposed learning outcomes (Dodlinger 2007 p.28) and, for this reason, it must be noted that the effective implementation of these elements into everyday classroom curriculum is well beyond the capacity of the individual, already overworked educator. Game based learning, if planned and implemented wisely, has already proven to be a more effective teaching and learning tool than many forms of conventional learning and the importance of serious games in teaching and learning can no longer be overlooked. However, the “learn by doing” approach of applied learning (constructivist learning) is still highly relevant in developing good learning games and, in the future, “learner-generated content will be recognized as one of the principle design mechanisms for learners to demonstrate mastery of a game’s learning objectives” (Derryberry 2007 p.12). In other words, the players (students) themselves may end up participating in designing the game (or modifying aspects of the game) for the next generation of players. To many educators schooled in the old ways of teaching and learning, this may seem incredibly disempowering and potentially quite threatening to their status as teachers.
Whilst there is considerable enthusiasm in educational circles regarding the potential of computer based learning, it is also important to ensure that the tried and tested methods of teaching, often developed and refined over many centuries, are not forgotten. Outdoor education, for example, has long been recognised as a powerful motivational strategy as well as a powerful character building activity (if that is not too “old fashioned” a term). Experiential learning and environmental education allow students to learn about the world they are studying by being actively a part of it and the work of Kurt Hahn and the Outward Bound organisation, which Hahn founded during World War II, is well known in this regard. As the literature shows, outdoor learning and teaching activities can be developed across almost all areas of curriculum, as well as addressing more contemporary themes such sustainable development education and global citizenship (Morris 2003 p.14). Cooper (2006) argues that since most children are naturally adventurous and that “they like to do new things, experiment, try things out and create their own adventures” (Cooper 2006 p.23) it makes sense for them to spend more time outdoors. Being outdoors also prevents young citizens from losing contact with nature—a child never exposed to the natural environment develops less awareness for the natural environment and may develop a tendency to be more open to the “continued exploitation and destruction of nature” (White 2004 p.5). Outdoor learning also has the potential to deliver other psychological benefits, such as reducing stress and improving the attention span of students due to its positive effect on mental alertness and by reducing attention deficit (Grinde and Patil 2009 p.235). For all of these reasons, it became clear to me quite early in the literature review, that if a way could be found to combine the benefits of outdoor education with the advantages of computer based learning, the outcome might be much greater than the sum of the parts.

1.1. The Research Problem and Associated Questions.

The literature review revealed quite early in the study that computer based simulations mirroring real life examples are known to be highly effective in developing an understanding of complex systems. It also became clear that such strategies could be readily applied to developing real time educationally focused games that address complex environmental and scientific issues and that outdoor learning was a tried and tested educational strategy well suited to support this area of learning. For these reasons, the study was designed to find out whether or not the idea behind the Jumping the Fence educational game would work in practice and whether the gaming and learning strategies developed might be refined for further use in other areas of education. Furthermore, it became apparent that if such an idea was successful, such a game might encourage users to reflect critically on their daily computer use and provide educators with a healthy educational alternative to the current classroom based approach to computer based learning activities. Educators would be able to use the game model developed in JTF to develop alternative learning strategies that encourage
physical and social engagement, but which can be implemented within other areas of the primary school curriculum. The questions arising from the literature review and the ideas discussed above resulted in the formulation of the following five guiding questions:

- Can a computer based educational game be developed that encourages young people to physically interact with the natural environment?
- Taking into consideration the sophistication of many online and console based gaming environments, what can we learn from their structure and design that can be applied in a much simpler educational context? Specifically, what kind of activities can we develop using these tools that will encourage young students to leave their computers and engage more in outdoor activities?
- Could a game-based environmental simulation be designed to enhance the learning experiences and educational outcomes associated with the Queensland Education Department’s identified Essential Learnings?
- What interpersonal strategies might be identified that would help achieve these outcomes?
- What other digital tools might be used in data transfer, collection and communication?

1.2. Methodology.

The Jumping the Fence project utilises design-based research as its primary methodology, since this approach allows for the carrying out of both design and testing in the context of real-life settings (Barab et al. 2005 p.91). Although normally considered to be a methodology primarily associated with educational practice, the iterative nature of design-based educational research aligns directly with the working methods used extensively in both creative arts practice and throughout the design professions. The use of an educational, design-based research methodology allowed the author to create an initial application which could then be used as a test vehicle, from which outcomes could be used to improve the application in an iterative process. This iterative approach to design allows for unexpected or unpredicted events and outcomes identified during test trials to be accommodated into the design process and hence future outcomes. In this way, the researcher can be open minded to surprises and react appropriately by adjusting the design of the application to cater for the needs of the research subjects and the environment where the test takes place. Design-based research is not static and it evolves from one stage of the development and testing to the next stage, aiming for refinement after each iteration. In addition, situated instructional design is used to ensure that all of the stakeholders in the learning process are included in the project outcome and that the game does not become what Royle (2009) describes as overly “teacherized.” As Wilson (1995) explains:

A key element in effective [instructional design] ID is the nature of the design team. Instead of a designer and subject expert working in relative isolation, situated ID suggests that all major constituencies be represented on the design team, including
teachers and students. These end users—the “consumers” of the instructional “product”—should contribute directly to the project’s design and development (Wilson 1995 p.655).

Although a combination of design-based research and situated design models inform the primary methodology, acquiring both quantitative and qualitative data to support the developmental processes is also integral to this project. Whilst immediate feedback through the use of surveys and questionnaires was deemed useful and used at the end of every game trial, it was decided that field observations, through note taking, interviews and videotaping of the actual game play in the field would also reveal interactions and outcomes that might not be reported in the post-game surveys. Both these approaches were planned in advance in association with the school in which the project was trialed and were undertaken under the University of the Sunshine Coast’s Human Research Ethics Committee’s approval (EC00297). Observational findings and the results of informal discussions recorded with the participant’s approval are included in the discussions and analysis of the research findings.

1.3. Structure of the Exegesis.

This exegesis has both a theoretical and a practical component. The theoretical part consists of seven chapters discussing the current literature on topics including computer based instructional design, computer gaming, the side effects stemming from excessive gaming and the positive effects of computer game use. From here the concepts for building an effective learning and teaching game are explored. The next chapters cover the methodology, the design and construction of the game, the observations made during the testing phases and end with a broader discussion on the outcomes of the research project and by finally providing some suggestions for future research. The practical component of the study consists of a prototype computer based game called Jumping the Fence that was used to test the strategies determined as an outcome of the literature review and to explore the creative and technical challenges involved in designing and building such a game.

Chapter Two is essentially a conventional literature review. It commences with a brief overview of the development and history of both offline and online computer gaming, the ways in which early games developed and how the early games developers came to define many of the computer game genres still in use today, including combat and shooting games, strategy games and a diverse range of role-playing games including the popular Massively Multiplayer Online Role-Playing Games (MMORPGs) which, in some instances, are now played by hundreds of thousands of people simultaneously around the world. Some of these perpetual virtual worlds are based on fictional realities with their own rules, laws and even physics and it is not unknown for some players to spend days and even weeks immersed in these “other world” activities. Another genre related to virtual worlds is simulation games and in recent years the sophistication and level of detail inherent in these games has made some
of them almost indistinguishable from reality—to the extent they could almost be described as interactive movies. Given their sophistication, it is natural that players want to spend long periods of time engaged with them, so Chapter 2.2 examines some of the psychological and physical issues associated with excessive video gaming and long periods of time spent using interactive media, including the contemporary phenomenon of cyber-bullying and the more obvious challenges of obesity and lack of exercise.

Fortunately, the story is not all bad. Computer games and game based learning have quite a number of beneficial effects, which are also investigated in this chapter. Several authors point to game based learning as a powerful application of computer games, pointing particularly to the use of simulation games and their ability to accurately model real world experience, whilst some suggest that the long recognised benefits of outdoor learning and outdoor activities might be combined with simulation games in order to provide children with the dual benefits of computer based learning (GBL) and engagement in physical activities in an outdoor environment. In order to understand some of the principles and strategies that might be central to the making of such a game, the chapter next looks into how existing (and effective) instructional design techniques and games design strategies have been developed and tested and how these could be adapted for use in the Jumping the Fence project. These findings are outlined and a proposition for extending game based learning outside the classroom is made based on the author’s contention that by designing the requirement for physical activity directly into the computer based learning process, some of the negative aspects of computer based learning (such as those caused by the sedentary nature of most computer based activities) might be overcome. A survey of several learning methods and theories that support outdoor learning is then presented to support the author’s contention and some of the negative issues evident in the literature (such as growing concern over the teacher’s duty of care and health and safety issues in modern schools) are discussed. Chapter two ends with the researcher’s observation that digital augmentation of academic content delivered via a computer based game combined with outdoor learning experiences offers a promising way to enhance the process of learning by giving the students a chance of exploring and reflecting on learning materials in real time—whether indoors or outdoors.

Chapter Three describes the motivation for the research and the research methodology, starting with a broad summary of the implications of the literature review and the positive and negative aspects of computer gaming. The Chapter introduces the reader to the author’s motivation behind the study and explains his interest in the Australian environment and his passion for environmental education. In addition, there is a brief discussion of the ways in which rapidly changing technology is altering the methods and tools by which digital content is being delivered and an acknowledgement that some of the technologies used in the study
may well be obsolete or changed beyond all recognition within just a few years. The role of
the Queensland Studies Authority in planning and overseeing the K—12 curriculum across
the state is discussed, as well as the function and purpose of the Key Learning Areas (KLAs)
and the identified Effective Learnings (ELs) that inform the KLAs. In the Methodology
section, the choice of methodologies and the theory that supports them is outlined and the
author’s rationale for the choice of de Freitas and Oliver’s (2006) four dimensional framework
as the model for designing and testing the effectiveness of the game application is discussed.
Finally the four stages of the research are presented (Researching and developing the game
idea, Testing of the paper based prototype, Design and initial testing of the computer based
prototype and Multiple revisions and testing of the prototype and analysis of findings) and
the activities undertaken in each are outlined.

Chapter Four describes the development of the Creative Component of this research
project—the design and production of an alternative form of computer game, which seeks
to blend the benefits of computer based educational gaming with a range of strategies that
encourage the gamer (and student) to move beyond the restrictions of the computer and
the classroom and engage directly with the natural environment—in the process forming
research groups, developing social skills and taking part in a range of low-impact, outdoor
physical activities. The chapter outlines the design processes and discusses the development
of the different components that make up the game and that (often invisibly) underpin the
production of the entire creative work.

To begin with, the practical development of the first trial version of the Jumping the Fence
game is described and its implementation into a primary school environment is outlined. The
discussion continues with an analysis of the preliminary data collected and how it impacts
on the design of the following stages of the game. Since it had been decided to structure JTF
and its educational outcomes, its visual design and language, as well as the levels of computer
literacy required to play it so as to be relevant to Australian Year 5–7 students engaged in
the standard Queensland primary school curriculum, an analysis of the relevant Queensland
Studies Authority’s KLAs and ELs was undertaken and this is presented at the start of the
Chapter.

Twelve visits in all, of two to three hours duration, were undertaken in the process of
testing the game prototypes, making observations and gaining feedback. Following the
initial visit to the school in which a preliminary survey of the students was undertaken,
the first version of the game (already prepared in a draft form) was revised based on
information obtained from the survey prior to its first trial. Chapter 4.1.2 discusses the
design and development of the paper based game prototype, and presents examples of some
of the preliminary sketches and notes used in the initial design phase. The different Level
designs (only two in the first test) are outlined and the thinking behind the graphical style
is discussed—in particular the author’s decision to base his work on the Flashimation style
already familiar to many of the students. Following this is a detailed examination of the
JTF narrative and how this came about and the key character and game guide Kangi the
kangaroo is introduced. The next section (4.2) deals more specifically with the gameplay and
game mechanics that determine how the game is played at the superficial level and then at
the deeper programming level. The eight key gameplay elements informing JTF’s design and
learning outcomes are described in this section and are summarised in Table 4.2, whilst the
game flow design is summarised in the section immediately following.

Section 4.2.3 goes into greater detail about the introductory animations and the
associated quizzes, before the activities in the main game level are introduced. It at this
point that some of the first screenshots of the digital game (still in development) are shown.
Following this, the roles and the role play mechanics are described and the motivational and
rewards systems are outlined, along with the guidelines developed to inform the Graphical
User Interface (GUI), the visual style and audio elements. From section 4.4 onwards, the
description of the game and its development becomes more engaged with “behind the
screen” considerations including navigation systems, screen structures and the technical
implementation (data flow, input/output, database and scripting). To make the Chapter
accessible to most non technical readers the scripting is only shown and discussed in small
elements, although the full code is available in Appendix B and online, where it is freely
available under a creative commons license (http://www.tnt-media.com.au/jtf/).

Chapter Five examines the actual implementation of Jumping the Fence and details how
the students interacted with the game, with their peers and with the course work in both the
preliminary and secondary phases of testing the game. Photographs, videotapes, discussions
and field observations, inform this stage of the study, although the author was asked by the
school to limit visual recording in the second phase of the study for privacy reasons and,
for this reason, there are no student images in the second part of the chapter. Nevertheless,
the value of observation, discussion and field notes is still of value. The chapter discusses
in detail what lessons were learned and the behaviours that were observed while the game
was actually being played by the students and these findings and observations are used to
support and clarify some of the data interpretations presented in Chapter Six. Evidence in the
form of field notes, teacher observations and feedback, informal interviews and unpublished
photographs support the second stage of the study. Perhaps one of the most interesting
outcomes of this chapter is the extent with which the students interacted with each other,
how readily the teacher in the role of game master engaged with the group and the reluctance
of the students to return indoors at the end of the sessions.

Chapter Six describes the data analysis and findings resulting from the surveys and questionnaires undertaken with the two study groups. The first half of the chapter presents the data gathered from the first visit to the primary school in 2008, during which the students filled in initial and post game questionnaires and the paper based game was tested. The first questionnaire was designed to provide an overview of the students—in particular their preferred learning styles based on Gardener’s (1983) Multiple Intelligences theory—which would help the author to develop a profile of the game’s potential audience and thus help him refine the prototype game to better suit their different learning styles. The survey answers provided following the second questionnaire (18 questions) were intended to inform the design of the next, fully digital prototype of the game and were consequently concerned more with the student’s response to the game structure and playability than the technical outcomes. Since the game was tested on a volunteer basis in after school time, any negative outcomes on student learning caused by playing the game that may have impacted on actual curriculum related requirements were largely eliminated. Students were still delivered the same learning content as their peers in class and subject to the same assessment.

The second part of Chapter Six looks more closely at the game and the game structure in terms of its potential use as an educational tool. In this visit, the class group was twice the size of the initial group, although the game was tested during class time and overruns in time did not occur. As with the first visit, two sets of questionnaires were presented to the students prior to and after playing the game, with twelve questions being asked in the first survey and thirty two being asked in the second survey due to the need to gain addition feedback on the graphical and technical aspects of the computer based game.

Chapter Seven, perhaps the shortest chapter, presents the conclusions and implications drawn from this study and suggests some ways in which the project can be taken further by those that may be interested in the ideas presented in this exegesis. The obvious limitations of the study are discussed and the potential benefits for educators who might want to use the JTF game model to develop alternative online learning strategies that encourage physical and social engagement are outlined. Importantly, the issue of dealing with the impact of rapidly changing technology is considered and some strategies for maintaining relevance are put forward. Finally, the need to encourage and maintain an interest in the Australian environment amongst young people is reiterated—although it probably doesn’t need to be.
Chapter 2

*Offline and Online Computer Gaming*

As the second decade of the twenty-first century dawns, the long-held dominance of the household television as the centre point for the daily provision of news, entertainment and information has finally come to an end. The television, of course, has not gone away, but its role and function have changed dramatically. In keeping with Moore's Law, which alludes to the fact that the processing power, storage capacity and the resolution of digital devices should double annually, advances in digital technologies have made the passive consumption of broadcast data from a single media source almost obsolete. Today’s television is now a multipurpose display device, hooked up to games consoles, computers, storage devices, DVD players and, of course, the Internet. However, for most people born since 1990, television use is secondary to time spent using a personal computer—and its major application for some members of current generations is now primarily as a high quality games display.

Even the most savvy of media corporations have been left behind in the tidal wave of change and, for many of these organisations, the end game has become a desperate attempt to catch up with technological change or to rewrite the rules in order to maintain the *status quo* of the past fifty years. Established global players such as Sony, Disney, NewsCorp, Time Warner and numerous other national and international corporations are now mortally challenged by the two way flow provided by the Internet and by the computing power of the personal computers sitting on the desks or on the laps of even the most casual of users. As a direct result of this widespread access to sophisticated computing power, massive storage capacity and the ability to network with other users, the demands of media “consumers” have changed significantly. Anyone who has access to the Internet, who uses a PlayStation, Wii or X-Box, or who plays a computer game of any sort, is now an active participant in an interactive experience. The passive absorption of prescribed content, such as reading a newspaper, listening to or watching a pre-manufactured CD or DVD disc, or
watching broadcast television, is now only a very small part of the communications mix. Users now generate and share their own content on sites such as YouTube, they chat and video conference online, they belong to specialised world-wide communities of like minded individuals, they participate in virtual worlds and they play interactive games that involve thousands of players. Most importantly, however, no matter what computer users are doing, they are spending an ever increasing amount of time sitting in front of a screen doing it.

Computer gaming has come a long way since the earliest computer based games first saw the light of a screen in the early 1960s. According to Fuchs and Eckermann (2001) early computer programmers and game designers (often the same people) initially developed the types of games that have come to define the computer game genres still in use today, including combat and shooting games, strategy games (such as those based on role playing games like Dungeons and Dragons) and a diverse range of simulation games. To the contemporary reader, it can be hard to imagine just how few computers were actually in use during the early 1960s and just how difficult it was to gain access to them. The engineer and physicist Howard Aiken, who was involved in designing and building the pioneering IBM Harvard Mark 1 computer in 1944, was quoted in 1962 as having predicted (albeit some years earlier) that a dozen computers would be sufficient to service the needs of the entire world in the future, with eight to ten of them being used in the United States (Cohen 1998 pp. 27-32). Although by the early 1960s this number had been greatly exceeded, only people with high level access to computers at work or in dedicated research facilities had any chance to engage with early computer games such as Spacewar (1962) a shoot-up game with animated spaceship icons designed by Steve Russell at the Massachusetts Institute of Technology (MIT) laboratories and which ran after hours on the room-sized PDP-1 computer (Stuckey 2008 p.13).

Now considered to be the world’s first true computer game, Spacewar allowed two players to shoot at each other and, because the original game quickly wore out the control switches on the front panel of the computer, it was also the first computer game to have dedicated gaming controllers built for it. Given the difficulty and expense of gaining time on these early computers, many of the early games were highly complex and were often related to the research topics the computer scientists were working on, but even so, the inherent possibilities of these emergent games were evident from the start. Just a few years later, in 1971, a young Information Technology (IT) student by the name of Nolan Bushnell (who later founded Atari) used his familiarity with the PDP-1 and Spacewar to built the first computer based arcade game, which he called Computer Space. Unfortunately, the game was extremely complex and never really became popular, especially given the general public’s unfamiliarity with computer technology at that time (Figure 2.1).

Nevertheless, by the time of the Apollo moon landings in 1969, a limited number of
so-called minicomputers such as the DEC PDP-8 were starting to become available in some North American high schools and enthusiastic students were learning to program them in languages such as FOCAL and BASIC. *Lunar Lander*, a text based simulation game that ran on the DEC PDP-8, was developed just months after the Apollo 11 landing by one such student, Jim Storer. Using less than 50 lines of code and operating in just 12 Kilobytes (KB) of Random Access Memory (RAM) the game required the player to land the lunar module on the surface of the moon by typing in the correct acceleration and deceleration figures, with the computer calculating the fuel consumption, landing speed and height above the lunar surface. The results of crashing or landing safely on the surface were displayed in white letters on a black screen background (Edwards 2009).

Perhaps one of the earliest computer games that developed a widespread following was *Hamurabi*, a text based serious game simulating economic processes within a virtual country. Originally written in the programming language FOCAL, its popularity spread rapidly when the game was rewritten in BASIC and made available to the growing number of microcomputer users that were adopting the second wave of personal computers (such as the Apple II, Tandy TRS-80 and the Commodore PET) in the late 1970s. Although players interacted with the game using only text-based input, the game strongly influenced the makers of *Hunt the Wumpus* (1973) and, much later, the well known city simulation game *Sim City* (1989). To an extent, the development of text based computer games occurred hand-in-hand with the growth in popularity of fantasy-role playing games such as the well-known *Dungeons and Dragons*, which was first published in 1974—and it is easy to see how the two genres of gaming would naturally come together.
The widespread popularity of coin operated pinball machines during the 1960s and 70s as a form of low cost entertainment in pubs, arcades and other public places, meant that the general public were already familiar with the concept of mechanical games. In fact, by the late 1960s pinball machines had become such a familiar icon of youth culture that they were used as a central theme in the 1969 rock opera *Tommy*, which was written by the British band *The Who* and later made into a highly successful film. Given the widespread popularity of pinball machines, it was a natural step for early computer game developers to introduce fairly large, table-top style coin operated machines containing the first generation of graphical computer games into the same locations as pinball machines. As noted earlier, an important step towards the mass production and widespread availability of computer games had already been taken with the founding of the computer hardware company Atari in 1972 by Nolan Bushnell and Ted Dabney (Fuller 2005). The first game that could be played on coin operated machines (as well as on Atari’s first generation home gaming devices and computers) was *Pong*, an electronic version of ping-pong played with two paddles on a black and white screen (Figure 2.2). The rapid development of more complex and colourful arcade games such as *Space Invaders* (1978), *Galaxian* (1979), *Pac Man* (1980), *Battlezone* (1980) and *Donkey Kong* (1981) saw the rapid demise of pinball as a mainstream form of entertainment during this decade. Although today some teenagers and young adults still spend large sums of money on coin operated games machines, by the late 1980s the arcade boom had started to fade significantly due to the availability of relatively low cost home computers and the introduction of Liquid Crystal Display (LCD) based hand held gaming consoles (Ahl 1984 p.30). Two of the early personal computers that drove the computer gaming industry from 1975 to 1978 were the Commodore PET, a home computer with a conventional audio cassette recorder as a storage device and the Atari VCS 2600, which could be hooked up to a home television (Fuchs 2005).

Perhaps the biggest challenge to arcade-style gaming in the early 1980s was the development of the first handheld portable gaming devices such as Nintendo’s seminal *Game and Watch* series, which first introduced several present day classics including *Manhole* (1981), *Donkey Kong* (1982) and the spin-off *Mario Brothers* (1983)—all of which were the precursors of the ground breaking Nintendo *Game Boy*, released in 1989. The popularity and near universal penetration of these low cost portable games into the youth market permanently changed the gaming habits of a whole generation of children and teenagers, with games such as *Pokémon* (1996) competing with the *Mario* series for the position of being the most successful game of the 1990s (Boerboom 2009 p.4). Indeed, the *Game Boy* revolution has been compared to the Rock’n Roll revolution of the late 1950s and early 1960s in terms of the extent to which it impacted on—and permanently changed—the behaviour of adolescents and teenagers (Beck and Wade 2004 p.14).
The early 1990s saw Nintendo produce more sophisticated versions of their popular *TETRIS* and *Super Mario Brothers* games specifically for playing on coin operated machines—a strategy which helped popularise these games amongst older players and helped break down some of the “nerdish” associations that computer gamers had begun to acquire in the previous decade. At the same time, Id Software’s release of the original “first person shooter” game *DOOM* in 1993 (in which the gameplay is seen from the perspective of the character being played by the player) profoundly changed the nature of computer gaming. Introducing complex three-dimensional environments, in which the character could freely move about, the option for players to connect machines and engage in multiplayer games and the ability for them to modify the game environment, *DOOM* brought a new level of interaction and immersivity to computer gaming. Given that the game was also considered to be extremely violent and that it contained supernatural themes also meant that it generated immense publicity—thereby introducing a whole new range of people to digital game playing. Today, *DOOM* is considered to be the foundation on which dozens of contemporary “first person shooter” games are now based. Inspired by the incredible success of *DOOM*, Id Software followed up a year later with the ultra violent game *Quake*, which also allowed more advanced users to develop their own modifications (or “mods”) to change the game environment, including sound and scripting behaviour. In competition, Epic Games released *Unreal* in 1998, which was one of the first games to come with built in 3D game editing software that allowed players without extensive programming or scripting knowledge to design their own 3D worlds and write add-on levels for the game. In particular, it was claimed by many gamers that the graphics were far more realistic than those available in *Quake* and *DOOM* and sophisticated user created environments, weapons and mods were exchanged and traded for money via the Internet (Gilbert 2007). The most recent versions of the game engine used in *Unreal* are still available for download for developers from the company’s web site.
Since 1994 the games console market has expanded enormously and developed into a multi-billion dollar industry, with manufacturers and developers engaged in an almost constant battle for supremacy in the highly competitive console market. Sony Computer Entertainment, for example, claim that more than thirty-eight million PlayStation 3 units were sold in 2009 alone (Sony Computer Entertainment 2010). Some producers, such as Sega and Atari have not been highly successful (Sega is now primarily a software development company) whilst some new players have emerged (such as Microsoft with the introduction of the X-Box in 2001) or have evolved new playing and interactive strategies, such as is the case with Nintendo’s Wii console and its movement based interface. Importantly, the development and widespread adoption of games consoles has not only brought computer games into the homes of many families, but it has permanently changed the way that family members now spend their leisure time (Mitchell 1985 p.135). Computer games and dedicated games consoles have reduced television consumption to the extent that the average an North American spends one to two hours per day less watching television due to their being engaged in console or computer based gaming (Beck and Wade 2004 p.4).

2.1. The Advent of Online Gaming.

Perhaps the biggest change in the way users accessed and played games came with the rapid expansion and spread of Internet services during the 1990s. Although government, military and educational institutions had been accessing and using text based Internet services such as email for some years, along with file transfer protocols (FTP) and other protocols such as Gopher to share content, it was the introduction of the first web browser Mosaic in 1993 that really caught the attention of the general public—due largely to its ability to display text and images within a simple, easy to use interface. It is argued that it was id Software’s decision to take advantage of the general public’s growing interest and access to Internet technology and release DOOM online as shareware (thereby making it freely available) that made it, along with World of Warcraft, one of the most popular multiplayer games of the 1990s (Egenfeldt-Nielsen, Smith and Tosca 2008 p.80). However, it was the fact that users had developed familiarity with networked games such as DOOM through using local area networks (LANs) that made the move to the Internet a natural and logical transition.

The use of networks for multiplayer gaming can be traced back to 1969 when Rick Blomme wrote a two player version of Spacewar that could be played on MITs in-house network PLATO—a game which turned out to be so popular that player numbers grew to nearly 1000 users by 1972 (Mulligan 1999 p. 2). Given their early experience with Spacewar, a number of MIT students were quick to develop a number of prototype games to run on these early computers, games which provided important experience for future game developers and a source of inspiration for the gaming industry. Across the United States in particular,
students were often the driving force behind adapting computers for game playing during after hours sessions and “downtime,” when the expensive machines were not being utilised for more important Faculty projects. For example, at Cornell University a *Dungeons and Dragons* style game called *Avatar* became the forerunner of the later game *Wizardry*, whilst Bruce Artwick, the programmer who later who wrote *Flight Simulator* in 1977, worked as a research student the Digital Computer Lab at the University of Illinois where he wrote his thesis on creating 3D style graphics for flight simulation. Part of Artwick’s applied work at the Digital Computer Lab involved developing systems for linking multiple terminals and the design of dial in systems to allow external connections and communication between remote users (University of Illinois 1996). Although *Flight Simulator* was first released for the Apple II, Microsoft founder Bill Gates was so impressed he bought Artwick’s company in 1980 and released the first version of *Microsoft Flight Simulator* in 1981 (Wapedia 2008).

A significant development in networked gaming can be traced back to John Taylor and Kelton Flinn, who were students at the University of Virginia during 1980. Taylor and Flinn had developed a dungeon based game called *Dungeons of Kesmai*, which incorporated simple ASCII graphics but, after seeing an advertisement by CompuServe which mentioned the software game *DECWAR* in 1981, they approached the company with a prototype of their own game which they were able to test on a DEC20 computer over three days—at a cost to CompuServe of nearly $100,000 in CPU time (Mulligan 2003 p.446). After forming the Kesmai Company the following year, they then developed *Island of Kesmai* as a multiplayer Multi User Dungeon (MUD) game for release by CompuServe in late 1985. Although CompuServe did not charge for access to the game, offering it as a free service, Flinn later noted “the price was actually $6 an hour for 300 baud, $12 for 1200 baud. Serious players paid the bucks” (Mulligan 2003 p.447). Kesmai were also hired by CompuServe to update and modify *DECWAR* (largely to remove copyrighted Star Trek references) and this was released in 1983 as *MegaWars* which, after 15 years, became the longest running pay-for-play game in the history of online gaming (Mulligan 1999 p.2).

The idea of pay-for-play online games caught on quickly and was instrumental in attracting customers to the fledgeling online service providers that were being established during in the early 1980s. Aside from commercial ventures (such as CompuServe) set up by the larger telecommunications companies, programmers and games enthusiasts themselves also engaged in creating their own networks, using existing telephone services and dial up modems. For example, game developer Mark Jacobs, founder of Adventures Unlimited Software Incorporated (AUSI) (later renamed Mythic Entertainment in 1995) set up a server system and 8 phone lines—charging players 40 $ US per month—to run a text based role-playing game called *Aradath* that was the forerunner of the new generation
of Massive Multiplayer Online Role Play Games (MMORPGs) such as *Ever Quest* and *World of Warcraft*. However, the efforts of game developers themselves were small when compared to the resources made available by the larger commercial Internet providers, such as CompuServe, General Electric’s Information Services (GEnie) and Quantum Computer Services (later America Online)—all of which launched a range of online gaming services on hourly or flat rates (Oracle ThinkQuest 2008). According to Mulligan (2003) this was the beginning of the “golden era” of online gaming and some notable games developed at the time for GEnie and AOL were *MidiMaze*, *Never Winter Nights* and the widely admired *The Hundred Years War* (1990), which was developed by strategy game expert Jim Dunnigan under commission from GEnie. *The Hundred Years War* was one of the first games that could host up to 300 players simultaneously and could take more than 400 days to play through (Oracle Education Foundation 2010), although the first widely recognised graphical Massive Multiplayer Online Game (MMOG) was the 1986 multi-player flight combat game *Air Warrior*, which was developed by Kesmai and available only on GEnie (Mulligan 1999 p.5). AOL reported that by 1992 there was estimated to be between three and ten million users using dial up modems to subscribe to online services who were actively playing online games as well as using other Internet services (Mulligan 1999 p.3).

It was the shift away from government control of computer networks developed primarily for use in military, government and educational communications which began following the demise of the Soviet Union in 1991, that really began to change the nature and accessibility of the large networked systems. In 1993, the DARPANet (Defence Advanced Research Projects Agency network)—later called more simply the ARPANet (Advanced Research Projects Agency network)—was opened up to commercial and public access and quickly became a key element of what soon became known as the Internet. The opening of the Internet to commercial enterprises, a greater number of universities schools and colleges, more government agencies and private individuals literally opened the floodgates to new applications and new users and, by the end of 1993, the Internet was estimated to have had approximately 4 million users (Mulligan 1999 p.9). However, it was the introduction of the first *Mosaic* web browser, which allowed ordinary users to view and create graphical and textual web content that made the greatest change to the ways in which users could relate to and access the Internet. Almost overnight, the commercial implications of online commerce were recognised and what later became known as the “dotcom bubble” began its exponential inflation. For gamers though, the graphical interface made available using web browsers was revolutionary and, just a year after *Mosaic* was launched, the MMO game *DOOM* flickered on to the computer screens of the rapidly growing online gamer scene.

Perhaps the biggest success in the early years of the World Wide Web was that of id Software’s *Quake* in 1996—a typical example of the incredible growth in participation in
Massively Multiplayer Online Role-Playing Games (MMORPGs) that followed the opening up of the Internet. *Quake* became so popular during that year that dedicated *Quake* servers were established in several countries to avoid global Internet traffic bottlenecks. More than 10,000 players could be logged in simultaneously and be engaged directly with other players in various locations within the game environment. The rapid expansion and development of this multiplayer technology is made apparent when we compare the situation with that of just five years earlier when, in 1991, BioWare’s *Neverwinter Nights* was limited to 50 simultaneous players and, more recently, the example of the MMORPG *EVE Online*, which claimed to have created a new record for itself on June 6 2010, when 60,453 players were concurrently logged onto the same server (Wikipedia 2010 b).

2.1.1. Massively Multiplayer Online Role-Playing Games.

MMORPGs are a genre of computer game in which the players take on a role as a character in a virtual world and interact with large numbers of other players via the Internet. The term was coined by Richard Garriott, the creator of the game *Ultima Online*, in 1997 (Wikipedia 2011). Since the mid 1990s, MMORPGs have become the most popular and time consuming forms of computer games and today they can be played using desktop computers, laptops, play consoles and, increasingly, Personal Digital Assistants (PDAs) and mobile telephones. The increasing availability of wireless Internet access has contributed significantly to their popularity, since access is no longer limited to a fixed connection and the games can be accessed at any time—a key factor for many players since many of the games are constantly evolving in real time.

In an MMORPG the game world exists before the user logs on and continues to exist when the user logs off. More importantly, events and interactions occur in the world (driven by other users) even when the user is not actively engaged in the persistent world. In order to accommodate the large number of users and minimise the impact on players at the micro or local level, the worlds in MMORPGs are huge and varied (in terms of terrain, flora, fauna and local inhabitants) and thus allow players to engage in events at a local level whilst participating in a more global context, as their strength, influence or powers develop. In contrast, the worlds of most standalone and locally networked games are more simplistic and generally accommodate only a few players (Yee 2006 p.5). Typically, the player takes on the role of a fictional character, often in the form of an *Avatar* (represented online as a customised figure usually designed by the player) that has a specific knowledge and set of skills. Players sharing the game space mostly work together to accomplish a set task and depend extensively on the help of other users—although each individual user ultimately decides which form of advancement they will pursue and what directions they will take. According to Yee (2006) “the richness and complexity of the game world’s environment generally eliminates the
need for super-ordinate goals or story lines” (Yee 2006 p.6). Major tasks are mostly set by the game developers that also host the game setting and game world (Wikibooks 2010). Conventionally, when the player leaves the computer his or her online status changes from at the keyboard (AK) to away from the keyboard (AFK) and all actions performed during the session are stored in the game database, allowing the player to continue with their mission or tasks on their return. Increasingly however, many games constantly develop whether the player is present or not, since they take the form of virtual worlds where competition is not necessarily a key element of the user experience, such as in Linden Labs’ Second Life.

Naturally, MMORPGs have evolved in different ways as users and designers incorporate new ideas and new technologies into the multiplayer gaming model. In recent years, variations such as MMO Social Games (MMOSGs), Real World Simulations (RWS) and Alternate Reality Games (ARGs) have appeared and are attracting new players and new interest as games engage with a wider range of activities and experiences. MMO social games focus primarily on social interaction as players develop characters and engage in some form of community or virtual world (which may have different rules, laws and economic structures—and even physics—to those of the real world) rather than “winning” through the achievement of some pre-specified objective. Maxis’ popular computer based city simulation game Sim City (first released in 1989) and its highly successful spin off The Sims, in which the player creates and manipulates virtual people in a virtual city, was released as an MMO game in 2002 but failed to achieve major success. Second Life (http://secondlife. com) was launched the year after by Linden Labs and has attained a much wider and longer term following, perhaps in part because it did not follow on from or try to replicate the sophistication of an already successful console game. As with The Sims, Second Life allows users to engage in a virtual world (in this case as an individual through the use of an Avatar) although at a more sophisticated level. In Second Life, objects and property can be created, traded or sold and social interaction can take almost any form, including the development of relationships with other players, the construction of homes and the participation in community activities such as meetings, classes and even politics. The game’s economy depends on the sale and purchase of user-created content using the in-world currency known as the Linden dollar—with Linden dollars in some cases being converted by players into real-world currency—a situation which unexpectedly led in 2008 to the directors of Second Life being forced to close several of its “virtual banks” in the wake of the US sub-prime mortgage crisis (Sidel 2008).

Online Real World Simulation (ORWS) games, which sometimes fall into the category known as serious games, are designed to simulate—with considerable realism—real world events, systems or activities in order to provide education, training or hands-on experience
without any of the risks associated with the actual activity. Although primarily intended for educational or training purposes, the games are often popular in that they demand intellectual engagement and provide experiences often unavailable to users in the real world. Again, the online versions of these games are often directly derived from computer or console based games, although their multi-player modes allow for far more complex scenarios to be simulated. Simulations include activities such as surgery, banking and investment scenarios, war games (for example World War II Online: Battleground Europe) weather and climate predictions, economic forecasting, ecological dependencies and many more (Rafter 2009).

The advantage of ORWS games is that they are risk-free and are available at little or no cost to users who may be unable or unwilling to undergo the experience in real-life. Air traffic simulation games such as the Virtual Air Traffic Simulation Network (VATSIM) and virtual airlines such as Air Northwest (http://www.airnorthwest.org) are typical examples of ORWS games, with players from around the world taking on the roles of airline pilots and air traffic controllers, flying and managing virtual planes in a virtual world and simulating flights under a range of weather conditions and traffic densities. Indeed, some RWS simulation games have become sufficiently sophisticated in recent years that their use is accredited as part of the formal training and licensing process, as is the case with the flight simulator XPlane.

Alternate Reality Games (ARGs) are a subset of MMO games but differ in their purpose and functionality from the game types discussed above. Because of their deliberate strategy of creating alternative realities where many of the rules of real life may or may not exist and the borders between fiction and reality are deliberately blurred, they will only be briefly mentioned here, as they are only of limited relevance to the Jumping the Fence project. Although gaining in popularity, ARGs are often tied in with advertising and promotional activities and are well suited to competitions, art-based community engagement and viral hoaxes, especially given the predominance of parody and humour within the genre. For example, the Wikipedia spoof Uncyclopedia, which describes itself as “the content-free encyclopedia anyone can edit” (Uncyclopedia 2010) copies the graphic design and logo of Wikipedia almost exactly in order to intentionally deceive visitors to the site, whilst the San Francisco based SFZero group describe their ARG project as a street based “collaborative production game” in which teams of players co-operate to “…build character by completing tasks for their groups and increasing their score. The goals of play include meeting new people, exploring the city, and participating in non-consumer leisure activities.” Tasks given to players including activities such as surreptitiously building children’s swings where none exist or secretly placing artist’s books into public libraries (SFZero 2010).

The phenomenal growth of MMORPGs is now drawing the interest of researchers around the world in an attempt to better understand the demographics, motivations and
experiences of users. According to Yee (2006, 2007) MMORPG users are motivated by a combination of possible rewards, although the same online game may have “very different meanings or consequences for different players” (Yee 2007 p.8). However, a notable motivational factor for many players is the emergence of “meaningful relationships between users which emerge during interaction”. The development of these meaningful interpersonal relationships extends beyond the game world and into out-of-game contact and communication—although it is the “functional constructs within the [game] environment [that] facilitate these social networks—[such as] combat groups (temporary collaborations between a few users), guilds (persistent user-created membership organizations) and ideological alliances (agreements between guilds or ‘racial’ groups)” that contribute to the development of these relationships in the first instance (Yee 2006 p.7). Yee also points out certain gender differences in initial player motivation, noting that whilst female players (typically older than male players) “find the same appeal and derive the same emotional salience and impact from online gaming,” they are also:

more likely to use the MMORPG environment to build supportive social networks, escape from real-life stress and to be immersed in a fantasy world. Female players do form stronger friendships than male players, but female players are not significantly more emotionally invested in the environment than male players (Yee 2007 p.36).

Yee (2006) also observes there are four factors that enable positive social interactions online:

Firstly, people have greater anonymity online. Second, the importance of physical appearance is greatly reduced. Third, the Internet transcends the problems of physical space and wide dispersion. And finally, users have greater control over the time and pace of their interactions. Again, all of these factors, except for perhaps the last one, are present in MMORPGs and suggest why enhanced social interactions occur in these online environments (Yee 2006 pp.12-13).

Millions of users around the globe enter into virtual online environments for many hours per day where they are engaged in tasks ranging from fighting battles, managing large numbers of people, building cities or saving the planet (not only one). In taking on these tasks, they may switch gender and age, live in the past, present or the future or experience life on another planet altogether—returning to reality after the game has finished or the user feels the need for a break. According to Yee “these hyper personal interactions are more intimate, more intense and more salient because participants can reallocate cognitive resources normally used for nonverbal gestures in face-to-face interactions and focus on the structure and content of the message itself” (Yee 2006 p.12).

2.1.2. Enhancing the Simulation—Improving the User Experience.

As a boy, I remember playing Pac Man, Phoenix, Space Invaders and Frogger on coin operated game machines at the local ice skating hall every afternoon until I ran out of pocket
money. The games were hugely popular and, as I played the games with my friends, the excitement seemed to stem from the fun of interacting with a new form of machine and the ability to control the “life” of a virtual character without any risk to my own personal well-being. The flashing colours and sounds these new machines could create were a major part of the attraction and, although the pinball machines we had grown up with were shiny, noisy and highly sophisticated, they were also old-fashioned and a symbol of an earlier generation. In contrast, these new games were definitely symbols of the future—the graphics were abstract and certainly not realistic, but they were unlike anything we had ever seen before. Every new machine that appeared was always more sophisticated than the last and every new game had more memory, better graphics, better sound and ever more realistic graphics. Thirty years later, we are almost at a point where the characters and world settings of computer games, consoles and online games are almost indistinguishable from reality. Figure 2.3 shows a scene from RockStar Games’ 2010 release Red Dead Redemption and illustrates the sophistication of the graphics and character rendering now regularly associated with console based games.

Along with ever more realistic graphics, the audio and special effects are increasingly more realistic and oftentimes even exaggerated, with customised explosions, car crashes that model everything from minor dents to major collisions and blood and gore splattering at every opportunity. The weapons used in many games are often hybrids of weapons that exist in the real world—but are naturally more powerful and destructive than their physical counterparts. The sound comes in quadraphonic surround quality and adds to the immersive experience of the game play. To add ever more realism to the games, game developers in the mid 2000s began looking towards Visual Simulation (VS) and Virtual Reality (VR) as the next stage in enhancing the user experience of the games (Zyda 2005 p.1).

Figure 2.3. Screenshot from the console game Red Dead Redemption, produced by RockStar games (RockStar Games 2010).
The aims of visual simulation and virtual reality are quite different, in that a simulation may take many forms and does not need to exactly replicate the appearance or physical form of the thing being simulated—for example, numbers on a table that change according to a user’s input may simulate the fluctuations in interest rates under the influence of certain political events. Virtual Reality may simulate a real environment, but at the same time it also seeks to replicate as much of the actual experience of being in that environment as realistically as is technically possible. According to Herdman (1994):

> virtual reality (VR) is the popular name for an absorbing, interactive, computer-mediated experience in which a person, or persons, perceives and interacts through sensors and effectors with a synthetic (i.e., simulated) environment and with simulated objects in it, as if it were real. The experience is characterized by inattention to the artificiality of the experience. The experience is provided by sensory stimuli generated by special human-computer interface (HCI) systems in response to the user’s movements or speech, which are detected by other interface systems and interpreted by computer (Herdman 1994 p.1).

Although some forms of simulation often also seek to replicate the appearance of the thing being simulated, it is the accuracy of the model that is most important. Hartmann (1996) points out that:

> Simulations are closely related to dynamic models. More concretely, a simulation results when the equations of the underlying dynamic model are solved. This model is designed to imitate the time-evolution of a real system. To put it another way, a simulation imitates one process by another process. In this definition, the term "process" refers solely to some object or system whose state changes in time. If the simulation is run on a computer, it is called a computer simulation (Hartmann 1996 p.6).

Herdman emphasises *experience* as the key objective in the creation of a Virtual Reality environment whereas Hartmann emphasises the idea of *process*, where the process is used to explain, prove, disprove or test a given set of circumstances. Kim, Park, Lee, Yuk and Lee (2001) see the use of virtual reality as a powerful extension to the art of simulation, especially within a teaching and learning context:

> A virtual reality physics simulation (VRPS) is an educational tool using a virtual reality interface that brings together a 3D model of real apparatus and a virtual visualization of physical situations in an interactive manner. VRPS enhances students’ understanding by providing a degree of reality unattainable in a traditional two-dimensional interface, creating a sensory-rich interactive learning environment (Kim, Park, Lee, Yuk and Lee 2001 p.1).

Virtual Reality and computer simulation have provided a highly successful model for the creation of both online and computer or console based games. The extent to which players...
become immersed in some of these digital games and simulations is widely noted in the literature on gaming (Behrman 2000, Brown 2005, Egenfeldt 2009, Griffiths 1997 etc.) but it is the ability of these games to also inform and educate that is of particular interest, to the extent that “some scientists claim that only through games and simulations we will ever be able to reach the engagement, learning and performance levels educators and trainers have been seeking for centuries” (Appelman 2005 p.2). Virtual reality not only adds to the realism that the player experiences while interacting with the computer-mediated and simulated environment, it immerses the player in the experience and thereby delivers and reinforces the content in a multimodal manner.

That students often find and engage with sophisticated simulation games with little need for direct encouragement became apparent to the author during the early stages of this research project. Many of the popular games identified by the test group of primary school students fell into the category of simulation games, with the most popular being Maxis’ strategic life simulation game The Sims. This game is a follow on from the highly popular city simulation game Sim City—both of which were developed by Will Wright, one of the first games designers to make simulation games popular (Prensky 2001 p.1). Originally, the Sims were the inhabitants of Sim City but, as that game dealt primarily with city level issues, their behaviour was that of citizens en masse, rather than as individuals. Interestingly, the individual characters simulated in The Sims are generally portrayed as being in their late teens to early twenties and they live largely independent lives (although infants and children are represented) providing a scenario which allows younger people to experiment with and simulate life experiences and social interactions that they may not yet be able to undergo in real life. At a more mundane level, one appeal to the primary school students might also have been that “The Sims takes the whole concept a step further by letting players create and control the inhabitants of Sim City, right down to their going to the toilet” (Prensky 2001 p.1). Some of the more technical aspects of The Sims and Sim City are relevant to the development of the Jumping the Fence project and will be discussed in greater depth in Chapter 4.

The creation of an artificial world which allows the player to experience its environment with all of his or her senses and in a realistic 3D space is the goal of many games developers and training providers. As technology progresses and our ability to simulate both real and imagined worlds increases, we will soon be faced with the situation where it might become impossible to differentiate between the game or simulation and reality itself. This state is widely alluded to in science fiction and in many recent movies, such as Larry and Andy Wachowski’s The Matrix (1999) and Christopher Nolan’s Inception (2010). Unfortunately, deep immersion in even present day interactive content may produce less than positive
effects, as noted by Strasburger (2004). Strasburger undertook a meta-analysis of 54 video game studies involving 4262 subjects and found that playing violent video games increases aggressive behaviour in children and young adults, increases physiological arousal and aggressive thoughts and feelings whilst simultaneously decreasing pro-social behaviour (Strasburger 2004 p.62). Today, many MMORGs and other simulation games are so well designed that some players enter into a long lasting state of flow, a state of mind were time and space becomes irrelevant and excessive time may be spent in engagement with the game. Where the game is fee based and the gamer is showing signs of addiction, financial predicaments can also result for the gamer.

Some of the games identified as being regularly played by the primary school students that took part in the study fall into the category of games that might cause problems if played excessively. Problems associated with such games include attention deficit disorder (ADD), aggression, violent behaviour, social withdraw and obesity. The next section examines the problems that can arise from excessive computer game play as well as some of the benefits that computer games can have for young gamers.

2.2. Problems Arising from Excessive Video Gaming and Engagement with Interactive Media.

The Jumping the Fence interactive learning project was developed specifically for children between the ages of 8 and 12 years old. In this section, we start by examining some the demographics of this group of Australian children with regards to their engagement with computer gaming and their use interactive media, before looking at some of the negative and positive effects that have been associated with extensive use of such media.

The findings of the national research study Interactive Australia 2009, conducted by Bond University for the Interactive Entertainment Association of Australia and the 2007 Use of Electronic Media and Communications: Early Childhood to Teenage Years report produced for the Australian Communications and Media Authority (ACMA), produce the rather startling finding that during the last few years of the 2010s approximately 88% of Australian households owned a device for playing computer games—clearly more than than the number of households that did not have children or adolescents living in them. Of all households, 39% had one device, 27% had two devices and 16% had three devices. Unexpectedly, but not surprisingly, 18% of digital game owning households indicated that they owned four or more devices for gaming (Brand, Borchard and Holmes 2009 p.6).

2.2.1 The Uptake of Digital Gaming in Australia—a Snapshot.

A better understanding of the familiarity with—and the integration of—digital gaming on the target audience of this project (children aged 8 to 12 years old) is revealed when
some of the relevant demographic data is considered. The first thing that stands out is the extent to which computer gaming has become a normalised activity amongst primary school aged children, with “95% of all children 6–10 years of age play[ing] computer games compared with 52% of those over the age of 50” (Brand, Borchard and Holmes 2009 p.7). This clearly indicates that young children are (naturally) being familiarised with both gaming and computer technology at a much earlier stage than the older generations were. Because computer gaming is such an integral part of contemporary childhood, it will inevitably shape their responses to emerging computer technologies in future years—and for this reason the author predicts that any apprehension of new technologies will be less evident as new generations emerge.

That the extensive use of computers and digital games has become an issue of community concern and a potential health issue was recognised by The Australian Government’s Department of Health and Ageing in 2004, when it recommended that children should spend less time using electronic media for entertainment (Australian Government Department of Health and Ageing, 2004). However, these early calls for attention were largely unheard, and a study conducted in 2007 found that only 7% of Australian children aged 9–13 years met the recommendations for sedentary screen based activities (CSIRO Preventative Health National Research Flagship and University of South Australia, 2007). The long term effects on the health and social behaviour of children exceeding these recommendations are yet to be seen.

An interesting fact to emerge from the literature is the shift in the ways young people access and use the Internet compared to older users. Whilst the Internet has long been promoted as a valuable learning resource in schools, it would appear that the majority of 7–8 year olds use the Internet primarily for online gaming and much less so for gathering information or communicating with their peers: “Most 7-8 year olds used the Internet at home at least some of the time (84%) mainly for playing games. The popularity of console and handheld games peaks with 8–11 year olds (53 % for an average 27 minutes per day). Mobile phones [are now] being used by 75% of 12–14s” (ACMA 2007 p.7). As any contemporary observer can see, mobile phones are now extensively used by primary and secondary school students and have already become a very important device for gaming and information gathering due to their multimedia functionality (sound recorder, sound player, photo and video capturing). In this vein, there seems to be a greater trend towards using mobile devices amongst younger users as desktop devices become relegated to the home office or bedroom, where their more extensive storage capacity and larger screens offer a centralised but more powerful support and storage capability and the cost of mobile devices continues to reduce on an annual basis. Advantageously, mobile devices are useful in enhancing mobility
and access to centralised databases whilst reducing the need for more sedentary forms of engagement such as sitting on a couch for long periods in order to access and transfer information, communicate and/or play games. The increasing penetration of mobile and wireless devices such as iPods and MP3 players into the consumer market also frees users from the restriction of being bound to a fixed location or a dedicated workstation.

As we can see, the majority of 8 to 12 year old Australian children have access to electronic games systems and that the average time the children are engaged with computer game playing is roughly 27 minutes per day—which amounts to 3 hours and 15 minutes a week. Overall, the average amount of time spent watching television and using either a computer or games console was two hours per day, the maximum amount of time recommended under Australian guidelines and only 55% of parents with children aged 8 to 11 years old had rules in place that controlled the content of both computer games and television content (Brand, Borchard and Holmes 2009 p.25). Several of the studies cited earlier also suggest that the time younger children spent playing computer games was not reducing the time spent watching television (although this did decrease significantly in the later teenage years as increased socialising with peers changed the mix). Many of the parents questioned set a time limit for their children regarding how long they could play computer games or watch television, however the 2007 ACMA report also revealed that it is nearly impossible for parents to control their children’s Internet and mobile device usage both in regards of content and time spent (ACMA 2007 p.8). Anecdotal evidence from the author’s undergraduate students suggests that television viewing reduces dramatically in favour of gaming and electronic media engagement during high school years and almost ceases in the late teens—an observation supported by Yi in his 2005 paper Advertisers Pay for Video Games. In this paper, Yi quotes Michael Goodman, an analyst at the industry research firm the Yankee Group, citing a study done in 2003 which noted: “the bottom line is that ad dollars follow eyeballs and Nielsen research shows that video games are eating into TV viewership [indicating a] seven percent ratings decline among males 18 to 34 ... directly attributable to video games” (Yi 2005 p.1). The ever growing use of portable communications tools also indicates that more and more mobile devices are finding use as a means of accessing electronic games—as indicated by the incredible popularity of the mobile games application Angry Birds.

2.2.2. Negative Effects of Playing Computer and Video Games.

As we have seen, there is considerable research showing that children are spending an ever-increasing amount of time using computers and mobile devices at home, school and whilst travelling. The increasing amount of time spent engaged with digital interfaces—along with watching television—comes at the expense of other activities such as spending time
outside, interacting with friends, playing sport and engaging in social activities. According to Gentile, Lynch, Linder and Walsh (2004) adolescent girls at that time were spending an average of 5 hours a week playing video games whilst boys from the same age group played for an average of 13 hours a week, significantly longer than subjects in the 8–12 year age group discussed previously. Gentile, Lynch, Linder and Walsh (2004) identified a larger group of the subjects from the adolescent age group of their research study as showing signs of what the researchers identified as negative behaviours, including:

- Addictive behaviour.
- Aggressive thoughts and aggressive behaviour (identified as possible triggers for school shootings).
- Emotional and behavioural effects, such as emotional loneliness; decrease of pro-social behaviours in social interaction and decreased school performance due to pre-occupation and family disruption.
- Conditioning of children, such as sexist views and altered Weltanschauung (world view); racism and blurred perception of the boundaries between the real world and the virtual world.
- Physical health implications, such as obesity caused by a lack of physical activities; risk of epileptic seizures; muscular disorders of the upper extremities and increased metabolic rate.
- Cyber bullying in MMORPGs (Hinduja and Patchin 2008 p.1).

We will examine some of these negative behaviours in the following sections.

### 2.2.3. Addictive Behaviour.

That video games induce addictive behaviours, is suggested by observations that dopamine levels remain elevated following computer game playing in the same way they do after engaging in other risk taking activities, such as extreme sports or gambling (Vorderer and Bryant 2009 p.2) and (Dejoie 2001 pp.523–530). Dopamine is a neurotransmitter naturally produced by the body and mostly has a calming positive effect on people due to its association with the “reward” system of the brain. Vorderer and Bryant consider that addictive gaming behaviour may be similar to responses exhibited by excessive gamblers (Vorderer and Bryant 2009 p.2). They also note that there is more to addiction than the rewards of chemically induced brain responses, arguing that psychological responses are also an integral part of addictive behaviour. Because video games allow the player to escape from real life constraints (often through the vehicle of an Avatar or virtual character that they control) they are able to engage vicariously in all kinds of risk taking behaviour without immediate threat to the health and life of their physical body. The sense of control that players have over their virtual characters may well be part of the reason that players (and especially children) may become so easily attached to their video games. Since children normally have only a
limited level of control over their own lives and are mostly subject to decisions made by their parents and teachers, the opportunity to experience worlds and interactions beyond their own boundaries (and the autonomy with which they can engage with them) present new opportunities and powerful incentives for deeper exploration. Computer games easily become a place where children can flee from their real world limitations and become “heroes” in full control of their actions and destiny.

Deep immersion in game playing induces in players a state of flow, a state in which one loses track of time and space. Being in a state of flow can cause issues related to the overuse of existing or limited time and may lead to social dysfunction and social disruption (Khan 2007 p.4). A simple example of this occurs when school homework is not done or is forgotten due to extensive time spent playing on a games console. Similar, more serious levels of time distortion can be also seen in addictive disorders such as gambling, but equally disturbing findings come from a 2006 survey conducted by the U.S. Council on Science and Public Health, which revealed that one of the top reasons for college failure or dropping out in the U.S. was excessive time spent on online gaming. College students at that time were mainly playing MMORPGs such as World of Warcraft (Tate 2008 p.10). Three years earlier, the Young Media Australia (2003) report summarised the negative effects caused by excessive exposure as follows: “excessive exposure to games can lead to a number of problems, such as poor eating habits, not mixing with others, poor communication, trouble with school work, social isolation and not paying attention in class” (Young Media Australia 2003 p.2). World of Warcraft continued to remain highly popular throughout the decade, and was later cited as a classic example of a “highly addictive” game in a somewhat sensationalist article in the Brisbane Courier Mail newspaper in June 2010, titled Gamers go Into Rehab as Teens Become Hooked on Computers. After noting that “school-age children have become so dangerously hooked on computer games that they are being offered live-in treatment at psychiatric facilities,” the article describes how Australia’s “first teenager admitted to hospital partly due to computer addiction” was “receiving therapy and doing schoolwork” in response to a condition known as “pathological Internet use” (McDougall 2010 p.1). In the same vein, McDougall goes on to state that:

Last year the first retreat for Internet addicts opened in Washington State in the US, welcoming a teen who was a captive player of World Of Warcraft. Mental health experts suggested Australia would soon need similar specialist rehabilitation facilities, with youngsters spending up to 50 hours almost non-stop playing online computer games. Psychiatrists have confirmed that some players wear nappies during long sessions so they won’t have to take a toilet break (McDougall 2010 p.1).

Perhaps the most level headed statement in the article was the reported observation by an Australian psychiatrist that excessive time spent on gaming was analogous to addictive
gambling behaviour. Sensationalism aside, it is clear that excessive time spent gaming is not productive or healthy behaviour.

2.2.4. Aggression and Violence.

Other studies on the effects of excessive computer gaming indicate that video games with extensive violent content may make children and teenagers respond to real world events more aggressively than usual. Strasburger (2004) argues that one reason for children and teenagers becoming more aggressive after playing violent video games is a failure by their parents or guardians to limit the time allowed for engaging in such games. According to Gentile, Lynch, Linder and Walsh (2004) only 55% of parents in the U.S. restricted the time available for their children to play computer games. Quoting Funk, Hagan and Schimming (1999) Gentile et al. point out that most parents are unaware of the content of the games played and the maturity rating given to the games by the U.S. Entertainment Software Rating Board (ESRB) (Gentile et al. 2004 pp.7-8). At the time of writing, Australia is the only developed nation without an Adults Only (18+) classification for computer games, with 63% of all Australian adults unaware of this fact—even though Australia does have an R18+ for other media (Brand, Borchard, and Holmes 2008 p.1).

Gentile et al. (2004 p.6) argue that teens who play violent games for extended periods of time tend to be more aggressive, are more prone to confrontations with teachers and may engage in fights with their peers—as well as showing a decline in academic achievements. Lynch (2002) states that young adults who (according to standard psychological profiles) are not “naturally aggressive” but who spend a lot of time playing violent video games were almost ten times more likely to be involved in fights than other “non-aggressive” young adults who did not play violent games as much (38% vs. 4%) (Kaiser Family Foundation, 2002 p.2). The level of violence has risen as the technical and graphical sophistication of computer games has increased; according to an 18 year longitudinal study of gaming magazines undertaken between 1988 and 2005, the mood and themes of games become less positive in outlook and introduced more supernatural, scary, and dangerous themes. Violent elements become more frequent and characters died in more extreme ways, whilst their appearance, attire and weapons increasingly reflected the aggressive nature of the characters (Miller 2009 p.12).

Since one of the principal features of computer games is their ability to deeply immerse players in the role of their chosen characters, it is understandable that some players may begin to blur the boundaries between reality and the virtual world of their characters. Boerboom argues that players come to identify themselves with these roles because they can make decisive choices on behalf of their virtual characters, often taking control of situations that are beyond their real world existence (Boerboom 2009 p.13). In the first shooter games genre,
players are rewarded for their aggressive behaviour by advancing to a higher level, where the intensity of combat and the responses required of the player are even more intense. Anderson (2003 p.121) observes that playing video games may increase aggressive behaviour in the real world because violent acts are continually rewarded by advancement in the video games. Dill and Anderson (2004) found that players who had prior experience playing violent video games responded with an increased level of aggression when they encountered difficult or challenging situations in the real world (Dill and Anderson 2004 p.1). According to Anderson and Bushman, playing violent video games significantly increased physiological arousal and feelings of anger or hostility whilst simultaneously decreasing pro-social helping behaviour (Anderson and Bushman 2001 p.358). However, a similar study conducted by researchers at Stanford University School of Medicine found that reducing time spent watching TV and playing video games to under seven hours a week decreased verbal aggression by 50% and physical aggression by 40% among 3rd and 4th graders (Robinson 2001 pp.17-23).

Lieutenant Colonel David Grossman, a former Army psychologist who is a specialist in using computer games and computer simulations to assist in desensitising soldiers to violence observed that when the blood, gore and emotions of the victims in the games were eliminated, the soldiers began to think of killing as more of a game (Glaubke et al. 2001 p.9). Grossman argues that playing violent computer games encourages children (and soldiers) to become desensitised to violence. Anderson and Dill (2004) see a parallel between the violent behaviour engendered by extensive video gaming and some of the training techniques used by the military to desensitise civilians prior to military service, especially in times of war. Table 2.1 compares some of the techniques traditionally used to condition soldiers psychologically for combat and some of the techniques used in computer games to enable players to advance to higher levels.

Table 2.1. Techniques used to condition soldiers for combat and techniques used in computer games to enable players to advance to higher levels (Anderson and Dill 2004 p.38).

<table>
<thead>
<tr>
<th>Training Technique</th>
<th>Military Strategy</th>
<th>Video Game</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brutalization and desensitization.</td>
<td>Demean and humiliate soldiers in boot camp and then demonise the enemy so that soldiers will be willing to kill.</td>
<td>Desensitise gamers through repeated exposure to violent acts and images so that they can advance through the game.</td>
</tr>
<tr>
<td>Classical conditioning.</td>
<td>Condition soldiers to associate pleasure with death.</td>
<td>Condition gamers to associate pleasure with killing within the game environment.</td>
</tr>
</tbody>
</table>
Training Technique | Military Strategy | Video Game
--- | --- | ---
Operant conditioning. | Teach soldiers reflexive, stimulus level response reactions to battle situations. In other words, condition the mid-brain so the soldier can kill on demand when involved in war. | Teach gamers reflexive stimulus response reactions to gaming situations. Train players to shoot to kill in order to advance through the game.

Since the Columbine High school shooting on the 29th of April 1999 researchers, educators and politicians have been attempting to identify the factors that drive young adults (and older people) to commit such horrifying acts. Since that year many studies have revealed links between violent video games and the growing number of school shootings, for example (Muschert 2007), (Gentile 2007), (Kline 2000), (Anderson 2003), (Ferguson 2008), (Jenkins 2006) and (King and Delfabbro 2010). Although school shootings are still predominantly a North American phenomenon (in March 2011, there had been 180 school shootings since 1966 in the United States and 20 in Canada) the problem is also evident around the world—in the same period there have been 17 school shootings in Europe and 10 in the Asia and the Pacific region—of which three occurred in Australian Universities (Wikipedia 2009). The problem is also emerging in China, with news stories emerging from time to time, but media censorship makes an accurate estimation difficult to make. One finding of interest is that evidence presented at the subsequent enquiry into the Columbine shootings revealed that the perpetrators of the massacre had customised a version of the popular first person shooter game *Doom* to resemble the actual layout of the high school in order to rehearse for the real thing (Subrahmanyam et al. 2000 p.133). Today, most first person shooter games provide level editors (such as *Sandbox* for the *CryEngine* games engine) which allow technically savvy players to modify, edit or create new levels or locations in which the game can be played. Along with changing the original environment, new characters may be created that reflect those in the real world of the player—such as teachers, bullies, friends or parents. A more recent incidence of a student creating a virtual model of his real world environment in order to plan and rehearse a shooting occurred in 2006 with the Geschwister Scholl school attack in Emsdetten, Germany. A former student of the school, Sebastian Bosse (whose online alias was RESISTANTX) spent countless hours playing *Counter Strike* and had modified the game’s environment to reflect the scenery of his former school. Bosse had downloaded the scenery from Google Earth and implemented it into *Counter Strike*, announcing his plan in a popular Internet forum for computer gamers shortly before the rampage (Dambeck 2006 pp.1-2). Luckily, no innocent people were killed (although eight people were wounded) in this incident. Bosse later committed suicide.

Unfortunately, copy-cat crimes are a common phenomenon. A more tragic shooting occurred at a secondary school in Winnenden, Germany three years later in which 16 people
died (including the perpetrator Tim Kretschmer) and several people were wounded. In the subsequent enquiry into the shootings, psychiatrist Reinmar du Bois presented evidence that Kretschmer was heavily influenced by two ego shooter games (Counter Strike and Far Cry 2) which he played both online and offline. Du Bois noted at the enquiry:

The clothes he [Kretschmer] wore on the day of the killing resembled those in Counter Strike and the kind of apparently cold-blooded killing he committed against most of his victims—with targeted shots in the head—is of the variety that is particularly rewarded in the game. As he later fled with a hostage at gun point, it was similar to a scenario in the game Far Cry 2 (Kaiser 2009 p.3).

Although there is a large body of evidence to suggest that there is a strong relationship between playing violent computer games and aggressive (even murderous) behaviour in some individuals, it is the age at which children are exposed to them that is of most concern. Younger players often lack the life skills and emotional maturity to enable them to differentiate between the simulation and the reality when it comes to the decision making process and such blurring of boundaries may have lasting repercussions in establishing the ways in which future patterns of behaviour are established. Thus, the earlier children play violent games the more likely it is that they may become more aggressive in later life—and aggression is only one of many effects that violent computer games can have on the players. Violent computer games have also been associated with psychological effects on gamers of all age groups and include such effects as emotional and behavioural disturbance, emotional loneliness, decrease in pro-social behaviours such as social interaction and decreased school performance due to preoccupation and family disruption. The next section will examine some of these broader social and psychological issues in greater depth.

2.2.5. Depression and Social Exclusion.

There is evidence of an increase in the symptoms of loneliness and depression associated with extensive Internet use and long periods of playing computer games, amongst both teenagers and adults. Declines in social involvement within families and social networks and feelings of loneliness have been measured (Byron 2008 p.20 and p.31). These findings are supported by a later study published in the 2007 Council of Science and Public Health Report (CSAPH). The CSAPH report’s author, Mohammed Khan, noted that symptoms of inappropriate time usage and social dysfunction/disruption appear in patterns similar to those of other addictive disorders. Addictive behaviours have also been identified in minors and include preoccupation and family/school disruption. Others effects such as somatic complaints, attention deficit problems including hyperactivity and family-based interaction problems have also been identified in similar studies (Dworak, Schierl, Bruns and Stru 2007 p. 979). Different game genres have greater or less social effects on the players, with
MMORPGs having the most significant emotional and social effects on players due to their highly competitive nature and their requirement for real time social interaction with other players. It is the constant need for communication with other players that allows MMORPGs to become a substitute for the real world social networks that the players had before playing (Ng 2005 p.111).

Japanese researchers have been particularly interested in understanding the social implications of computer, console and online games and the effects they have on players of all ages, in particular because Japan is well known for its computer gaming scene and is the world leader in the design, development and production of console and computer games. Atari, Sega, Nintendo and Sony were all household names and dominated the games market until the advent of Microsoft’s X-Box in 2001 and, even today, Nintendo and Sony still hold the lion’s share. Australian gamers still look to Japan as an indicator of future trends because of their advanced technology and leadership of the field—across the globe, most of today’s young adult gamers probably grew up with Nintendo’s Pokemon during the 1980s.

The Japanese have been extremely proactive in identifying aberrant or unusual behaviour associated with computer and online gaming, although the boundaries between generalised declines in social standards and specifically games related behaviours are impossible to define. Educationalist and philosopher Uchida Tatsuru describes several anti-social trends emerging amongst Japanese youth in his 2007 book Karyu Shika: Manabanai Kodomotachi, Hatarakanai Wakamonotachi (Downwardly Mobile Youth) including a lack of commitment to job, school, or home and behaviours such as shōnen hanzai (juvenile violence) and enjo kōsai, compensatory dating in which young women are caught up in the desire to acquire fashionable goods and don’t see any harm or danger in being paid to go out with older men—whether sex is involved or not (Uchida 2007 pp.11-14). Other negative behaviours include futōkō (dropping out of school) and gakkō hōkai (classroom breakdown—a steep rise in truancy and bullying in schools) (Brasor 2001 p.1). Perhaps the most serious development that can be specifically associated with computer gaming is Hikikomori, a phenomenon first described by Japanese psychologist Tamaki Saito and which describes a trend towards complete social withdrawal among some Japanese youth (Dziesinski 2003 pp.2-3). Persons identified as showing symptoms of hikikomori tend to sleep all day and spend the evening and night watching TV and playing video games (Muramaki 2000 p.1). Tatsuru partly blames computer gaming for this phenomenon, which affects Japanese children, teenagers and even adults in their late 30s. Hikikomori has been identified as a worldwide issue and is recognised as being commonplace in Australia—today the Japanese word has been widely adopted in many English speaking countries. One of the recognised causes of hikikomori is bullying at school and, for this reason, the victims often retreat into the safer worlds of their online game
spaces, where they are able to communicate with more like-minded individuals. Although Internet MMORPGs and Social Networking sites are often social spaces and are places where people with social disabilities or a lack of communication skills are able to make friends and live a social life via their avatar, many of these sites have also become the location for a new type of harassment—cyber-bullying.

2.2.6. Cyber-bullying in Online Social Media and Games Sites.

Cyber-bullying is now a common phenomenon amongst teenagers and, increasingly, younger children and even adults. Hinduja and Patchin (2008) define cyber-bullying as international and repeated harm inflicted through the use of computers, cell phones and other electronic devices. According to a study conducted by Juvonen and Gross at UCLA in 2008, nearly three in four teenagers were bullied at least once during the 12 month period of the study. Webster (2007) describes cyber-bullying as a fast growing trend that is more harmful than typical schoolyard bullying, since victims can be reached at any time and any place. Webster points out that for many children, home is no longer a refuge from the bullies because “children can escape threats and abuse in the classroom, only to find text messages and emails from the same tormentors when they arrive home” (Webster 2007 p.1). The range of bullying behaviour can extend from sending an e-mail containing abuse or expressing a wish to have no further contact with the victim, to more serious threats, sexual harassment, hate speeches, spreading rumours, lying about a person, speaking negatively about the victim’s friends and family and ganging up on someone (mobbing). Posting false statements on online forums designed to misrepresent or humiliate the target is also common. In extreme cases, cyber-bullying has involved identity theft and the unauthorised disclosure of personal information on public websites—often in a negative context or providing false information, for example, announcing that a person is homosexual or is a member of a terrorist organisation. As can be imagined, there is a no shortage of ways to use the Internet and social networking sites to humiliate a person and, in some cases the victims of cyber-bullying go on to commit suicide as a direct or indirect result of these bullying activities. Such suicides have become known as cyberbullicides. The Cyber Bullying Research website (www.cyber-bullying.us) is a valuable source for learning more about the different ways cyber-bullies use online communications to attack their victims.

Most (85%) cyber-bullying victims are also bullied at school or work (Juvonen and Gross 2008 p.78). Amongst school students, many victims do not tell their parents that they have become a victim of cyber-bullying because they fear that their Internet access will be limited or denied. For most young adults, the Internet is now the primary place where they socialise with friends, using social networks like MySpace and Facebook (although in 2011 MySpace is rapidly losing popularity) so taking away that source of communication is often
a social disaster for teenagers. According to Juvonen and Gross (2008) 51 percent of victims interviewed said that they were bullied online by someone they knew from school, whilst 43 percent of bullies were encountered online. Whilst bullying on social media sites is typically perpetrated by someone known to the victim or who has been introduced via the social network, bullying from online encounters often takes on a more anonymous—and sinister nature—since the real perpetrator may not be known to the victim (often operating under an alternative identity) and they may even be in another country. Massive Multiplayer Online Role Playing Games (MMORPGs) are an example of how this form of cyber-bullying can have serious psychological implications.

MMORPGs can be played in either person versus machine mode (PvM) or the more popular person versus person (PvP) mode. If the player decides to be in PvP mode, playing the game against or with other players, then the typical MMORPG requires both cooperation and competition with other, often unknown players. Because many MMORPGs are ranked based, beginners start at a much lower level in the hierarchy of players and must spend considerable time developing skills, acquiring knowledge and fulfilling basic tasks (a process known as “grinding”) in order to gain advancement. Senior players have at their disposal better weapons, greater magic and the ability to undertake more advanced missions or quests, using the skills and armour accumulated (often over a long period of time) by their game avatar. As the player becomes increasingly familiar with the game, the immersive nature and deep level of commitment generated by the role can foster quite intensive levels of competitiveness and may even cause significant emotional distress for those players whose avatars are killed and thereby lose or lose status within the game. To lose one’s character (by accident or as a result of treachery or deception) can hurt players to the extent that many withdraw from the game altogether and some, in known cases, develop depressive thoughts that can lead to suicide.

Because some players may reveal their disappointment in their lack of skill or success in the online game, they can also (inadvertently) open themselves up to bullying, embarrassment or other victimising behaviour. Wagner (2008) is of the opinion that anonymity is partly responsible for cyber-bullying in MMORPGs because the nature of the game environment makes it harder to identify the people responsible for the bullying and therefore encourages the cowardly actions of the cyber-bully (Wagner 2008). In 2002, the technology magazine WIRED published an article about the suicide of Shawn Woolley, who, according to his mother, was addicted to the online game EverQuest. Shawn’s mother Elizabeth Woolley blames addiction and possible bullying inside the game for the death of her son:

“One of the things I personally would like is for them [Sony] to look into his account,” Woolley said. “He quit his job the week before he did this and played (the game) the whole week, and I want to see if there was something that made him do this because he
didn't have any major crises in his life (Patrizio 2002).

In the same article, Dr. J. Michael Faragher (co-director of the Center for Addiction Studies at the Metropolitan State College of Denver at the time) was quoted as saying "anything that has the potential to generate significant changes in mood, effect or feeling is potentially addictive to someone and EverQuest, a game with no end—unlike your typical video game—is no exception" (Patrizio 2002). Unfortunately, owners of EverQuest, Sony Online Entertainment, refused to provide Woolley with information about her son's online activities, citing privacy concerns for the other players.

Online games researcher Nick Yee, from the Palo Alto Research Centre (PARC) and founder of the Daedalus Project—which studied the behaviour of more than 40,000 players involved in MMORPGs and the social effects on those players between 2002 and 2009—specifically looked into the relationship between children and MMORPGs as a part of the project. Yee asked parents who were regular MMORPG players themselves to identify the threats such games might have on their own children. Table 2.2 summarises the principal risks identified by parents in the study and provides some quotes made by parents.

Table 2.2. Principal Risks to Children Playing Online Games as Identified by MMORPG Playing Parents (after Yee 2008).

<table>
<thead>
<tr>
<th>Type of Risk Identified and Percentage of Respondents.</th>
<th>Parent’s Comments.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposure to Inappropriate Language and Themes (42%)</td>
<td>Exposure to ideas and behaviour that they are not ready for—e.g. inappropriate language or subjects in OOC chat (porn, aggressive or unfounded political or religious attacks, etc.) [M, 38].</td>
</tr>
<tr>
<td>Online Predators (32%)</td>
<td>A serious (but not very likely) danger would be for an Internet perv to attempt to contact my kids. Still, it’s something I’m on the lookout about [F, 50]. The sharing of personal information such as addresses, phone numbers and such by people preying on the gullible and inexperienced [M, 29].</td>
</tr>
<tr>
<td>Spending Too Much Time Playing (25%)</td>
<td>I would also be slightly worried about them becoming addicted to playing on the computer, and ignoring their real life commitments, like school work, or playing outside/exercising [M, 32].</td>
</tr>
<tr>
<td>Abusive Behaviour (13%)</td>
<td>There are very rude and hurtful people in every MMO, and children can be very sensitive to personal attacks [M, 32].</td>
</tr>
<tr>
<td>Social Immaturity (10%)</td>
<td>My primary concern is that he is not perceived as rude or annoying to players that don’t realize his age [F, 38]. Also concerned about the adults not being able to enjoy being adults because of the presence of the child [M, 34].</td>
</tr>
<tr>
<td>Being Taken Advantage of (6%)</td>
<td>Mostly players that persuade the kids to sell something for way too cheap, i.e. they are susceptible to con men [M, 37].</td>
</tr>
<tr>
<td>Type of Risk Identified and Percentage of Respondents.</td>
<td>Parent’s Comments.</td>
</tr>
<tr>
<td>-----------------------------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Thinking of Violence as a Solution (5%)</td>
<td></td>
</tr>
<tr>
<td>Lack of Social Skills (4%)</td>
<td></td>
</tr>
<tr>
<td>Lack of Exercise (3%)</td>
<td></td>
</tr>
<tr>
<td>Inability to Distinguish Reality from Fantasy (3%)</td>
<td></td>
</tr>
<tr>
<td>Learning Incorrect Grammar / Spelling (1%)</td>
<td></td>
</tr>
<tr>
<td>Developing Inappropriate Online Relationships (1%)</td>
<td></td>
</tr>
</tbody>
</table>

Note: some parents indicated multiple risks so percentages add up to more than 100%.

Although the views of parents are highly subjective, it is interesting to note that whilst 32 percent identified online predators as a significant risk factor (possibly based on their own experiences or observations) only 5 percent thought that playing MMORPGs might alter their children’s attitude towards violence as a problem solving strategy. Whilst there is research showing that playing MMORPGs present risks to children and young adults in terms of cyber-bullying, none of the parents identified it specifically as a significant risk factor, although 13 percent identified abusive behaviour as an issue (*there are very rude and hurtful people in every MMO, and children can be very sensitive to personal attacks*). It may well be that the parents did not differentiate between bullying and rudeness or personal attacks, but saw them as unrelated issues altogether. Nevertheless, the observation made above suggests that the existence of a more aggressive style of player is not unusual.

As described earlier, when a player immerses him or herself as a character within a role playing game—the possibility arises that some (usually more immature) players may find themselves blurring the boundaries between their character’s persona and those of their real world beliefs. Frequent role playing of characters that may be imbued with a sexist attitude, racist values or aggressive tendencies may lead to an altered *Weltanschauung* and the merging of behavioural responses between the game world and reality. However, even less immersive styles of video games may not always be as harmless as many parents might believe, since many console based, hand held and computer based games may also convey or reinforce less than positive social messages. The next section will discuss some of these issues in more detail.

### 2.2.7. Reinforcing of Stereotypes in Children’s Games.

Computer games send out messages to their players in very real and yet very subtle ways, and these messages have the ability to influence children’s attitudes, values and self perception. Whilst video games have been shown to improve such things as psychomotor and spatial
skills, visual acuity, strategic thinking and, in educational games, academic skills—the negative impact of the messages sent out by certain computer games also have the ability to reinforce gender and racial stereotypes, promote violence as a solution to social challenges and promote the use of firearms and other weapons. In 2001, the US based Children Now organisation conducted a study of 70 PC and console based games across seven playing systems entitled *Fair Play? Violence, Gender and Race in Video Games*. The game platforms surveyed were the Nintendo 64, the Game Boy Colour, the Game Boy Advance and the Sega Dreamcast (the latter was not widely sold in Australia) all of which were predominantly marketed towards children and adolescents—along with Play Station versions One and Two and a generic Personal Computer system. All the games selected for the study represented the top ten best-sellers for each gaming device and, since the Play Stations and PCs were (and still are) used by a much more diverse age group, the best selling games for these devices would have represent a much broader age demographic. The study examined each game at macro level (genre, rating, game elements and levels of sexual and violent content) and at micro level (individual characters were analysed in terms of gender, race, role and the character’s ability to commit and be a victim of violence) and each game was played fully through the introductory level by the research team (Glaubke, Miller, Parker and Espejo 2001 p.28).

The key findings of the study indicated that many of the video games studied were “overwhelmingly violent” and sent “strong negative messages about violence, gender and race to their youngest and most vulnerable players”. The authors concluded that video games often glorify violence by depicting it as being “without consequence to the perpetrator or the victim, sending the message that violence was an acceptable way to achieve one’s objective, was funny or harmless, or that players could be heroes if they used violence successfully.” Women and non-whites were large represented in “insignificant or stereotyped roles” with male roles making up 84 percent of all characters. Even so, males “are often cast in stereotypical roles and given unrealistic hyper-muscularized bodies”. Unlike the real world, games show little racial diversity and “people of colour [are] rarely ever cast as champions, rescuers or heroes, their portrayals often amount to nothing more than hyper-muscularized brutes, exotic fighting machines or athletes displaying near-supernatural ability” (Glaubke *et al.* 2001 p.27). Table 2.3 summarises the key findings from the *Fair Play? Violence, Gender and Race in Video Games* analysis of computer and console based games.

### Table 2.3. Violence, Gender and Racial Issues in Computer and Console Based Games. Based on Glaubke *et al.* 2001 pp. 2–3.

<table>
<thead>
<tr>
<th>Subject of study</th>
<th>Key Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Violence</td>
<td>Most of the top-selling video games (89%) contained violent content, almost half of which was serious in nature.</td>
</tr>
</tbody>
</table>
**Subject of study** | **Key Findings**
--- | ---
Killing was almost always seen as justified in the games and players were always rewarded for their acts of violence. | 
The negative consequences of violence were rarely shown, with most victims appearing unaffected by the aggressive acts committed against them. | 
More than three fourths of games rated “E” for “Everyone” (79%) contained violent content. In half of these games, violence was significant to the plot. | 
Gender | Female characters were severely underrepresented in video games, accounting for only 16% of all characters. | 
Male characters were most likely to be portrayed as competitors (47%), while female characters were most likely to be portrayed as props or bystanders (50%). | 
Male and female character roles and behaviours were frequently stereotyped, with males more likely to engage in physical aggression and females more likely to scream, wear revealing clothing (20% vs 8%) and be nurturing. | 
Video games in the study contained very few features found to be appealing to girls. | 
PC based games were the most likely of any of the game systems to contain features that appeal to girls. | 
Race | White characters were the majority in the video game population (56%) and were the only human characters in children’s games. | 
There were no Latina characters or Native American male characters in any of the games. | 
Nearly all heroes were white while African Americans and Latinos were typically athletes and Asian/Pacific Islanders were usually wrestlers or fighters. | 
African American characters were the least likely to show harm when they were victimized (61%), while nearly all Latino victims demonstrated harm and pain (83%). | 

Aldrich (2006) believes that the content of many computer games creates or exploits stereotypes—ethnic, racial or gender in that game developers often take shortcuts by using clichés and stereotypes to create a game character’s profile without needing to develop or explain how that character fits and will behave within the structure of the game world (Aldrich 2006 p.1). Whereas once “gangsters” were stereotypically represented in American movies as highly dressed, cigar smoking Italians with Brooklyn accents, they now appear in contemporary screen based media as sinister African American “gangstas” in reflectorised sunglasses (Figure 2.4). Directors do not need to spend valuable time describing to the audience who these people are and what their values or role might be—the stereotype does all the explaining and the plot proceeds unhindered. Glaubke notes this is a major reason that: “sexy female characters are created to appeal to males” and (vice-versa) muscle packed male characters are designed to appeal to females. However, those clichéd and super natural depictions of gender might paint pictures of male and females that have little to do with reality and how males and females live their lives in modern society: just as young girls may interpret highly sexualized characters as symbols of the ‘ideal woman,’ so too may young boys. These impressions may influence girls’ feelings about themselves and their place in the world, and they may also influence boys’ expectations
and treatment of females. In both cases, these images can have unhealthy effects on children's self-esteem, behaviour and relationships with others (Glaubke et al. 2001 p.14).

The Glaubke study also revealed that there is a scarcity of girl-friendly games within the computer game market, pointing out that this might also send out a message to girls that using computers and video games are activities for boys and that gaming therefore might not be acceptable for girls—a view that seemed to be reflected by the games industry at the time of the study. However, research quoted by Glaubke et al. also indicated that girls liked different game elements than boys liked to see in video games, such as “the ability to create something, to a reality-based environment, to the absence of violence” (Glaubke et al. 2001 p.16).

However, it is the broader misrepresentation of the real world through the use of racial and gender stereotypes, along with the depersonalisation of violence and its results that brings about the greatest concerns. When these factors are combined with excessive video game consumption, it brings about the possibility that children may develop a blurred perception of the boundaries between the real world and the virtual world and this state may engender difficulties in distinguishing between the roles taken on in the game world and the roles they have “being a child living in reality” (Byron 2008 p.11). This is particularly relevant for younger players and children between the ages of four and eight. Egenfeldt-Nielsen and Smith (2003) quote Buckingham (2000) saying that: “according to the social learning perspective, children imitate what they see and the extent to which it is fiction or reality is of no great significance. From a cultural perspective, however, it is pointed out that children are capable of making this differentiation early on” (Buckingham 2000 cited in Egenfeldt-Nielsen and Smith 2003 pp.22-23). It is clear that there still remains significant disagreement on just how children and young adolescents psychologically respond to the fluctuating boundaries between fantasy and reality that are now a part of almost every child’s existence.

To properly understand how computer gaming affects the growth and well being of young
people though, it is also necessary to understand some of the physiological implications of long periods of computer and video use and to identify ways in which some of the more negative implications can be minimised. The next section looks at some of the physical problems associated with spending extensive time sitting before a computer or screen and makes clear why the author of this study has been inspired to find alternative ways of implementing the powerful learning tools made available by computer based learning systems.

2.2.8. Obesity and Physical Health Issues.

A significant number of negative impacts on the physical health of players have been associated with excessive gaming. Unfortunately, many of the problems develop over long periods of time and so their implications are not always immediately apparent either to researchers or the gamers themselves. Issues such as obesity caused by a lack of physical activity, risk of epileptic seizures, muscular disorders of the upper extremities and increased metabolic rate are just a few of the problems that have been identified. However, this section outlines some of these issues at a fairly superficial level and is not intended to be a comprehensive analysis of the extensive literature that deals in considerable depth with this particular aspect of video and computer gaming.

The World Health Organisation (WHO) defines obesity as follows:

Overweight and obesity are defined as abnormal or excessive fat accumulation that presents a risk to health. A crude population measure of obesity is the body mass index (BMI)—a person’s weight (in kilograms) divided by the square of his or her height (in metres). A person with a BMI of 30 or more is generally considered obese. A person with a BMI equal to or more than 25 is considered overweight. Overweight and obesity are major risk factors for a number of chronic diseases, including diabetes, cardiovascular diseases and cancer. Once considered a problem only in high income countries, overweight and obesity are now dramatically on the rise in low and middle income countries, particularly in urban settings (WHO 2006).

Obesity is not only a problem for adults, it is becoming an increasingly wider problem amongst children and young adults. Hesketh, Wake, Graham and Waters (2007) describe obesity as the major contributor to the global burden of chronic disease and disability, warning that if children become obese in early childhood they are more likely to stay obese into adulthood and have an increased risk of developing both short and long-term health conditions, such as Type 2 diabetes and cardiovascular disease (Hesketh et al. 2007). A parallel study at the time also brought to light the significant impact obesity has on the Australian economy, with the total annual cost—including health system costs, loss of productivity and damage to careers being estimated to exceed $58 billion per year (Australian Bureau of Statistics 2008 p.1). Obese children are also more likely to be at higher risk of psychological and social problems, including discrimination, victimisation and bullying due to
their body size and restricted movement (Janssen et al. 2004 p.1187). A causal link between obesity and excessive gaming has been identified by Swiss researchers, Stettler, Signer and Suter (2004) who measured 872 children in first, second and third grades in 10 schools in north eastern Switzerland in order to identify the environmental and behavioural factors—in particular the type and duration of sedentary activities—that were associated with obesity amongst that demographic. The research team reported that obesity was directly associated with time spent playing electronic games and the time spent watching television and was inversely associated with physical activity (Stettler 2004 p.898). These findings concur with the later 2008 findings of the 2007–08 National Health Survey (NHS) and 2006 Children’s Participation in Cultural and Leisure Activities Survey in which children and teenagers aged 5–17 years old were monitored and which also concluded that children should not spend more than two hours a day watching TV, playing computer games or using other electronic media for entertainment (Australian Bureau of Statistics 2008).

Another health effect linked to excessive computer gaming is the triggering, frequency and intensity of seizures in subjects diagnosed as suffering from epilepsy. Graf et al. (1994) reviewed 35 reported cases of screen induced seizures and found that abstinence from video games was the preferred treatment, compared to anticonvulsant medications. The team found that quickly flashing images were in part responsible for triggering epileptic seizures in patients with photosensitive epilepsy (Graf et al. 1994 pp. 551-556). Finally, excessive computer game playing also has been associated with a unique form of tendonitis, called Nintendonitis (after the popular Nintendo games devices) which is a sports-like injury characterised by severe pain in the extensor tendon of the right thumb, a direct result of the repeated pressing of buttons during game play (Hoeysniemi 2006 p.198).

A range of related data indicates that excessive interaction with electronic devices, such as PCs, laptops and mobile devices (interactive technologies) may also cause muscular disorders of the upper extremities and increased metabolic rates as noted by Glaubke: “There are, however, several concerns that excessive computer use can become addictive and can cause physical harm to young children in the form of muscular-skeletal injuries, such as carpal tunnel syndrome, visual strain, and obesity due to lack of exercise” (Glaubke 2007 p.15). Other health issues linked to extensive time spent in sedentary gaming include musculoskeletal disorders of the upper extremities and an increased metabolic rate (Kahn 2007 p.3). Jannsen et al (2004) also draws a connection between childhood overweight/obesity and associated metabolic health risks that have the potential of causing problems with social interactions and relationships (Jannsen, et al, 2004 p.1993). Both Hesketh and Glaubke conclude that children’s active screen time needs to be monitored and reduced to below 2 hours per day and that children need to be encouraged to take a more extensive part in physical activities.
to counteract the increased lack of mobility associated with time spent in front of computers (Glaubke 2007 p.15) (Hesketh, et al. 2007 p.1).

As we have seen, there is considerable evidence to suggest that spending excessive amounts of time spent sitting in front of a computer or games console is not good for children, adolescents or teenagers. In fact, extended periods of sedentary activity and immersive engagement with a computer or electronic games, passive viewing or any online activity is not good for anyone. Of importance to this study though, is evidenced based research showing that the negative aspects outlined in the sub-sections above are especially serious when we consider their impacts on younger children (Kline 2000 p.12). As noted, games containing violent and stereotypical content are especially problematic because children and young people are influenced by what they see in the media and they have difficulty in differentiating between fantasy and reality. Engaging in long hours of computer based gaming and sedentary activity is linked to childhood obesity, epileptic seizures, tendonitis and metabolic disorders. Associated negative effects of excessive computer game play range from addictive behaviour, aggressive thoughts, emotional loneliness, decrease of pro-social behaviours, reduced school performance due to preoccupation and family disruption, altered Weltanschauung (including racism and stereotyping), the blurring of boundaries between the real world and virtual world and cyber-bullying.

2.2.9. Positive Effects of Playing Computer and Video Games.

So far, this section may seem to have taken a rather gloomy view of what is, to many people, an exciting and rapidly developing form of new media. Fortunately, there has also been a large number of studies undertaken that emphasise the positive effects that video and computer games can have for young computer game players. Positive outcomes include such diverse benefits as enhancing fine motor skills, developing visual acuity, developing three dimensional spatial skills and providing training in logical thinking. Amongst other things, computer games are also an excellent vehicle for introducing children to computers and computer technology (Subrahmanyam, Kraut, Greenfield and Gross 2000 p.2), they provide powerful educational and training tools (Behrman 2000 p.128), they may be used therapeutically as tools for treating phobias and behavioural disorders (Knight 2003) and they can help develop problem solving skills in a real time environment (Prensky 2001 p.14). The next section will examine how computer games are being developed into powerful learning tools and are finding application in an ever-widening range of sophisticated learning and teaching applications.
2.3. Game Based Learning and Outdoor Learning.

This section examines the ways in which game based learning and outdoor activities might be combined in order to provide children with the dual benefits of computer based learning and engagement in physical activity in an outdoor environment. It is the author’s contention that by designing the requirement for physical activity directly into the computer based learning process, it is possible to overcome many the disadvantages discussed in the previous section—in particular those directly caused by the sedentary nature of most computer based activities. The need for alternative learning games that educate, are fun to play and that encourage the player to engage in physical activity and (ideally) with the natural environment, is clear if computer based learning is to achieve its full potential.

Computer games are very popular amongst young children and young adults and are today an integral part of contemporary society, playing a bigger role in the lives of children and young adults than does television. Prensky (2001) coined the term “digital natives” to describe the generation that has been brought up entirely in a world that encompasses mobile phones, computers, digital interactive TV, the Internet, email, instant messaging, web cams, games consoles and digital cameras. The use of digital technology in almost every form of communication and as a means of sourcing information is second nature to these so called digital natives and computer games naturally play a large role in their life (Prensky 2001 pp.1-6). So entrenched have digital communication become, it is no longer possible to isolate children from them, even if we see it as a means of protecting them from some the negative effects discussed earlier—since attempting to do so would exclude them from being members of what is now a societal norm.

2.3.1. Game Based Learning as a Part of the Solution.

Educator Marc Prensky suggests that cognitive development is greatly influenced by learners’ interaction and the ‘trigger speed’ at which their ICT (Information and Communication Technology) rich world operates (Royle and Clarke 2003 p. 5). Prensky (2001) points to the following attributes as defining his “digital natives”:

- They are used to receiving information at high speed,
- They have developed the ability to parallel process and multi-task,
- They prefer to access graphics before text,
- They prefer random access (such as hypertext) rather than linear structures,
- They work best when net worked,
- They thrive on instant gratification and frequent rewards,
- They prefer games to "serious" work

and goes as far as to suggest that as a result of these factors "today’s students think and process information fundamentally differently from their predecessors” (Prensky 2001 b p.2).
Whether Prensky is correct in his assumption that Generation Y students actually reason differently to older, non-digital, generations is still being debated, though it is clear to the author (from his own teaching experience) that the ways in which students choose to learn have changed significantly in recent years. In particular, the change in student learning behaviour that has taken place since the advent of the Internet is of critical importance in creating content and in the planning and building of a learning environment suited for today's new generation of learners. One genre of electronic media that has become a natural focus of educators is video games, with the adaptation of existing games and the customised development of new games for purely educational purposes. Prensky, for example, describes his own team's development of a computer based game called *The Monkey Wrench Conspiracy* as means of teaching highly technical new CAD software to 20-30 year old engineers who had otherwise showed little enthusiasm for learning it, due to the steep learning curve the software required (Prensky 2001b). Other authors have proposed the adaptation of existing, already popular video games and the tweaking of their content to cater for e-teaching purposes—thereby avoiding the need for students to spend time relearning the game and its playing style. The literature of Game Based Learning (GBL) paints a bright picture for the potential of video games for education (Malone 1981, Malone and Lepper 1987, Gee 2004, Foreman *et al.* 2004, Barab *et al.* 2009, Royle 2009).

The European Commission's *Lifelong Learning Programme* found that students of all ages learn better when they are having fun and are engaged in the learning process and also showed that learners benefit extensively from game based learning (Spectre and Prensky 2000 p.1). Van Eck (2006) makes the point that all games (not only video games) embody a diverse range of learning modes, arguing that meaningful learning takes place because the player learns in a manner that is directly related to the environment of the game and must apply the learned skills and knowledge in the immediate context of game scenario, thereby providing instantaneous application and reinforcement of new skills and knowledge. Van Eck observes:

> Learning that occurs in meaningful and relevant contexts, then, is more effective than learning that occurs outside of those contexts, as is the case with most formal instruction. Researchers refer to this principle as situated cognition and have demonstrated the effectiveness of this principle in many studies over the last fifteen years (Van Eck 2006 p.4).

Other authors (De Freitas 2006 p.18, Sandford and Williamson 2005 p.19) describe how computer games can further facilitate and enhance learning, arguing that they facilitate learning not only because they are fun or create a meaningful learning experience, but also because they are immersive, requiring the player to make frequent and important decisions, have clear goals, since they can adapt to each player individually and may involve a social
network. Pivec and Pivec (2008) in summarising MacMahan (2003); Paras and Bizzocchi (2005); Gentile (2005) and Kearney (2006) point out that effective immersive environments not only use authentic contexts, activities and assessment—they also involve mentoring and apprenticeships in communities of practice (Pivec and Pivec 2008 p.4). The combination of those applied strategies can produce a powerful pedagogy that allows for immersion and intense, extended experiences with problems and contexts similar to those of the real world, thereby providing the learner with a much more authentic learning experience.

In addition, motivation, reinforcement and reward are important aspects of good learning and should be continuous throughout the game play. The motivation cycle can be kept up by constant and immediate feedback, direct responses, the opportunity for reflection and active involvement in the decision making process in order that the designed learning outcomes can be achieved (Garris et al. 2002 p.441). Video games have proven highly successful in catering to all of these prerequisites to meaningful and effective learning. Furthermore, game based learning can present opportunities to rethink how we learn and teach because it can provide both learners and teachers with the same level of authority in the teaching and learning situation, thus providing educators with the potential to break with the traditional “teacher in front” classroom model.

Canadian educationalist Diana Oblinger points out a further advantage of game based learning applications, in that they can be used to create simulated spaces which she calls “immersive environments” (Oblinger 2006 p.3). Properly designed immersive environments provide learners with the opportunity to design and produce their own learning materials, share learning experiences and rehearse skills for use in the real world. Another advantage of applications incorporating such immersive environments is that aside from using them on fixed desktop computers they can be used on handheld devices that communicate via the Internet, enabling multi-channel communication with the core application, using these for accessing, uploading and sharing information with other users via a central database. Such technologies provide great mobility to the users and provides the flexibility for learning to move outdoors and to occur over great distances. This allows educators to move their teaching to places were the learning experience is more authentic—such as learning about animals and plants within the ecosystem of a forest, rather than in a sterile, indoor classroom environment.

Oblinger describes a future in which handheld devices are ubiquitous enough to enable learners to participate in real-time online learning and to interact with computer based agents (such as artificial intelligence) and other learning tools in a semi-virtual world, pointing out that virtual environments and augmented realities can induce a sense of psychological and physical immersion to the extent that the user may feel themselves to be actually inside
an environment (Oblinger 2006 p.3). More practically, game based learning applications, combined with handheld devices, can help create a realistic game environment that enables the gamer to explore and learn about spaces and places in the real world (especially outdoor environments) in greater depth than has ever been possible before now. As well, environments and activities normally inaccessible or impractical to access can be made available to students. Such game based learning applications are considered to be serious games and can realistically simulate a wide range of situations, such as flying an aircraft, running a government, driving a car and even exploring underwater or extraterrestrial environments. Researchers studying serious games aim to gain a better understanding of the ways in which games are used in education by bringing game developers together with educators in order to develop learning games that are fun, motivational and have educational value (De Freitas 2006 p.6). Rebetez and Betrancourt (citing McFarlane et al.) list the following advantages of game based learning:

- Developing skills and abilities: from specific skills like deductive reasoning or memorisation, to more contextual ones like co-operation and communication skills.
- A stimulus for learning: the game sessions can be used as a starting point for other activities such as creative writing or charts analysis. Video games influence affective and motivational aspects.
- Content related learning: this is possible but can be very peripheral. Moreover, content in the game can be presented in a very different way as it usually is in the classroom. Games allow direct knowledge and content learning (Rebetez and Betrancourt 2007 p.4).

Developing skills, providing the stimulus for learning and providing relevant content are essential elements of any successful teaching and learning experience. However, there is more to be considered when it comes to developing an effective computer based serious game with deliverable educational outcomes. Other researchers, such as Hadfield and Jopling (2008) encourage educators to better utilise deep learning strategies to encourage reflective, meta-cognitive learning that extends beyond immediate course requirements. Such “authentic” teaching and learning should be embedded in real-world contexts and should also be meaningful to the day to day life of the students wherever possible. Such motivational teaching must be clearly task and goal oriented, thereby “encouraging students to conduct research that goes beyond what is taught in a given teaching situation” (Hadfield and Jopling 2008 pp. 5–32). In a similar vein, Royle argues that “designing learning within schooling that emulates the practices of informal learning would be a positive step for both learners and teachers and would remove the separateness from life relevance ...”(Royle 2009 p.2). Royle blames the fact that many learners see formal school based learning as being too far removed from real life situations as the reason that many switch off when they are in class—a position very close to that taken by Prensky (2001b). Encouraging and providing more opportunities for self-directed, on-demand and informal learning is already recognised as a better way of achieving a higher level of learning outcomes and one well suited to the application of serious,
educational games. However, the trend towards game based learning introduces considerable developmental challenges and brings with it significant resourcing implications—implications often overlooked in the rush by managers to cut costs through the implementation of online learning technologies. The effort involved in designing, planning and developing the supporting information and communications technology (ICT) infrastructures, as well as in developing and testing the content, interface, graphics and support materials takes considerable time—far more than that required for conventional face to face teaching. More research on this aspect of online learning needs to be conducted, as the current literature is fairly vague on the topic of cost analysis.

2.3.2. Simulating the Real World Experience and Associated Learning.

Instructional design researcher Richard Van Eck is an advocate of Game Based Learning (GBL) and argues that well designed educational games embody well established principles and models of learning:

... games are effective partly because the learning takes place within a meaningful (to the game) context. What you must learn is directly related to the environment in which you learn and demonstrate it; thus, the learning is not only relevant but applied and practiced within that context. Learning that occurs in meaningful and relevant contexts, then, is more effective than learning that occurs outside of those contexts, as is the case with most formal instruction (Van Eck 2006 p.4).

This principle is referred as situated cognition and many studies in the past two decades have demonstrated the value and effectiveness of developing game based scenarios that build on the principle. Van Eck also points out that building effective interaction within a game requires a constant cycle of hypothesis formulation, testing, and revision (Van Eck 2006 p.5). Thus, the particular value of computer based games is that they provide immediate feedback to the individual player based on their unique responses to the challenge or task being set, whereas a teacher in a busy classroom cannot deliver immediate feedback on individual responses and reactions to every student at the same time. Cailliois (2001) outlines six formal qualities of conventional games that are equally applicable to computer based games:

- Freedom.
- Separateness (from events outside the rules).
- Uncertainty of outcome.
- Non productiveness.
- Games are governed by rules.
- Make believe (not real) (Cailliois 2001 p.12).

Salen and Zimmerman (2004) propose that the following four qualities of digital games could be also added to Cailliois’ list:

- Immediate but narrow interactivity.
• Manipulation of information.
• Automated complex systems.
• Network communication (Salen and Zimmerman 2004 p.91).

All of those qualities, if woven together in such a way as to create a structured learning experience, can turn even the most basic game into a powerful teaching tool through the creation of a continuous cycle of cognitive imbalance that can only be resolved by the player’s responses and reactions to the feedback provided. A feeling of success can be created through the games reward mechanisms, stimulating positive emotions within the player, whilst failure often results in learning and memorisation, especially when coupled with the option for the player to retry the task—as the old saying goes: “you only learn by your mistakes.” Van Eck (2006) lists further areas of research that account for how and why games are effective learning tools, including the use of anchored instruction, the ability to provide instantaneous feedback, behaviour modification and a host of other educational strategies (Van Eck 2006 p.5).

2.3.3. Strategies to Makes Game Based Learning Effective.

There is no single definition of effectiveness that could be used to embrace the wide field of game based learning. The terms game based learning and digital game based learning are widely used amongst educational researchers and are frequently used interchangeably. Since Wittgenstein wrote about language games and their attendant rules, there has been confusion about what exactly the terms game and game play mean. For example, Huizinga (1980) defined a game as any free activity standing quite consciously outside “ordinary life” and which is taken as being “not serious,” whilst Caillois (2001) considered society and people’s behaviour in society as a form of game and gameplay—with societies being distinguished by having different sets of rules. Michael and Chen (2006) differentiate between non serious games and serious games, defining serious games as: “a game in which education (in its various forms) is the primary goal, rather than entertainment” (Michael and Chen 2006 p.17).

Even given Michael and Chen’s definition, there are no clear cut boundaries, since many serious games are also entertaining—in part due to their ability to recreate scenarios that many people cannot experience otherwise. For example, computer simulations (known also as Sims) such as the city planning game Sim City that model real world situations, are a popular form of entertainment, whilst wargaming (as opposed to military war games) has been a popular hobby since the early nineteenth century. For practical reasons, including safety and cost, flight simulators have been used to train pilots since the earliest days of powered flight and today, desktop flight simulator software is widely popular amongst computer gamers. Indeed, the PC flight simulator software X-Plane is so detailed and accurate that North
American pilots can utilise time on the professional version of the simulator as a part of their flight training for their Federal Aviation Administration (FAA) certification.

For those who can remember the experience themselves, or those who have watched children deeply engaged in playing games, there is a stage that occurs where a game becomes all encompassing and the outside world is either forgotten, or is blended with the game world. In this state the player’s sense of time is changed, external distractions are ignored or only partly noticed and the mind is solely focussed on the activity at hand. This state is referred to by some games researchers as immersion. Games researcher and digital media theorist Janet Murray argues that computer based games present users with "three key pleasures" including immersion that are:

uniquely intensified in electronic media: immersion, rapture, and agency. Immersion, she says, is "the sense of being transported to another reality," such as a game world. Rapture is the "entranced attachment to the objects in that reality"—in other words, the addictive trance that gamers fall into for hours at a time. And agency is "the player’s delight in having an effect on the electronic world," which is possible because the player is a free agent who can make choices (Murray 1997 cited in Platt 2004).

Although immersion, rapture and agency are greatly enhanced in computer gaming, they not exclusive to it—as can be seen in the example of children’s play. However, for adults, the intensity of the physical experience that accompanies computer gaming is particularly attractive, since “reading about it can’t equal the feeling of being immersed in the aural and visual world of Myst, Doom, or Sim City. As for rapture, this may seem a fancy term to describe the addictive-compulsive behaviour of hard-core gamers, but the condition obviously does exist. And so does the free-agent feeling a player enjoys inside the game world” (Platt 2004). Csikszentmihalyi (1990) makes a connection between being in a state of immersion and learning, noting that “learning in immersive worlds is itself a process of learning, flow or of activity” (Csikszentmihalyi 1990 pp. 409–414). Thus, identifying when the player is in a state of immersion is an indication of deeper engagement, since deeper learning is known to be happening when a learner is fully engaged and active. In the same vein, De Freitas (2006) found that additional learning through play using games and simulations within immersive game worlds (which she calls “micro-worlds”) was a further facilitator of the virtual experience and provides potential benefits for a number of teaching applications (De Freitas 2006 p.11).

De Freitas agrees with Prensky that game based learning is an ideal tool with which to reach contemporary learners, suggesting that this is because of the widespread familiarity with the environments of computer games and computer simulations amongst the younger generations, which enables them to quickly adopt GBL applications. Some critics of Prensky’s writings point out that his findings are mainly based on opinion papers, rather than peer-
reviewed studies, and suggest he offers very little empirical research to support his claims (Pivec and Pivec 2008 p.5). However, it is clear GBL is also a powerful learning tool amongst students that do not belong to the group of so-called *Digital Natives*. Mitra and Rana (2001) conducted a study with children in rural India who had no previous experience in the use of the Internet and computer use. Pivec and Pivec summarise Mitra and Rana’s study:

> No training or tuition of any type was provided, yet these children were surfing the Internet within hours, downloading movies, using drawing software, playing video games, and even taught themselves how to cut, paste and save their files. They collaborated with each other and worked in groups, they formed social groupings, and became highly motivated to continue to use this newly introduced technology, all without supervision (Pivec and Pivec 2008 p.5).

Mitra and Rana intentionally provided no instructions or training, setting up kiosks equipped with a computer and Internet access and non-intrusively observed the results, concluding that “children seem to understand and use the technology fluently. Language and formal education do not seem to make any significant difference” (Mitra and Rana 2001 p.221). They also observed that whilst adults of both genders made no attempt to use the kiosk, many acknowledged the value of it for their children. As no instruction was provided, the children “invented their own vocabulary to define terms on the computer, for example, “sui” (needle) for the cursor, “channels” for websites and “damru” (Shiva’s drum) for the hourglass (busy) symbol” (Mitra and Rana 2001 p.232). The experiment demonstrates that GBL could be readily adapted to teaching even those who have not grow up in a digital world and, potentially, even those who are considered to be technologically illiterate.

Mitgutsch takes an interesting turn on Game Based Learning; he believes that it is not the computer game or the technology that promotes learning, but the sense of play that surrounds the interaction with the hardware and game application. Mitgutsch uses the term *Digital Play Based Learning* instead of GBL (Mitgutsch 2008 p.18). This suggests that the content and structure of games used in GBL must be created in such a way as to encourage play. Carson looks at GBL in a similar way and proposes the following definition:

> [Game Based Learning is] the process of taking an idea and creating an activity to deliver that idea in a manner that is motivating, challenging and fun, and has a measurable learning objective as a foundation (Carson 2006).

However, Royle (2008) warns that when teachers get too involved in game design the “fun” element of the game could be decreased—Royle uses the term “teacherized”—which means that the game becomes more focussed on the need to embed, add or refer to educational content linked to performance-related outcomes within a given curriculum (Royle 2008 p.1). Royle therefore suggests that the game based learning applications work best when they are optimised for the audience expectations and learning objectives by game designers. As long as the player is experiencing pleasure in the game, learning takes place regardless of the nature of
the game and often without the awareness of the player, as Prensky explains:

For whenever one plays a game, and whatever game one plays, learning happens constantly, whether the players want it to, and are aware of it, or not. And the players are learning “about life,” which is one of the great positive consequences of all game playing. This learning takes place, continuously, and simultaneously in every game, every time one plays. One need not even pay much attention (Prensky 2002 p.1).

If learning is happening regardless of the educational objectives of the game, the question arises as to exactly what the students are learning and how they learn through GBL. Prensky differentiates between learning from the games’ surface levels (the obvious content such as graphics, audio, animation, video and text) and from the game’s deeper, underlying themes and messages. He emphasises that care must be taken to ensure that the content of games designed for learning is adjusted to emphasise teaching objectives and that potentially negative aspects of video gaming (such as the requirement for extensive sessions of play to complete tasks or levels) be replaced by more appropriate tasks and content. Prensky proposes the terms how-level, what-level, why-level, where-level and when/whether-level of games as a possible structural basis from which to analyse the outcomes produced by different components of learning games (Prensky 2002). Prensky also suggests that those five levels apply to all game players at any age and are important because it is on these levels that real learning takes place while playing a computer game. Awareness of the five levels enables the game developer to develop an understanding of how and where learning takes place in the game and allows the developer to build those levels in a way that fosters a higher level of learning outcomes while the game is being played.

Three other elements that play a major role in producing effective learning games are described by Lepper and Cordova (1996 p.88), who suggest that effective computer based learning games are reliant on what they call intrinsic motivation, which is the result of a game providing competition, engagement and immediate reward(s). Competition, in their view, is important because it stimulates higher levels of motivation and provides immediate feedback on the player/learners performance. Competition is not seen as a strategy that necessarily requires competition between players engaged in the game, it also refers to the challenge provided by the game itself, for example mastering a problem or challenge, either as an individual or as a part of team. Engagement within gameplay can be generated through being challenged, through arousing the players natural curiosity, by providing a sense of control (Janet Murray’s agency) and by stimulating the player’s imagination. Rewards (both positive and negative) play an important role in engaging the player/learner with the application and in providing a source of feedback. Immediate rewards, such being allowed to move to another level in the game, victory over an opponent, points scored, a prize won or in the form of
written praise, all keep the player motivated (Lepper and Cordova 1996 pp.88–89).

Further elements that enhance engagement were outlined by prominent game designer Raphael Koster in his keynote address to the 2003 Austin Game Conference entitled *A Theory of Fun*. In the address, Koster cited the need to maintain a continuous level of challenge, the importance of developing an interesting storyline, the flexibility of the game to adapt to the player, the need to provide immediate and “useful” (or relevant) rewards as well as realism as key factors in making a game “fun”. Koster made the case that a good storyline makes players more motivated to succeed at a game, and recommended that educational game developers should make the story relevant to the topic being taught. For instance, Koster suggests that if students are being taught about a national tax system, the course content could be woven into a story of a forensic tax accountant stumbling over forged papers that lead him or her to a big corruption case—in other words: “rather than using games to escape from their studies, encourage students to use games to escape into their studies” (Koster 2003 p.1). He further argued that each player or team should be given a high degree of flexibility in designing their own playing strategies whilst maintaining the challenge level of the game, and that the achievement of learning objectives should not require the player to follow a predetermined path in order to do so. Koster was clearly impressed by games such as *Sim City* and Microsoft’s *Flight Simulator* that are more simulators than traditional games, although he maintained both styles of game still deliver a high level of fun and thus engaging gameplay.

De Leeuwe (2008) sees game based learning as an integral part of the Web 2.0 experience, in which web use has moved from the passive user experience of the first stage of Internet engagement (accessing and downloading predetermined content) to a participatory experience in which users create, interact and share content through numerous means, including on-line gaming and social media:

> Game based learning can be defined as a part of the web 2.0 experience. Most games (especially commercial online games) are collaborative activities. Game based learning is learning by playing games. These games are designed to teach people about a certain subject, expand concepts, reinforce development, understand an historical event or culture, or assist them in learning a skill as they play (De Leeuwe 2008).

De Leeuwe’s definition indirectly includes forms of engagement utilised by social web sites and some online business models, such as *Facebook, MySpace, eBay* and *Amazon.com*, where users take control over not only their personal web spaces, but also what content goes on the sites and how it is shared and managed. User control of content on sites such as these adds a level of personal agency that was largely impossible in pre-web business models and has the potential to build up self esteem as well as provide a motivational experience generating more meaningful and deeper engagement with the site—a key strategy in game based learning.
Kirjavainen (2010) argues that it is play, whether structured or unstructured, that conditions the human brain for transformation and learning. Kirjavinen suggests the process of the learner building the game themselves, along with the need to research the content, playing strategies and technical requirements for the making of the game, produces a learning situation in itself whereby deeper learning takes place. This is an interesting strategy that situates the learning process in the making and building of the games as well as in the playing of them and was a source of inspiration to the author in the development of this project.

Another important element in deciding to what extent game based learning applications are effective is the existence of measurable learning objectives and the intentional inclusion of motivational elements. Carson (2006) makes the inclusion of measurable learning objectives central to his definition of game based learning, which he defines as: “…the process of taking an idea and creating an activity to deliver that idea in a manner that is motivating, challenging, and fun, and has a measurable learning objective as a foundation” (Carson 2006). Carson provides a range of questions that can be asked in reviewing a learning game that assist in determining to what extent the in-built activities address the learning outcomes of the application:

- Does the activity have a competitive element? To be a truly competitive activity, it must have a winning condition. The player must be aware of the winning condition, which must be applicable to a measurable learning objective.
- Are there built-in elements of engagement? Does the activity stimulate the player to want to stay involved and complete the activity?
- Does the activity contain elements of challenge, player control, and does it stimulate curiosity?
- Is there a timing mechanism in the activity?
- Does the activity contain an element of reward?
- Is there a scoring mechanism built into the activity that allows the player to view their status as they progress through the activity?
- Does the activity offer descriptive or visual feedback of any kind? (Carson 2006).

Incorporating some or all of these conditions is an effective method of building motivation, another factor critical to making sure learning takes place.

As argued by Garris (2002) motivation needs to be sustained through feedback, reflection and active involvement in order for designed learning to take place (Garris et al. 2002 p.455). For this reason, a primary goal for learning game designers is to create and sustain a high level of motivation throughout the game, a goal which can be achieved by keeping the learner engaged and interested through providing a balance between enjoyable play and gratifying, pre-identified learning outcomes. However, it is widely understood that not all learners learn in the same way. Understanding the ways in which learners learn allows game designers to
produce a range of challenges and task types that are suited to the learning objectives and which can be tailored by the individuals themselves to suit their own preferences and learning styles. Oblinger (2006) sees the ability of learning games to immerse the player as being of greater importance than the fun element, since they require frequent decision making, embed clear objectives and require social interaction. Oblinger points out that all effective learning games have the capacity to address several specific attributes to varying degrees:

- **Social**: games are often social environments, sometimes involving large distributed communities. It is not the game play *per se* but the social life around the edge of the game that carries much of the richness in terms of the game’s meaning, its value and its social and cultural impact.

- **Research**: when a new player enters a game, he or she must immediately recall prior learning, decide what new information is needed, and apply it to the new situation. Those who play digital games are often required to read and seek out new information to master the game.

- **Problem solving**: knowing what information or techniques to apply in which situations enables greater success, specifically, problem solving. This often involves collective action through communities of practice.

- **Transfer**: Games require transfer of learning from other venues life, school, and other games.

- **Experiential**: games are inherently experiential. Those who play games engage multiple senses. For each action, there is a reaction. Hypotheses are tested, and users learn from the results (Oblinger 2006 pp.2–3).

Oblinger’s list identifies several essential elements that are often found in active learning environments but, most importantly, she sees game based learning as an excellent vehicle for providing an opportunity for experience and reflection within an immersive environment based on “authentic contexts, activities and assessment…involving mentoring and apprenticeships in communities of practice” (Oblinger 2006 p.3). Consequently, students may engage simultaneously in multiple forms of learning, including situated learning (being inside the game world), reflective learning based on insight (pausing and moving outside the game to evaluate activities) and extended experience with the learning task (immersive learning) which may occur within an extended social environment in “a context similar to the real world” (p.3).

To Oblinger, the social nature of game based learning, particularly in multi-player online games is especially significant, in that it:

...mirrors closely the definition of an educational community of practice. The community has a culture of learning; everyone is involved in a collective effort of understanding. The expertise of members is diverse; members are valued for their contributions and helped to develop further as the group continually advances...
its collective knowledge and skills. The emphasis is on learning how to learn and sharing learning. ‘It is not necessary that each member assimilates everything that the community knows, but each should know who within the community has relevant expertise to address any problem.’ Developing this skill is important personally and professionally, not just in the game world (Oblinger 2006 p.3).

Oblinger’s recognition of the social aspects of computer based game play and the requirement for players to interact in groups whenever possible in order to succeed, is increasingly relevant. As the ever increasing connectivity afforded by the Internet continues to drive almost every aspect of our daily lives, it is clear that technological, social and communication skills are becoming increasingly important. Throughout history, most work situations have been based on team work, but in the digital age, as the networking and interconnectivity between individuals increases, the need for communication and networking skills is almost vital.

Oblinger also emphasises the point that games should ideally have a research component, in which the player is encouraged to research content, investigate problems or explore spaces. In so doing, the player learns “how to learn” and where to get essential information from. Additionally, players should be encouraged to apply gained knowledge and skills to solve problems and thereby experience success—ideally founded on experiences that can be transferred to real life situations and not just abstract experiences (thereby providing an opportunity for experiential transfer). Whenever experiences are linked to real life situations, sense making takes place, which enhances the learning process and ensures that information is stored in long term memory rather than just short term memory. Finally, Oblinger notes that effective games should provide the learner with appropriate opportunities to take “time out,” in order to reflect on the in-game experiences, or to practice the skills or knowledge gained. Once this has happened, the new knowledge and skills should be applied in further levels of the game in order to reinforce and deepen the learning through application and repetition.

The provision of versatile learning activities within each of Oblinger’s list of learning attributes can also cater to the different learning profiles of individuals. Fleming (2010) breaks learning profiles down into four main categories: visual learners, auditory learners, learners who engage best with reading and writing and kinaesthetic learners (or tactile learners) which collectively he abbreviates as VARK (visual, auditory, reading and writing, kinaesthetic). Naturally, learners are not exclusively limited to one style of learning, but incorporate different forms to different degrees to produce an individual profile (Fleming 2010).
Thus far, the author has tried to outline what GBL/DGBL actually is and the different definitions and arguments educators and researchers have put forward in terms of its use and effectiveness as a teaching instrument. Overall, it is my contention that the findings of the literature are encouraging, and there is strong evidence to suggest that GBL/DGBL could and should be more actively adapted as a regular part of the educational experience. The next section discusses in more depth how and why GBL/DGBL strategies will form an essential component of the JTF learning model.

2.4. Game Based Learning and Digital Game Based Learning as part of the Jumping The Fence Project.

Salen and Zimmerman (2004) state that if a game is well designed it yields ‘meaningful play’, which they define as that which “occurs when the relationships between actions and outcomes in a game are both discernible and integrated into larger context of game play” (Salen and Zimmerman 2004 p.34). That context can just as easily be a learning and teaching context as one intended solely as entertainment. If a game is carefully designed to have educational outcomes, it makes serious, deeper learning possible. Joel Foreman points out that “Games expose players to deeply engaging, visually dynamic, rapidly paced, and highly gratifying pictorial experiences that make almost any sort of conventional schoolwork (especially when mediated by a lecture or text) seem boring by comparison” (Foreman 2003 p.15). Certainly, the major advantage of properly designed game based learning applications is their ability to incorporate multiple forms of media and interactivity in a manner suited to users across a wide range of skill levels—from beginner to experienced learner/player. In this way, learners progress at their own pace, neither slowed by students less familiar with the technology/content or left behind by those with more advanced knowledge or skill sets.

Annetta et al. suggest that the work of Averill (2005) supports that of Neal and Prensky, noting that “computer games have the potential to instruct students about what they don’t know and assess their recall of what they have been told” (Annetta et al. 2006 p.4). Annetta et al. go so far as to point out that a computer based game learning application has the potential to become a substitute for a teacher by providing testing and immediate feedback on the learner’s performance, providing a distinct advantage over a human teacher who would take a longer time to respond, especially if the student numbers are high. In a similar vein, Gee (2008) writes in his essay Game-Like Learning that “for some current learning theorists, to ‘know’ is a verb before it is a noun” and goes on to note that “Any actual domain of knowledge, academic or not, is first and foremost a set of activities (special ways of acting and interacting so as to produce and use knowledge) and experiences (special ways of seeing, valuing, and being in the world)” (Gee 2008 p.1). Gee supports his argument by noting that computer games are highly effective in providing a wide range of activities and experiences and lists
several highly successful educational games that teach different skills from a diverse set of disciplines, including mathematics, language and science.

Dondlinger (2007) observes that “there is widespread consensus that games motivate players to spend time on task mastering the skills a game imparts” but that to achieve that end “a number of distinct design elements, such as narrative context, rules, goals, rewards, multisensory cues, and interactivity, seem necessary to stimulate desired learning outcomes” (Dondlinger 2007 p.28). Importantly, Dondlinger adds narrative content and multisensory cues to the list of elements that make a good learning game application. Narrative content is important to keep the player/learner engaged and immersed with the game—a good story helps not only to maintain flow but can also be used to gradually unfold information and pre-designated content. Educators have long used metaphors and allegories to explain complex concepts, since they can be readily integrated within a narration that keeps the learner/player occupied, entertained and moving forward. In addition, computer games can be designed to provide a wide range of multisensory cues, including audio, visual, haptic and textual cues, addressing all aspects of Fleming’s VARK learning profiles.

All of these strategies help build a more immersive learning experience. De Freitas (2006) suggests that immersive learning can be a highly effective educational tool when used to support a range of individual learning styles. De Freitas focuses specifically on the use of simulation as a learning strategy, since it offers a means of providing multi-modal experiences suited to the learners individual needs, noting that “Simulations to date have been widely employed to support specified training needs, in particular to support professional and vocational training needs, i.e., military, surgical, and medical and business training” (De Freitas 2006 p.5). However, although the use of simulation in primary and secondary level education has already been demonstrated to be an effective and successful teaching tool, it became clear to the author, during the course of the literature review, that the majority of sophisticated applications are still being primarily designed and built for high level training in commercial and professional contexts, rather than at the classroom level.

Even so, there are some educators, schools and governments taking tentative steps in this direction, as is evidenced by the development of the Diploma in Digital Applications (DiDA) program in the United Kingdom. The DiDA Delivered program, which was originally developed for schools in the UK as a part of the National Grid for Learning project, sought to provide an integrated suite of information and communication technology (ICT) courses that would be freely available to secondary school students and lead to a Diploma level qualification—and is considered to be the equivalent of four General Certificate of Secondary Education subjects (GCSEs). Based on Adobe’s Flash technology the project allows teachers
and students to create game like teaching modules that also provide for online testing. DiDA Delivered allows not only the teacher to create content, it also enables the student to develop their own games and support materials for on-line critique, thereby encouraging the students to reflect critically on their own design and practice. DiDA’s original workflow was structured as follows:

- students conduct online research via visiting external web resources,
- students complete a set number of preparatory tasks,
- further web based research is conducted and online questionnaires answered before students go on to create content through the use of word processing and spreadsheets (often using open source software),
- students present their findings through various multimedia formats, such as websites, audio, video, animations and text based content, which the students are required to develop themselves. The final website is called an ‘eportfolio’.
- finally the student’s “eportfolio” is assessed online by the teacher and feedback delivered via the DiDA website.

Unfortunately, the National Grid for Learning was wound up in 2006 by the British Educational Communications and Technology Agency (BECTA) in a cost cutting exercise, although DiDA Delivered continues on as an independant project. BECTA itself was closed in 2010 following severe cuts to education funding in the UK following the turmoil of the Global Financial Crisis of 2007. Fortunately, at the time of writing, there is a growing number of game building tools becoming available that allow teachers and students to plan and design game based learning applications, including such as Missionmaker (Immersive Education), Thinking Worlds (Caspian Learning), Game maker (Yo Yo Games) and Neverwinter Nights (Bioware). New tools are becoming available on a regular basis as experience with game based learning grows and the technology and resources to support it continue to mature.

2.4.1. How are today’s learners different?

As outlined previously, today’s learners are digital natives that are used to locating information and resources instantaneously and from multiple sources, they are able to multi-task, they prefer images, sounds and video over text, they have grown up having access to hypertext based multimedia content, they interact in electronic social networks and are accustomed to instant gratification and instant rewards. Most importantly, this new generation of digital natives instantly master their electronic devices and expect content to be delivered in an entertaining and relevant way. Derryberry (2007) observes in her white paper Serious Games: Online Games for Learning that:

the stimuli these learners seek when learning bear a striking similarity to those stimuli present in online games. Since online games, then, provide a stimulating environment
that fosters development of critical skills and characteristics, it seems self-evident that serious games provide a natural environment in which to learn the necessary skills for today's work. (Derryberry 2007 p.11)

Importantly, teachers and educational content designers are often a long way behind the students they teach when it comes to understanding and using digital technologies. To a generation of students brought up on interactive first person games like *Red Dead Redemption*, a Powerpoint presentation with a fade in–fade out transition between two screens of dot pointed text simply doesn't even register.

Furthermore, there needs to be better integration between Learning Management Systems (LMSs) and the type of content and feedback serious games provide and generate. Often the demands of supporting serious gaming are well outside the capacity of most well known LMSs, which still struggle with on-line assessment strategies that go beyond simple multiple choice and yes or no answers. Assessment of group tasks and learning outcomes present even more formidable challenges as Derryberry notes:

In the ‘learn by doing’ world of serious games, learners are frequently called upon to ‘do’ things that result in the generation of content. In fact, learner-generated content will be recognized as one of the principle design mechanisms for learners to demonstrate mastery of a game's learning objectives. What tools will learners use? What standards will apply? What new learning approaches may or may not result as a function of this technical capability? (Derryberry 2007 p.12).

Derryberry's observations underline the important role that serious games will play in teaching and learning into the future and highlights the hands-on approach to practical learning that is already a prerequisite to the development of effective learning games. The dichotomy between the technological skills of current generation educators and the expectations of the student is reflected in a quote by Don Thompson, assistant director of Education and Human Resources at the National Science Foundation of the USA:

Perhaps the most fatal flaw in the education of young people is that we apprentice young people into 19th century science rather than letting them play 21st century scientist (Thompson quoted by Derryberry 2007 p.11)

Clearly, it is time to develop better strategies to enable learners to take responsibility for their own learning—not only through being an active and engaged learner who can apply the learned content to real life situations—but by making the learning an authentic experience.

2.4.2. Building an engaging and effective GBL application.

A good and engaging game needs to have certain features that enable learning and teaching to occur at a higher level and with longer lasting impact. Those key features must be
embedded tightly and seamlessly into the mechanics of the game. Malone (1980) argues that three key features that are essential in the creation of an engaging game: challenge, fantasy, and curiosity (Garris et al. 2002 p.444). Prensky (2001) agrees with Malone but suggests that several other features must be present in order to produce a truly engaging game:

- Rules
- Goals and objectives
- Outcomes and feedback
- Conflict/competition/challenge/opposition
- Interaction
- Representation or story (Prensky 2001 p.11)

Salen and Zimmerman (2004) add to this list the need for an observable state of flow and cite it as an essential element in the development of an engaging game. Csikszentmihalyi (1990) describes flow as a state that is “deep but effortless” and which involves losing an awareness of worry and of the frustration of everyday activity. To arrive at a state of flow, the player/learner must be presented with or possess:

1. A task that [he or she] can complete within reasonable time.
2. The ability to concentrate on a task.
3. A task with clear and definable goals.
4. A range of tasks which provide immediate feedback
5. Deep but effortless involvement (losing awareness of worry and the frustration of everyday activity).
6. The ability to exercise a sense of control over in-game actions.
7. A scenario in which concern for self disappears due to a sense of flow, but in which a sense of self is stronger after flow activity.
8. A situation in which the sense of duration of time is altered (based on Csikszentmihalyi et al. 1990 p.3).

The visual look and feel of the interface plays another important role in the design of any effective learning or entertainment application that involves user interaction. Prensky (2001) points out that a good game needs to be carefully balanced between what he calls eye candy and game play in order to assure that a game is sufficiently engaging to maintain the user’s sustained interest. According to Prensky, eye candy is the look and feel of the game whilst game play is the game’s structure and the game’s mechanics (Prensky 2001 p.23).

As discussed earlier, storyline is also understood to be an essential component when it comes to inducing a sense in the user of being fully immersed in the game—in the same way that a person at the cinema falls into a state of disbelief—forgetting about space and time and being carried away by the unfolding story as produced by the director. Klaila (2001 p.1)
stresses that without a good story line it is difficult, if not impossible, to create an immersive
game. However, unlike the cinematic experience, in which the audience can only participate
as a passive observer, game environments allow the audience to respond to onscreen events
and influence future outcomes. Naturally, any storyline in such an environment must be
sufficiently robust as to allow for any number of possible outcomes based on the user’s
personal decision making process, although in a structured learning scenario there must
be some limitation as to available outcomes if the student is not to be distracted from the
primary objectives. For this reason, Dziorny (2003) argues that an effective digital game based
learning environment must create a learner-centered, but guided environment. The principal
advantage in creating such a learner centred, guided environment is that:

The student has control over where he or she goes and what he or she does within the
game. The game also allows the freedom to freely explore and experiment within the
environment. As the student plays the game, he or she may adapt to the environment,
pick up the game vocabulary, undertake tasks, and find treasures and bonus items
so they can progress to more complex levels. As the student continues to play, he or
she must constantly re-adjust expectations and interactions based on the causes and
consequences of each interaction. (Dziorny 2003 p.5)

The key here is the fact that users are continually required to readjust their expectations and
their future interactions based on their personal decisions and actions—as in real life where
expectations are often not satisfied, thereby creating a situation which may cause pleasure or
disappointment—as well as pleasure and reward. Dziorny cites Begg, Dewhurst and Ellaway
(2003) in this context, who argue that when a player is constantly required to readjust his
or her expectations and interactions a “model paradigm for proactive self reflective critical
learning” is created (Dziorny 2003 p.5).

Structured and directed gaming strategies may be applied to any game, but in terms of
teaching and learning games the question naturally arises as to how they can be implemented
in such a way as to maintain sustained levels of user engagement. Unlike MMORPGs,
learning games must have defined outcomes, potentially removing a significant aspect of
gaming’s major attraction—uncertainty. Royle (2009) asks the question “How can one build
a game that both engages students in relevant learning and entertains enough that gamers
want to play outside of school?” and answers the question by arguing that such games must
“combine sound pedagogy with superior entertainment value, seamlessly integrating learning
into the world of the game” (Royle 2009 p.2). In other words, the quality, complexity and
believability of learning games should be on par with that of the games students engage with
of their own volition. Royle points out that although learning games should ask the player to
solve problems (which would do exactly what problem-based learning does) such games must
deliver the tools and information to the player/learner to solve a given problem. As a result,
successful learning games should invoke a purposeful, pedagogically sound, problem-based learning environment in which the structure and narrative of the game provides the purpose for learning, meaningful problems to solve, and an immediate motivation for pursuing the knowledge required. To achieve this objective, Royle proposes:

- The game should use authentic content in a believable setting.
- Opportunities to promote storytelling should be maximized in the game design.
- Players should be allowed to customise their characters (Royle 2009 pp. 2–6).

The integration of authentic and believable content creates a stronger connection between the virtual world and the real world and it also helps to establish links to the real world through which acquired knowledge can be applied and problems solved. Not only should the game narrative carry the player along through the game, the player herself should be made part of the story through role play and a flexible game structure that allows for alterations to the game mechanics and consequent outcomes. Thus, an effective learning game might provide the player with the possibility to take on a role that is related to the topic being taught and even one that is beyond the possibilities of everyday life, such as children taking on the roles that are normally reserved for adults—making decisions in the capacity of a well known environmental scientist, role-playing a journalist that has uncovered a scandal and who must make a range of ethical decisions, or a mathematician that develops a new algorithm that helps to understand the 5th dimension.

Commonly, many games use Avatars—virtual characters the player creates and manipulates to represent themselves in the game world. Players may change the avatar’s appearance to suit their own tastes and may create and use them to experiment with different personalities, different body forms and even different genders. Through the use of personalised avatars, players develop a stronger relationship with the character represented in the game scenario and, by having a personalised character in the game, students become more likely to take on ownership of a problem or challenge—taking direct responsibility for solving the problem either alone or in a team. Barab et al. apply role-play and avatars extensively to their own educational games and seek to foster in students what they call transformational play (Barab et al. 2009 p.77). Barab describes the conditions necessary for transformational play to take place as follows:

> To play transformationally, a player must become a protagonist who uses the knowledge, skills, and concepts embedded in curricular content to make sense of a fictional situation and make choices that transform that situation” (Barab et al. 2009 p.77).

The ability to make choices that transform the overall situation only occurs if the game structure and game mechanics are flexible enough to accommodate and respond to changes made by the player or game master. Importantly though, the ability to make changes should
not distort the game experience to the extent that it precludes teachers and students from arriving at the predetermined learning objectives.

Wastiau, Kearney and Van den Bergh (2009) recognise the need for the integration of a structured pedagogical framework that makes it possible to develop new skills built on what the learner has previously learned in the development of educational games (Wastiau et al. 2009 p.15). Wastiau et al. are talking about the need to incorporate an open game structure that allows for change and adaption which is driven in response to changes and input derived from students and teachers following discussion their in-game experiences. Referring to an earlier study conducted in Scotland, which looked into how primary school students responded to GBL in a classroom situation, Wastiau et al. concluded that student motivation in general was higher when using computer games than in a generalised classroom context, primarily because the students felt that the games provided a concrete activity directly related to the work they were asked to do and because computer games enabled them to be engaged more actively in their learning (Wastiau et al. 2009 p.26). Wastiau also claims that increased motivation seems to be directly linked to the greater self-confidence that some pupils develop when using games in the classroom. Additionally, experienced game players within the cohort students like to help out less experienced classmates and derive additional satisfaction and learning reinforcement from this interaction (Wastiau et al. 2010 p.11).

2.4.3. Extending Game Based Learning outside the Classroom.

At first glance, Game Based Learning, Digital Learning and Serious Game Learning might all sound like some sort of miraculous solution to the timeless challenge of providing an interesting, relevant and engaging educational experience to students of all ages and all levels of skill. Clearly, there is strong evidence to suggest that, if implemented with the right mix of educational content, continual and varied intellectual challenges and a set of game attributes that promote fun, immersiveness and engagement, it could be possible to make some types of learning and teaching more effective, responsive, stimulating and above all fun. But it is still early days and there is much to be learned before we, as educators, roll out these technologies to society’s must vulnerable, no matter what their age. Taking charge of teaching individuals, especially when new modes of learning are in question—and ensuring the quality of that learning—will always be a significant responsibility.

Since the proposed audience for the Jumping The Fence project was eight to twelve years old primary school students—Prensky’s digital natives—the majority of whom use computers and mobile phones regularly and who play computer games or console games every week, it seemed natural to test the author’s hypothesis on such a cohort. Such students are used to receiving information at high speed, they already possess the ability to parallel process and
multi-task, they prefer graphics before text are they are used to the concept of hypertext through their experience of online content since their pre-school days. With or without their parent's permission, many engage with computer based social networks such as mySpace and Facebook and, I suggest, most would invariably prefer games to “work”. The key problem is, in the author’s opinion, that extensive immersion in game based virtual worlds—whether for educational or recreational experiences—is a sedentary, indoor activity which can consume many hours of a person’s time which detracts from the time available for other, more active pursuits. As we have already seen, such a scenario is not always an optimal use of student time or today’s mobile technologies. Nor is it desirable when the health issues generated by lack of exercise, poor diet and obesity are acknowledged by the World Health Organisation as a “major risk factors for a number of chronic diseases, including diabetes, cardiovascular diseases and cancer. Once considered a problem only in high income countries, overweight and obesity are now dramatically on the rise in low and middle-income countries, particularly in urban settings” (WHO 2011).

The challenge is to gain the best of both worlds—to leverage the established educational advantage of games technology and, through the use of mobile communications technologies, to allow students to break free from the constraints of fixed, desktop or lounge-room based learning technologies and shift interactive learning from the virtual into the real world. No matter how well developed some simulated virtual worlds might be, they can never be compared to the detail and richness of the real world. And the real world is never a fixed entity either. The outdoors is still a place which provides the scenery for childhood fantasies in which children can still imagine and enjoy adventures on the Africa savannah, the old Wild West of North America or on the surface of the Moon, through the use of fantasy, props and, of course, the endless and novel spaces of the great outdoors. For these reasons, outdoor learning is presently undergoing a renaissance in its own right in the educational literature. The next sections will discuss aspects of outdoor learning/outdoor education in more detail.

2.4.4. Learning methods and theories that support outdoor learning.

Current literature in the field of education recommends a mix of formal and informal educational strategies, such as active learning applied in the classroom situation and informal learning situations which may occur in a number of planned (and unplanned) situations. Active learning and situated learning readily lend themselves to the field of environmental education, especially when students are learning about the complex relationships between everything that makes up the natural environment. Being outdoors and learning through hands on practical tasks makes this learning experience special and relevant. Active learning places the responsibility of learning on to the learner themselves, making the learner part of the education process and therefore has the ability to turn learner into a responsible citizen.
Active learning is an integral part of Glassers (1969) pedagogy that has been successfully applied in Australian primary schools since the 1970s. Glasser makes it clear that a mix of educational strategies is necessary for designing successful learning activities and that experience and reflection are reinforced when the knowledge is shared and then transmitted to others.

Barab (2005) notes that the educationalist John Dewey made experimental education popular amongst educators in the early part of the 20th Century, being one of the first to argue that education should be both a social and a co-operative process that occurs between a teacher and student and the student and other students. In this way the student could both experience and interact directly with the learning environment and it's intended content (Barab et al. 2005 p.89). According to Kolb (1984) experimental education can also be described as a philosophy and methodology in which educators purposefully engage with learners in direct experience and focused reflection in order to increase knowledge, develop skills and clarify values’ (Kolb 1984 p.41). Experimental education is also closely linked with formal education in classroom situations and in informal outdoor education.

Informal learning occurs whenever students learn through direct action and engagement with real-world situations rather than through passive listening and reading. Lave and Wenger (1990) argue that all informal “learning is situated; learning is embedded within activity, context and culture. It is also usually unintentional rather than deliberate” (Lave and Wenger 1990 p.1 authors italics). According to Lave and Wenger a learning activity should ideally take place in context and should not be removed from reality or it’s natural context and (if possible) it should be embedded within the learner’s own culture. Given these factors, informal learning can be difficult to plan for or predict in any structured way—although the opportunities for such learning can be built into the curriculum’s overall suite of learning strategies.

Outdoor learning, where the structures and discipline of the classroom are typically broken down, provides an ideal context in which situated and informal learning opportunities may occur. Naturally, most children will have their own personal experiences and understandings of the outside world and, depending on their culture and the place in which they live, the things found and experienced in the outdoors will have already determined a significant part of their personal knowledge of the world. Consequently, the child (or any learner) will bring to the experience their own pre-existing knowledge of the situation as well as a range of skills (i.e., climbing trees, collecting plants, swimming, identifying wildlife and so on) which educators can tap into to initiate a learning activity and which can be shared with other learners having less knowledge or experience. Because social interaction and
collaboration are also essential components of situated learning, Lave and Wegner argue that learners subsequently become:

“involved in a community of practice, which embodies certain beliefs and behaviours to be acquired. As the beginner or novice moves from the periphery of a community to its center, he or she becomes more active and engaged within the culture and eventually assumes the role of an expert” (Lave and Wenger 1990 p.1).

A learning community is not delimited by age or experience—any group of individuals with a common interest or learning goal may form such a community—and such communities may exist only for as long as the group continues to interact. However, in being engaged with a community that shares the same learning goals, the learner develops a set of skills that enable him or her to work collaboratively towards solving problems and towards successfully completing the given challenge or task. In this way, the learner is also indirectly encouraged to develop appropriate communication and social skills.

Resnick (1987) predicted the idea of situated learning by proposing that "bridging apprenticeships" should be required to bridge the gap between the theoretical learning associated with the formal instruction of the classroom and the real-life application of the knowledge in the work environment (Resnick 1987 pp.13-20). We see this being applied in mentor programs in schools where older students may be appointed as a mentor of younger students. This has several positive effects:

• Older students learn by teaching and helping younger students, thereby reinforcing their own skills and knowledge.
• Younger students may feel more comfortable in working with peers of a similar age.
• Students learn social responsibility and become more open to sharing.
• Mentoring helps to improve personal self-esteem.
• Younger students may look forward to becoming mentors themselves and thus put more effort into their work.

Dziorny (2003) analyses McLellan’s (1991) contention that there are are eight critical strategies that inform successful learning and argues that such learning must encompass the intentional and strategical use of: “stories, reflection, cognitive apprenticeship, collaboration, coaching, multiple practice, articulation of learning skills, and technology” (Dziorny 2003 p.7). However, acting as a teacher and teaching others is a fundamental role in any society and one which is not restricted solely to educators. Teaching others is a form of higher level social interaction which, according to Vygotsky plays a fundamental part in the cognitive development of all children (Vygotsky 1978). Vygotsky describes the existence of a person he calls the More Knowledgeable Other (MKO) who could be anyone with a better understanding.
or a higher ability level than the learner with respect to a particular task, process, or concept. In an educational game, the MKO may be the teacher who takes on the role as game master and allocates tasks and assures that no harm is done to the players, but can just as easily be a peer or fellow student who is familiar with the task or challenge at hand. In any peer to peer learning interaction, there is an identifiable area of knowledge in which a student’s ability to perform a task under adult guidance and/or with peer collaboration and the student’s ability to solve the problem independently. Vygotsky calls this the Zone of Proximal Development (ZPD) and it is in this zone that optimal learning occurs (Vygotsky 1978). Vygotsky’s major themes will be discussed in greater detail in chapter 4.

Although some learning might come about in a passive context, the majority of the learner’s real-world experience is both subjective and constantly changing—thereby making the process of learning a highly individualised encounter. Five individuals will experience the same learning situation in five entirely different ways—and the same will happen every time the same learning situation is repeated. Jaworski (1993) provides us with several constructivist principles that are paramount in understanding how learning occurs in an active learning framework: “Knowledge is actively constructed by the learner, not passively received from the environment. Coming to know is a process of adaptation based on and constantly modified by a learner’s experience of the world” (Jaworski 1993 p.7). In support of this observation, Jaworski cites Leontov (1981) and Crawford (1991) who suggest that Activity Theory may be useful for “describing the process through which knowledge is constructed as a result of personal (and subjective) experience of an activity” and concludes that, as a result, “Knowing is an action participated in by the learner. Knowledge is not received from an external source” but is rather “a process of comparing new experience with knowledge constructed from previous experience, resulting in the reinforcing or adaptation of that knowledge” (Jaworski 1993 pp. 6–7).

For the researcher working within the context of building an online learning based game, Jaworski’s observations demonstrate the need to create a range of game scenarios that enable the player to take part in a variety of action and task based activities, such as quizzes, real-world observations (such as physically surveying an area), taking photographs, making notes, drawing and sketching animals and plants, identifying scats and tracks and other types of activities that directly enable the player/student to acquire and apply knowledge through direct engagement. Taking into account Jaworski’s axiom that learning is in part a process of comparing new experience with pre-existing knowledge and building on and testing that knowledge, it is clear that the task of the educational game designer is to produce a game structure that starts the learning process gradually, by catering for both learners with some prior knowledge as well as learners with little or no previous knowledge and which
builds knowledge in a step by step process. Importantly, developing strategies to encourage social interaction amongst players must take a high priority throughout the game design, since “Social interactions within the learning environment are an essential part of this [the learning] experience and contribute fundamentally to individual knowledge construction” (Jaworski 1993 p.7).

Multiple players working together to achieve common objectives help to develop social interaction within the learning environment, but it is clear that some form of facilitator and arbitrator is necessary, if only to intervene should there be tensions within the team—an inevitable outcome when primary school age children come together for extended periods. Fortunately, when such tensions are resolved through negotiated outcomes, higher level learning and broader understanding may eventuate as noted by Jarwoski: “Shared meanings develop through negotiation in the learning environment, leading to the development of common or ‘taken-as-shared’ knowledge.” Where team players take on a range of different roles within the game, working towards a shared goal from different perspectives and utilising a variety of knowledge, a “community of practice” develops “in which we can think of social actions as well as social interactions” as being of relevance (Jaworski 1993 p.7). The benefits and opportunities for such interaction are thus greatly enhanced when the learning environment moves beyond the constraints of the conventional classroom.

Outdoor learning and outdoor education have long been recognised as providing an ideal opportunity for introducing new environments and situations to the learner, although there has been some widespread concern that outdoor learning opportunities have “decreased substantially” in recent years in the UK and Australia, even in the face of extensive evidence that “suggests students remember fieldwork and outdoor visits for many years” following the actual experience (Dillon et al 2006 p.107). The study conducted by Dillon et. al. examined 150 research publications dealing with outdoor learning and concluded that whilst “teachers and outdoor educators need to take account of factors such as students’ fears and phobias, prior experience and preferred learning styles” ... “the evidence from research carried out around the world is that fieldwork can have a range of beneficial impacts on participants” (Dillon et al 2006 p.110). Lugg (2007) proposes that the value of outdoor learning and environmental education also has valuable implications for the higher education sector in the development of sustainability literacy, but that to a large extent the potential of such a learning strategy is still somewhat undervalued in the Australian higher education sector, mainly because “there is still limited understanding of how and under what circumstances these environmental connections and perspectives develop” (Lugg 2007 p.108).

At the primary school level, when students feel both comfortable and safe in the environment being studied, outdoor learning has the potential to transform learning into a
“fun” experience that provides a higher level of learning outcomes due mainly to its highly contextualised nature. However, Dillon et al. also point out that “several studies suggest that outdoor settings can be the source of genuine fear and concern for young people” and that it is essential to understand the importance of taking the location into account during the planning stage, since “outdoor environments can place on students learning demands and emotional challenges, the impacts of which are not always sufficiently recognised by teachers and outdoor educators” (Dillon et al. 2006, p.109). Nevertheless, skills and knowledge gained in the classroom and via mobile applications can be effectively applied in a real world situation when consideration of the location and the potentially different responses of students is taken into consideration. For this reason, the researcher believes that computer-based representations, when paired with outdoor environments are able to create ‘micro worlds’ that provide a powerful learning tool that encapsulate all of McLellan’s (1991) critical characteristics of learning (apprenticeship, collaboration, reflection, coaching, multiple practice and articulation).

2.4.5. Outdoor Learning.

As children growing up in the 60s and 70s, they preferred to be outside roaming the nearby forests and fields of their home villages. Unfortunately, contemporary children seem to spend less time outdoors for a number of reasons, including parental concerns (i.e., stranger danger), greater availability of entertainment and communications options within and from the home and, in the western world, the availability of larger living spaces (more children have their own rooms and private spaces). In the same way that children spend less time engaged in outdoor activities during their own time, it appears that schools themselves are also engaging in less out of the classroom activities. In the school situation, field trips and outdoor activities are seen by educational researchers to be constrained by a number of barriers, including:

- fear and concern about health and safety;
- teachers’ lack of confidence in teaching outdoors;
- student’s personal fears and phobias;
- physical disabilities and special educational needs;
- school curriculum requirements;
- shortages of time, resources and support;
- ethnic and cultural identity;
- wider changes within and beyond the education sector. (Dillon et al. 2006, pp. 108–109).

Even given these restrictions, there is a wide body of evidence that outdoor learning has considerable advantages in providing deeper level, constructivist learning opportunities (see for example, Dillon et al. 2006; Orion, Hoffstein, Tamir and Giddings 1997; Lugg 2007) and it is clear that there is a need strike a balance between the perceived constraints and the accepted benefits of outdoor learning activities.
Given these factors, one question that naturally arises is to what extent people prefer to be engaged with natural environments rather than artificial or indoors locations. Fromm (1964) pointed out that humans generally show a tendency towards being attracted to all that is alive and vital. Wilson (1984) coined the term *biophilia*, using the term to describe the innate urge to connect subconsciously to the web of life, arguing that this urge is rooted in our biology, a direct result of our evolutionary upbringing in a natural environment surrounded by plants and animals since time immemorial (Wilson 1984 p.422) a hypothesis which, according to St Leger (2003) has “spawned research which suggest[s] that our relationships with nature are a fundamental component of building and sustaining good health.” St Leger points out that evidence for this positive connection comes from a range of traditional disciplines including “psychology and biology, and recent fields of research such as recreation and leisure, and wilderness therapy” (St Leger 2003 p.173). Kahn (1997) notes that even basic forms of connection with nature—such as looking at images that depict natural scenery or views of plants and nature—may bring back positive associations that improve well being. Bringing together the work of several researchers analysing the impact of nature on health, Kahn (1997) concludes that “recent research studies have shown that even minimal connection with nature—such as looking at it through a window, increases productivity and health in the workplace, promotes [the] healing of patients in hospitals, and reduces the frequency of sickness in prisons” (Kahn 1997 p.11). Those findings are also supported by Grinde and Patil, who observe that “there is a positive link between health indicators and living close to nature” (Grinde and Patil 2009 p.4).

Such innate drivers might explain the recent “sea change” and “tree change” trend readily observable across Australia, where increasing numbers of Australians are choosing to leave the bigger cities where they grew up, in order to “downsize” or change their life style to one more attuned to living closer to nature or the bush, where they can grow their own vegetables and fruit, or go fishing and engage in outdoor recreation far more easily. On almost every weekend in Australia, we see thousands of city dwellers leaving the city boundaries in their cars and caravans and heading towards the sea and mountains for relaxation and stress reduction. Grinde and Patil suggest that many people are aware of the connection between being engaged with the natural environment and the positive outcomes that derive from the experience “Nature has been reported to [provide] psychological benefits by reducing stress, improving attention, by having a positive effect on mental restoration and by coping with attention deficits. In addition to mental advantages, there appear to be direct physical health benefits such as increased longevity and self-reported [better] health” (Grinde and Patil 2009 p.4).

Dr. James Neill is an Australian expert in positive psychology and the utilisation of
outdoor, experiential and nature-based programs in the enhancement of personal well-being and self-confidence (Neil 2012). Neil is also founder of the Wilderdom website (http://wilderdom.com/) which is dedicated to promoting the benefits and advantages of outdoor education and outdoor activities. As Neil notes on the website, there are numerous definitions of what constitutes “outdoor education” and the benefits that incur from its implementation as a teaching and learning strategy. As well, Neil points out that the field encompasses a broad range of activities and, as a result, it uses a diverse number of terms (often interchangeably) and so there are few, if any, universally accepted definitions—which may result in confusion and even misleading conclusions as to the original author’s intent or viewpoint. Table 2.4, (based on Neill 2008) summarises some of the definitions of outdoor education made by prominent researchers working in the field and divides them into two major approaches to the subject—Psychosocial and Environmentally based. The right hand column is the author’s brief comments on the papers cited by Neill.

### Table 2.4. Psychosocial and Environmentally Based Definitions of Outdoor Education, based on Neill (2008).

<table>
<thead>
<tr>
<th>Psychosocial Benefits of Outdoor Education</th>
<th>Environment Benefits of Outdoor Education</th>
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<tr>
<td><strong>Outdoor Education is</strong> “…the use of experiences in the outdoors for the education and development of the ‘whole person’ [it] appeals to the use of the senses—audio, visual, taste, touch, and smell - for observation and perception” (Lewis 1975 p.9).</td>
<td>Lewis stresses the holistic qualities of outdoor learning that appeals to all senses and, from an educational point of view, this stimulates learning by activating the different learning styles of the individual learner, as defined by Gardener (1983). As a result, every learner has the opportunity to learn in their own preferred way.</td>
</tr>
<tr>
<td><strong>Outdoor Education is</strong> “…a means of curriculum enrichment, whereby the process of learning takes place out of doors. Outdoor education broadly includes environmental education, conservation education, adventure education, school camping, wilderness therapy and some aspects of outdoor recreation” (Lappin 2000).</td>
<td>Lappin (2000) focuses on the enrichment of existing school curriculum through outdoor learning, but also sees a number of therapeutic benefits as being associated with outdoor education. This could help students with disabilities or other health problems, as well as healthy kids from urban environments. Outdoor education blends “recreational” activities with learning and thereby blurs the boundaries between formalised instruction and learning and “fun”.</td>
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<tr>
<td><strong>Outdoor Education is</strong> “Interdisciplinary and multidisciplinary...an approach to achieving the goals and objectives of the curriculum” (Hammerman 1985 p.116).</td>
<td>Taking curriculum into an outdoor environment has the potential to put learning into a real-world context. Hammerman argues that many areas of learning can be adapted to, or encompass outdoor learning, and different disciplines can be combined by sharing common outdoor experiences.</td>
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<tr>
<td><strong>Outdoor Education is</strong> “…one of a range of mediums in which to offer informal educational opportunities addressing the personal and social development of both communities and individuals” (Neill 2002).</td>
<td>If humans are biophilic by nature, and much has been discovered by observing and copying nature i.e., flight, architectural structures, medical advances etc., then direct engagement with nature is an excellent way to observe scientific and physical principles first hand. In this way, a better understanding can be developed and learning deepened. Neill (2008) also sees outdoor learning as a means of fostering the social development of individuals and the wider community by including both in the process of planning and executing outdoor learning.</td>
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Outdoor Education is “… an experiential method of learning by doing, which takes place primarily through exposure to the out-of-doors … the emphasis for the subject of learning is placed on RELATIONSHIPS: relationships concerning human and natural resources” (Priest 1986 p.13)

Priest stresses relationships in terms of the bonds between humans and the natural resources they rely on. These are emphasised and strengthened when children have direct and sustained contact with natural environments, which creates a sense of being a part of the environment, as well as fostering a sense of responsibility towards it.

Outdoor Education is “… an experiential method of learning with the use of all senses. It takes place primarily, but not exclusively, through exposure to the natural environment. In outdoor education, the emphasis for the subject of learning is placed on relationships concerning people and natural resources” (Lund 2002).

Lund makes the point that outdoor education can take place primarily, but not exclusively, through exposure to the natural environment. As with Lewis (above) Lund observes that all senses are activated and thus deeper learning may occur. Lund also stresses the importance of emphasising the vital connection between people and ‘natural resources’. Subjects directly linked to environmental studies as well as physical education are well suited to outdoor learning.

Outdoor Education is “… an experiential method of learning by doing, which takes place primarily through exposure to the out-of-doors. In outdoor education, the emphasis for the subject of learning is placed on relationships: relationships concerning human and natural resources” (Neill 2002).

Neill highlights two important points: firstly outdoor learning is an experiential method of learning, and thereby has the potential to accelerate learning and, secondly, that outdoor learning is about the relationships between humans and the natural world. In the longer term, reducing any fear and uncertainty associated with the outdoors amongst children and adolescents can only be beneficial to both the individuals concerned and the environment they inhabit.

A common theme running through the papers cited by Neill is the educational benefits attained through developing a set of practical, outdoor activities which are directly connected with the subject matter (Hammerman 1985) and the social and interpersonal benefits that accrue from combining so-called “recreational activities” (i.e., “fun”) with learning—benefits that are in the main part due to the increase in multisensory input that occurs when learning involves physical as well as mental activity and an increase in interpersonal communication. These benefits go beyond purely educational outcomes in that they have the potential to lower stress and improve mental health and physical health problems (Lappin 2000). Outdoor education also impacts on the way participants feel and think about their environment and themselves and therefore enhances personal development amongst students (Neill 2002). Curricula that is specifically designed to bridge indoor and outdoor education seems also to enhance the opportunities for experiential modes of learning, which in turn increases the potential to accelerate or reinforce the learning process (Hammerman 1985). Two of the authors cited above note that outdoor learning is about the development of interpersonal relationships between group members as well and developing an appreciation of our connectedness and reliance on the natural environment and the resources it provides (Priest 1986, Lund 2002). Such relationships strengthen and tighten the ethical relationship between participants and the natural environment in a number of ways that might help to protect the environment from further damage or destruction in the future.

In Australia and the United Kingdom, several organisations exist that actively promote the benefits of outdoor learning and outdoor experience on young people. In Australia, the Outdoor Council of Australia acts an advocate for both educational and commercial groups
engaged in outdoor activities. The longer established UK counterpart is the English Outdoor Council, which operates as an umbrella organisation for organisations engaging with outdoor learning, training and recreation and is overseen by observers from the Department for Education and the Royal Geographical Society. The English Outdoor Council uses Roe’s definition of outdoor learning in it’s publications and work, which she defines as “...an activity that involves active learning in the outdoors, where participants learn through what they do, through what they encounter and through what they discover ... outdoor learning is real learning, where students can learn about themselves and each other, at the same time developing skills of enquiry, experiment, feedback, reflection, review and cooperative learning by seeing, hearing, smelling and touching real things, where their actions have real consequences” (Roe 2006 p.2). Roe’s definition summarises what other author’s have said, but emphasises the potential of outdoor learning in terms of a providing a more holistic approach towards education and the development of social skills and environmental awareness.

The British House of Commons 2005 report into outdoor learning outlined the importance of outdoor education and emphasised the connection between academic achievement through fieldwork projects and the development of so-called “soft” skills and social skills, particularly in students with learning difficulties or those who were considered “hard to reach” emotionally or academically (House of Commons 2005 p.5). The report paved the way for changes to several laws and regulations in a way that made it easier for British schools to conduct teaching in outdoor environments. At the time of writing, the UK, Scandinavia, Canada and Scotland are leading the trend to incorporate outdoor learning and outdoor education into school curriculums. It is hoped that other governments and countries might follow suit, encouraging and supporting the inclusion of outdoor learning initiatives more frequently in our schools.

2.4.6. Further Benefits of Outdoor Learning.

Learning starts when we are born and babies learn constantly through trial and error. As they grow, young children learn through play, an active form of learning that unites the mind, body and spirit and utilises all of the senses in the process of building knowledge and experience. By playing together with other children, children learn a range of social behaviours, including co-operation, sharing and problem solving in both indoors and outdoor settings. Cooper (2006) points out that when children play as a group outdoors, they have more opportunities to choose activities that are less structured and are naturally encouraged to play cooperatively due to the higher levels of motivation and stimulation provided by the natural environment. In addition, Cooper argues that most children are naturally adventurous and, because of this, they prefer to try new activities, experiment and test things in their environment and thereby create their own adventures (Cooper 2006 pp. 22-25). Natural,
outdoor environments provide less structured and more diverse opportunities for such self-directed play to occur.

Scotland is frequently put forward in the literature as a leader in outdoor learning and teaching. Education Scotland, which is the top level administrative body for all aspects of education in Scotland subject to Scottish Government policy, is highly proactive in promoting and studying the benefits of outdoor learning and their website contains a host of information dealing with outdoor education, including several key reports such as those by Nichol, Higgins, Ross and Mannion (2007) and the 2005 House of Commons Education and Skills report. Education Scotland’s concept paper *Curriculum for Excellence through Outdoor Learning* points out that outdoor learning offers motivating, exciting, different, relevant and easily accessible learning opportunities at all levels of education from preschool years through to tertiary education and that “the journey through education for any child in Scotland must include opportunities for a series of planned, quality outdoor learning experiences” (Learning and Teaching Scotland, 2010 p.5). The paper also notes that progressive outdoor learning experiences are best delivered through a combination of school-based outdoor learning and residential programmes and that to be effectively implemented, co-operation at national, local authority and cluster/community levels needs to be established—as well as commitment at the organisational level. In other words, the authors point out that whilst outdoor learning is recognised by educators to be highly beneficial in helping young people learn by experience and to grow into confident and responsible citizens, implementation of outdoor learning strategies requires far more than a curriculum based requirement or teacher driven enthusiasm (Learning and Teaching Scotland, 2010 pp. 5-6, 25).

Outdoor learning is not only an effective learning strategy for children and young adults, it is also of benefit in adult education, often providing benefits in ways secondary to the principal educational objective. White (2004) explains: “learning in a natural environment has profound effects on the well-being of adults, including better psychological well being, superior cognitive functioning, fewer physical ailments and speedier recovery from illness” (White 2004 p.4). Aside from making outdoor learning a more meaningful experience for teachers, parents involved in outdoor school activities as chaperones or assistants can also benefit from outdoor learning activities. Adult students engaged in outdoor learning also benefit from many of the positive aspects of outdoor learning already discussed and, given that some forms of learning can sometimes be a stressful experience for some adults, the benefits are compounded.

Not only does outdoor education improve the physical health of students it also helps stimulate imagination. White summarises the findings of several researchers in the field
of imaginative play—including Moore and Wong (1997), Taylor et al. (1998) and Fjortoft (2000), noting that: “when children play in natural environments, their play is more diverse, [exhibiting] imaginative and creative play that fosters language and collaborative skills” (White 2004 p.4). White argues that since children playing in an unfamiliar environment as a group need to communicate about any unfamiliar, imaginative or abstract items they use in their play, they are required to explain unusual concepts, negotiate settings and discuss strategies that are sometimes beyond their immediate knowledge of their known world. Frequently, this happen through speech and body language or improvisation, and the more they practice the better they become with mental conceptualisation and verbal expression. Since communication is an abstract process based on agreed actions and interactions between the parties concerned, all information being processed in the brain increases brain activity, promoting the player’s cognitive development. White cites Pyle (2002) in this regard: “Exposure to natural environments improves children's cognitive development by improving their awareness, reasoning and observational skills” (Pyle 2002, cited in White 2004 p.4).

Stress amongst today’s children and young adults can have many causes, ranging from school pressure, family issues through to bullying and harassment at home, school or, increasingly, in a virtual form known as cyber-bullying. Bullying, often started in school now sometimes extends into the children's private digital world of communication, making even time at home open to invasion of their personal space and privacy. As noted earlier, the increasing use of digital social networks such as Facebook, Twitter, Google+ etc. amongst children and adolescents means that any time spent in front of a computer or using a mobile device in a social context is open to such abuse. Being outside and not being connected to the Internet provides the bullied children with some peace, and there is some evidence that “play in a diverse natural environment reduces or eliminates bullying” (Malone and Tranter 2003 cited in White 2004 p.4)—although, in the author’s own opinion, total elimination of bullying is not really possible. However, being outside and having more space to move away from confrontation or bullying activities might enable children and young adults to significantly reduce tensions.

Nina Morris of the OPENspace Research Centre, conducted a literature review of over 165 papers written between 1970 and 2003 dealing specifically with the connections between health, well being and access to open spaces and identified five key ways “in which exposure to the natural environment is beneficial to human health.” These are:

- Enhanced personal and social communication skills.
- Increased physical health.
- Enhanced mental and spiritual health.
- Enhanced spiritual, sensory, and aesthetic awareness.
- Ability to assert personal control and increased sensitivity to one's own well-being. (Morris 2003 pp 13–14).

Morris points out that there is no consensus as to how these benefits can be measured or quantified, since “terms such as ‘quality of life’ are not well defined, and there is little information which outlines the ways in which health professionals understand the term” (Morris 2003 p.14). However, some of the identified benefits discussed in the review include the development of practical skills, such as gardening, landscaping and wood work; social skills that enable students to get along well with others and to work in a team environment; presentation skills and improved physical and psychological well-being (Morris 2003 pp.4-20). Morris also identified positive improvements amongst individuals with severe behavioural problems which resulted in violent behaviour and drug abuse. Her findings indicate that there is evidence that children and young adults showed a reduction in the symptoms associated with mental illness, a reduction in stress and improved self management of stress and a subsequent reduction in the relapse rate amongst subjects with drug and alcohol dependence (Morris 2003 pp. 20).

Outdoor learning is, of course not a new idea and many of the core principles can be traced back to the ancient Greeks. However, in Europe, Jean Jacques Rousseau (1712–1778) was amongst the first to introduce the notion of a more holistic approach to education and learning, an approach taken up by the American John Dewey (1859–1952) and later by Kurt Hahn (1886–1974), amongst many others. Hahn was the founding headmaster of the prominent Schule Schloß Salem, one of Germany’s most exclusive private schools and later Gordonstoun in Scotland, which he founded following his imprisonment and subsequent exile from Germany as a result of his public criticism of Hitler. Later in his life, Hahn became known as the father of outdoor education, largely due to his belief that shifts in societal values were leading to what he called “the decline of modern youth,” the inevitable result of a number of broader “social diseases.” According to Knoll (2011) Hahn identified six factors contributing directly this overall decline:

- Decline of fitness and physical health: in particular due to the modern methods of motion, e. g. car, train, and elevator;
- Decline of initiative and the spirit of adventure: easily to be recognised as “spectatoritis,” an “illness” brought about by the new media, e. g. radio, film, and television;
- Decline of imagination and recollection: especially fostered by the restlessness of modern people and their increasing fear of silence, loneliness, and seclusion;
- Decline of carefulness and thoroughness: primarily caused by the dwindling importance of the crafts and by the increasing inclination to look for quick results and easy solutions;
- Decline of self-discipline and renunciation: chiefly furthered by material affluence and the easy access to alcohol, cigarettes, and pills;
• Decline of compassion and mercy: in particular encouraged by the diminished community life and the expanding subjectivism, individualism, and egoism (Hahn 1962 cited in Knoll 2011 p. 7).

To address these declines, Hahn proposed an educational program based on balancing social and practical activities within the curriculum, a program he labelled Erlebnistherapie, or “experiential therapy”, which is based on four approaches to learning, each of which addresses specific declines, but which collectively address all six. Knoll (2011) summarises these as follows:

• fitness—covered the physical component: in a “training pause” between school lessons, the students practiced running, throwing, and jumping, the former students were invited to pass the German sports certificate and to abstain from drugs such as alcohol, coffee and cigarettes;
• expedition—accentuated the affective component: during journeys, walks and other exhausting activities, the students should be exposed to experiences and adventures which they might curse at the moment, but which they would not like to miss later on;
• project work—emphasized the cognitive component: on Saturdays, the students had the whole day at their disposal for planning and realizing projects on their own—[for example] a translation of Ilias, an analysis of the rivulet Aach near Salem, the construction of a model airplane;
• service—stressed the social component: the commitment for others—as with the fire brigade, the sea and mountain rescue service, the social and environmental service—the students should assume responsibility and experience the sublime feeling: “You are needed” (Hahn 1962, cited in Knoll 2011 p.9).

Perhaps Hahn’s greatest educational legacy is the international Outward Bound schools network, originally set up under Hahn’s guidance in response to the loss of lives caused by German U-boats sinking merchant shipping in the Atlantic during the Second World War. Hahn was asked to help address the urgent problem of why it was typically the younger seamen who died in the lifeboats during the time between the sinking and rescue—rather than the older, more experienced—but less fitter men. Hahn ascribed this to inexperience, lack of personal resourcefulness and failure to understand their own strengths and limitations amongst the younger crew. The first Outward Bound school was set up to educate young sailors in survival skills, increase their fitness and develop their personal awareness prior to service on the merchant ships. Today, Hahn’s four approaches to a balanced curriculum have been expanded into the Ten Learning Principles that inform the Outward Bound program and the philosophy of the schools that subscribe to the network, whilst the aims and objectives of the program have expanded significantly, encompassing all aspects of contemporary
education. The Outward Bound program is offered in 34 countries at the time of writing (2012) and over 60 schools in Australia (Outward Bound Australia 2012).

The researcher believes that Hahn’s key principles are timeless and have not lost their relevancy. Indeed, they will become more relevant as the current educational system continues to embrace ICT at all levels—inevitably resulting in more emphasis on indoor, sedentary activities and less on physical exercise and physical engagement. The need to balance the benefits of continual intellectual stimulation and instantaneous on-line communication with physical activity and a reconnection with the natural world has never been more evident—it is time to regain the balance between mind, body and nature.

2.5. Conclusion.

Effective outdoor education demands that children be actively engaged in both mental and physical activities and, as we have seen, it presents an opportunity to address some of the more obvious shortcomings of the negative effects of excessive computer use. The benefits of outdoor learning have long been understood and are widely acknowledged. That computers and the Internet provide powerful new learning opportunities for educators and students alike has also been well understood for some years but, at the same time, the limitations and disadvantages have become equally apparent as our familiarity with these new technologies has developed. The advent of mobile computing, sophisticated and highly connected personal hand held devices and almost instantaneous communication means that users can now be freed from the constraints of desktop devices and, as a consequence, the need to work in a single, indoor location in a sedentary position and for long periods of time. Even so, the standard approach to Computer Based Learning in schools and universities is still largely fixed in the model of classroom based, desktop computing—a model well suited to administrative and managerial needs, but one not always in the best interests of students.

The next chapter, the Methodology, discusses the inspiration for, and the aims and objectives of the Jumping the Fence Project and the way in which the creative project associated with this study was developed, tested and brought to completion.
Chapter 3

The Project and the Methodology.

The literature review makes clear that game based simulations mirroring real life examples are known to be highly effective in developing an understanding of highly complex real-world systems (for example, the city planning game Sim City, the lifestyle simulation game The Sims, Laminar Research’s advanced flight simulator X-Plane)—as well as providing a means of effectively replicating numerous other real-world, historical, scientific and theoretical scenarios. Simulations have long been used for training and experimental purposes across a wide range of human activities and scientific applications—to the extent that it is difficult to think of an activity or thing which today cannot be modelled or simulated in some way. Airline pilots train extensively on advanced simulators, scientists model the universe at subatomic and cosmic scale, the military plan missions and train personnel without subjecting them to actual risk, whilst surgeons and medical staff rehearse surgical procedures many times before putting them into practice on real patients. The ancient game of chess is essentially a simulated battle between two opposing monarchies.

As the review indicates, the availability of low cost computing and high speed networking has revolutionised not only the sophistication of the tools available to produce such simulations, but their availability and the extent of their use, a fact widely recognised by many of the educators surveyed in the preliminary study. As well, with the growth of the Internet and the spread of low cost computing, advanced simulation tools have moved from high tech research laboratories and military installations into the average teenager’s bedroom in less than 20 years. Unfortunately, far more effort has been focussed on using the technology for entertainment than has been directed towards developing educational applications, since the entertainment industries have always had the expertise, the skills and the resources to adapt to new media environments—or at least match those of the entrepreneurial
startups. Indeed, some new computer games regularly out gross the returns made on highly successful “blockbuster” movies, whilst some Massively Multiplayer Online Role-Playing Games (MMORPGs) such as *World of Warcraft* (*WoW*) claim to have millions of regular subscribers—in late 2011 *WoW* claimed to have over 10 million active members (*World of Warcraft* 2011). Educators, who recognise that they could put this technology to much more effective use, have largely been trampled in the stampede for massive profits and the production of sophisticated technological novelties.

Fortunately, the literature of Game Based Learning (GBL) paints a bright picture for the potential of computer based games in education (see for example Malone 1981, Malone and Lepper 1987, Gee 2004, Foreman et al. 2004, Barab et al. 2009, Royle 2009; Spectre and Prensky 2000; Pivec and Pivec 2008) as well as demonstrating the effectiveness of many types of GBL (Foreman 2003, Averill 2005, Dondlinger 2007, De Freitas 2006). The ability of some computer games to create what Oblinger calls “immersive environments” (Oblinger 2006 p.3) also provides learners with the additional opportunity to design and produce their own customised learning materials and to share those learning experiences with their peers, although collaboration at higher level between educators and game developers is necessary to embed these learning objectives effectively into the game structure, as noted by De Freitas 2006 (p.6). However, it is also clear that the divide between the technology, the educational content and the abilities of games developers cannot be bridged by individual teachers working alone—as is often expected by school principals and managers who see the purchase of off-the-shelf Learning Management Systems (LMSs) as a simple response to these challenges. Properly designing, planning and developing the supporting ICT infrastructures, as well as developing and testing the content, interface, graphics and support materials takes considerable time and effort—far more than that required in preparing content for conventional face to face teaching—and can only be achieved effectively by well supported, dedicated teams bringing together a diverse range of skills. That is why the creative artefact associated with this project—the learning game—is not as fully developed in some aspects as the author would have wished.

The literature also recognises that a balance must be found between producing content which is educational and maintaining the sense of play which keeps players continually engaged. Although Michael and Chen define computer games in which education is the primary goal, as being “serious games” (Michael and Chen 2006 p.17) it is also clear that it is impossible to define or impose a boundary between education and entertainment, since removing the pleasurable or “fun” aspects of the game may also greatly diminish the game’s effectiveness as both a learning tool and a source of pleasure, as pointed out by Royle (2008) and Koster (2003). Game based learning is seen as an integral part of the Web 2.0
experience, in which web use has moved from a passive to a participatory experience in which users create, interact and share content (De Leeuwe 2008). The uptake of social media applications such as Facebook, which claimed to have “more than 800 million active users” in January 2012—of which “more than 50% of active users log on to Facebook in any given day” (Facebook 2012) is a single example of the integration of the Internet into the daily lives of both young people and adults and demonstrates the extent to which the boundaries between work, play, social interaction and learning have already become blurred. Oblinger (2006) sees the social nature of game based learning (particularly in multi-player online games) to be well suited to the Web 2.0 environment in that it provides a deeper sense of immersion in the learning process by “…mirror[ing] closely the definition of an educational community of practice” (Oblinger 2006 p.3).

Today’s primary school age children—Prensky’s “digital natives”—are totally comfortable with computer gaming and computer based learning in the classroom situation. Wastiau, Kearney and Van den Berghe (2009) conclude that student motivation in general is higher when using computer games than in a generalised classroom context, because students feel that games provide a concrete activity directly related to the work they were asked to do and because computer games enable them to be engaged more actively in their learning and to engage in more interpersonal activities, such as team based learning and peer mentoring (Wastiau et al. 2009 p.26). However, the literature also reveals a more negative side to extended computer use, largely confirming what many parents have been observing for the past two decades.

As early as 2004, the Australian Government Department of Health and Ageing recommended that children should spend less time using electronic media for entertainment, a recommendation that largely went unheeded, as noted by the CSIRO in 2007 when it observed that only 7% of Australian children aged 9–13 years met the recommendations for sedentary screen based activities (CSIRO Preventative Health National Research Flagship and University of South Australia, 2007). Gentile et al. (2004) and Hinduja and Patchin (2008) identified a number of negative behaviours as being associated with excessive computer gaming, including addictive behaviours, aggressive thoughts and actions, emotional isolation, altered world view and antisocial conditioning (i.e., acceptance of sexist or racist views and attitudes), blurred perception of boundaries between real and virtual activities, physical health issues including weight gain and musculoskeletal problems and cyber-bullying. At the extreme, connections between school shootings and video games have been established by a number of researchers including Muschert (2007), Gentile (2007), Kline (2000), Anderson (2003), Ferguson (2008), Jenkins (2006) and King and Delfabbro (2010). Japanese researchers have been particularly active in identifying aberrant or unusual
behaviour associated with computer and online gaming and a number of Japanese social commentators such as Uchida (2007) have related a wide range perceived declines in social standards to excessive gaming and computer use. Japanese psychologist Tamaki Saito has coined the term Hikikomori, which describes a trend towards complete social withdrawal among some Japanese youth, although the phenomenon has been identified in most countries where computer gaming is commonplace (Dziesinski 2003 pp. 2-3) and the term is now in fairly regular use in Australia and the United States.

As might be expected, increased amounts of time spent in sedentary activities also means that less time is available to engage in more physical forms of activity. A link between obesity and excessive gaming has been identified by Swiss researchers, Stettler, Signer and Suter (2004) whose study sought to identify the environmental and behavioural factors—in particular the type and duration of sedentary activities—that were associated with obesity amongst children in grades one, two and three. The research team reported that obesity was directly associated with time spent playing electronic games and the time spent watching television and was inversely associated with physical activity (Stettler 2004 p. 898). Glaubke (2007) notes that “excessive computer use can become addictive and can cause physical harm to young children in the form of muscular-skeletal injuries, such as carpal tunnel syndrome, visual strain, and obesity due to lack of exercise” (Glaubke 2007 p. 15) a finding supported by Kahn (2003) who adds increased metabolic rate to the list. Both Hesketh and Glaubke conclude that children’s active screen time needs to be monitored and reduced to below 2 hours per day and that children need to be encouraged to take a more extensive part in physical activities to counteract the increased lack of mobility associated with time spent in front of computers (Glaubke 2007 p. 15) (Hesketh, et al. 2007 p.1). These findings are reinforced by the Australian Bureau of Statistics (2008) recommendations which also concluded that children should not spend more than two hours a day watching TV, playing computer games or using other forms of electronic media for entertainment.

As we have seen, outdoor education has long been a valuable and respected part of the curriculum in many countries with an established education system. That it offers educators the opportunity to implement a range of learning strategies unavailable in the classroom environment as well as providing physical, mental and health related benefits is well known and widely recognised in the literature. Outdoor learning provides multisensory modes of learning as well as encouraging and developing interpersonal relationship and communication skills and an appreciation and awareness of the natural environment (Priest 1986, Lund 2002, Hammerman 1985, Roe 2006). Cooper (2006) notes that outdoor learning is particularly well suited to primary school level education, because outdoor environments provide less structured and more diverse opportunities for directed, as well as self-directed play to occur,
and thus suits the naturally adventurous nature of most children (Cooper 2006 pp. 22-25). White (2004) and Lugg (2007) both note the benefits of outdoor education in an adult learning context, with White emphasising the benefits of psychological, physical and health related benefits of learning in such environments (White 2004 p.4). Morris’s extensive 2003 survey of the literature pertaining to outdoor learning identified five key ways “in which exposure to the natural environment is beneficial to human health” including social and communication skills, improved physical health, mental and spiritual benefits, improved sensory and aesthetic awareness and a heightened self-awareness (Morris 2003 pp 13–14). As well, the growth of internationally based outdoor learning associations, such as the Outward Bound program and the keen interest in outdoor learning shown by governments in a number of countries, attests to the universal acceptance of the concept of outdoor learning and the benefits it brings to students of all ages. The challenge, in the author’s opinion, is to blend the educational advantages of computer based learning and communications technologies with the well-known benefits of outdoor learning. In this way, the primary disadvantages of the former (computer and communications technologies) can be reduced or minimised, whilst the proven benefits of the latter can be encouraged and promoted. At a time when some researchers report a declining interest in outdoor learning due to both perceived and real restrictions imposed by factors such as health and safety requirements, curriculum, lack of financial and physical resources and shifting social trends (Dillon et al 2006 pp. 108–109), introducing a learning method that combines the two may well be a practical and viable strategy for overcoming some of these issues. For students and educators alike, this can only be a beneficial outcome.

It is clear that many of the issues and many of the learning strategies examined in the literature review could be effectively used as a basis for developing an educationally focused computer game that addresses environmental issues. Importantly, studying the environment also requires students to actually experience the physical world—and this means getting outside and exploring it, measuring it, touching it and interacting with it. It might mean getting dirty hands and perhaps being cold and wet (or hot and thirsty) but it also means having fun, interacting with peers and engaging in physical activity. The researcher personally believes that it is important to teach Australian children more about their own unique environment and the wildlife and plants that constitute it. Only by learning to appreciate and understand the environment—and how fragile it is—will future generations be inspired to maintain and protect it. If, as it might eventuate, young people are isolated from it and protected from it, if it becomes to them an alien, unpleasant place filled with mysterious and nasty, dangerous creatures, it will never be valued and will become increasingly vulnerable to clearing and degradation. As well, by teaching children about the complexity of ecosystems and about biodiversity and the interdependence of all aspects of their environment, they
will come to understand more about themselves and the diversity and fragility of their own species. In this project the author aims to encourage students to learn about—and reflect on—their own, immediate place in the environment that surrounds them every day. In the process, they will be asked to demonstrate their understanding of the complexity of these ecosystems in a practical and tangible way. And, when the project is complete, they will be able to see the results of their study and their effort long after the semester or session finishes.

To achieve this aim, the researcher has sought to develop and test a prototype computer based educational game that requires the players to physically interact with the natural environment as an integral part of playing the game and progressing through it. In order to identify the most effective interactive strategies that would help achieve this outcome, the researcher sought regular feedback from both the players and the teachers involved in the testing and development of the interactive game. Further to the development of the game itself, the researcher also sought to identify and use a range of appropriate software and hardware tools that could be used in data collection and communication in the field, using such as handheld devices as mobile phones, global positioning systems, personal digital assistants, digital video cameras and sound recorders. Because of the ubiquity of such devices (even at primary school level many students have mobile telephones) and the fact that many are now being combined into single devices (most smart phones now have a built in video and still camera, GPS devices and network access) it quickly became apparent that designing the game to suit any one platform or device would be futile, given the rate of technological change and the constantly evolving technologies. In addition, access to such devices is not equal amongst students—some students may have parents who do not wish for their children to own smart phones or they may not be able to afford them.

Whilst such devices could port many of the activities that the planned game assigns to the classroom or a desktop computer into the field, in the early stages of the study it was decided to maintain a clear division between computer based activities (the theoretical and curriculum based content informing the game, such as the data input and final recording of data, the maintaining of a diary and online research activities and tests and quizzes) from the actual outdoor learning activities. However, the use of such devices, when available, was not discouraged—although the trial game was structured so that no student would be actively advantaged by having access to such digital tools. In later iterations of the game the use of these devices increased noticeably amongst the students, through the sharing of personal devices and use of the school’s own resources—although there were often issues of compatibility, connectivity and accessibility (such as video cameras using unusual or proprietary file formats, mismatched cables, incompatible software versions and so on). These practical and technical issues will be discussed in more depth in Chapters Five and Six.
It is intended the outcomes of this project will impact positively on young children and their future life. There is considerable evidence that shows that if children spend more time outside the home or classroom engaged in educational and physical activities this will help them develop a diverse range of social skills (such as working in groups to achieve shared goals) and this in turn will help them to become healthier and more responsible citizens. A second aim of this project is to investigate how effectively educational games can be adapted to include outdoor activities into a range of subjects beyond the traditional physical education subjects. Many students are not inclined to sports and contact games or are not competitive in nature and, even though most health and physical education courses today cater for a wider range of personalities and interests, they are still widely seen as being oriented towards the more athletic and “outgoing” students. This trend certainly becomes more evident in the higher grades, as students seek to define their own identities and peer pressure to conform to set roles increases.

In Queensland, the Queensland Studies Authority (QSA) is the statutory body that oversees all aspects of the Kindergarten to Year Twelve curriculum in the state. The QSA identifies eight Key Learning Areas (KLAs) as core to the State’s K–9 school curriculum:

- The Arts,
- English,
- Health and Physical Education,
- Languages,
- Mathematics,
- Studies of Society and Environment (SOSE),
- Technology and
- Information and Communication Technologies (ICTs)

(Queensland Studies Authority (a). 2012).

Each KLA is made up of a number of identified Essential Learnings (ELs) that describe what students will know and understand at the end of particular year junctures (years 3, 5, 7 and 9). One of the main things this study seeks to demonstrate is that educationally focused computer games can be developed that not only deliver relevant curriculum in a number of Key Learning Areas, they can also be designed in such a way as to “invisibly” incorporate many of the ELs of the Health and Physical Education KLA into their everyday learning activities, as will be discussed in greater detail in Chapter Four.

Finally, the author hopes that this project will encourage children to reflect critically on their daily computer use and find their own ways to blend the benefits of emerging mobile and networked technologies with the freedom and potential benefits that such technologies offer. It will be student demand for greater mobility and for the opportunity to spend more
time outdoors or away from the classroom that will ultimately provide educators with the motivation and the argument for developing online learning strategies that support and encourage outdoor learning. It is the students who are familiar with these types of learning from their own education that will drive this process into the future and, hopefully provide the innovative approaches and creative solutions that will drive education and game design forward in the twenty-first century.

3.1. Methodology

The Jumping the Fence project utilises design-based research as its primary methodology, since this approach allows for the carrying out of both design and testing in the context of real-life settings (Barab et al. 2005 p.91). Although normally considered to be a methodology primarily associated with educational practice, the iterative nature of design-based educational research aligns directly with the working methods used extensively in both creative arts practice and throughout the design professions. The use of an educational, design-based research methodology allowed the author to create an initial application which could then be used as a test vehicle, from which outcomes could be used to improve the application in an iterative process—as is typically done in most design related research. According to Barab and Squire (2004) "design-based research involves introducing innovations into the booming, buzzing confusion of real-world practice (as opposed to constrained laboratory contexts) and examining the impact of those designs on the learning process" (Barab and Squire 2004 p.4). From such testing the "lessons learned are then cycled back into the next iteration of the design innovation" (Barab 2005 p.92). This iterative approach to design allows for unexpected or unpredicted events and outcomes identified during test trials to be accommodated into the design process and future outcomes. In this way, the researcher can be open minded to surprises and react appropriately by adjusting the design of the application to cater for the needs of the research subjects and the environment where the test takes place. Design-based research is not static and it evolves from one stage of the development and testing to the next stage, aiming for refinement after each iteration.

Svarovsky (2009) describes how design-based research methods are applied in the context of designing learning and teaching applications to extract research data. Svarovsky observes that each iteration of a design experiment commonly involves three phases that reflect those used in engineering practice:

"...the design phase, where a learning environment is crafted to test a particular theory of learning; the implementation phase, where learners are carefully observed as they engage in the designed environment; and the analysis phase, which examines the learning outcomes and processes of the environment in order to potentially refine both the theory being tested as well as the next instantiation of the learning environment” (Svarovsky 2009 p.11).
However, it is understood that before even the first application is built, the designer / researcher will naturally bring to the project a set of ideas, assumptions and experiences previously developed from personal and professional experience and, in projects such as this, the conclusions drawn from an extensive literature review. Such expectations about the research and the design project itself are described by Gero and Kannengiesser as being informed by three world views and the interaction between them: “the external world, the interpreted world and the expected world” which, they argue gives rise to a state of “Situatedness” (Gero and Kannengiesser 2008 p.3). Situatedness (and thus Situated Design) is “a paradigm that provides a framework for understanding how a designer’s interactions affect both what is designed and the designer’s experience ... drawing on models of situated cognition”—a model of learning based on the work of Donald Schön. In Schön’s view:

design concepts are the consequences, intended or unintended, of the designer moving through the state space of possible designs. Every step of the designer through that space is seen as a ‘move experiment’, which is then taken as the basis for both evaluating previous design concepts and generating new design concepts. Reflection is [the] cognitive process that is the driver of this [process] (Gero and Kannengiesser 2008 p.3).

Although the combination of design-based research and situated design models inform the primary methodology, acquiring both quantitative and qualitative data to support the developmental processes is also integral to any project such as this. Whilst immediate feedback through the use of surveys and questionnaires was deemed useful and used at the end of every game trial, it was decided that field observations, through note taking, interviews and videotaping of the actual game play in the field would also reveal interactions and outcomes that might not be reported in the post-game surveys. Both these approaches were planned in advance in association with the school in which the project was trialled and were undertaken under the University of the Sunshine Coast’s Human Research Ethics Committee’s approval (EC00297). These aspects of the study are covered in detail in Chapters Five and Six and in the relevant appendices. To guide the design of the game and to inform the analysis and the interpretation of the observations made in the testing process, the researcher chose to use the pedagogical framework defined by deFreitas and Oliver (2006) as a guide.

Ulicsak (2010) identifies deFreitas and Oliver’s four dimensional framework as an effective strategy for designing and evaluating educational software and serious games and testing the effectiveness of simulation based or serious game applications. The four dimensions of deFreitas and Oliver’s framework are summarised below:

- **Context** which covers where the learning occurs—it includes the macro level, so historical, political and economic factors (for example, are you playing because it is a
school directive), through to micro, the tutor’s background and experience, cost of game licences etc.

- **Learner specification**, for the individual or group, requires the tutor to consider their preferred learning style and previous knowledge and what methods would best support them given their differing needs.

- **Mode of representation**, this includes the level of interactivity required, the fidelity, level of immersion produced. It also covers diegesis, the separation of the immersion aspect with the reflection around the process of playing the game. Most importantly it highlights the potential of briefing and debriefing to reinforce the learning outcomes.

- **Pedagogic principles** requires the tutor to reflect on the learning models ... which enables them to produce appropriate lesson plans (de Freitas and Oliver, cited in Ulicsak 2010 p.62).

Figure 3.1 is based on de Freitas and Oliver’s four dimensional framework, and shows the interconnections between the learner, the pedagogy, the learning context and, importantly, the modes of representation selected for use within the game and the game playing activity and demonstrates how variations in any one dimension influence (and are influenced by) changes in other dimensions.

Figure 3.1. De Freitas and Oliver’s four dimensional framework showing the relationship between context, learner, game representation and pedagogy. Redrawn from (De Freitas 2006 p.23).
interdependent on the others, modifications to one aspect of the game (such as adding the capacity to change the nature of tasks required at different levels) naturally implied a potential impact on the other three. Whilst De Freitas and Oliver’s framework provided a useful and practical set of benchmarks with which to analyse the developmental and testing process during the more in depth testing of the project, it also provided a handy reference point when making more minor adjustments or changes. A quick review of the three dimensions outside of the modification being made quickly provided a handy check list of areas which may require later troubleshooting. However, in any such project, it is also necessary to analyse just how the end users, the teachers and students who are using it in the classroom and school grounds, are actually engaging with the game itself and whether or not its intended function—that of an educational tool—is actually being realised.

To gain a better understanding of how teachers and students were responding to the design and functioning of the game, the researcher relied primarily on the gathering and analysis of both quantitative and qualitative data, which in turn determined the evolving technical structure of the game mechanics and game story. Throughout the testing of the game, student and teacher interaction with the game, as well as the learning outcomes were measured by practically assessing the student’s acquired knowledge, reactions and experiences in four ways—via oral assessment (interviews with students and staff before and after playing the game); by questionnaires at set intervals during the study; by confidential feedback from teachers based on course assessment and subsequent classroom observations and, lastly, by observation in the field (video recording how students and teachers acted and interacted and documenting a range of associated activities, such as what students observed and wrote about in their field diaries). In particular, teacher and student feedback and interviews later proved to be a valuable source of evidence that clarified many of the activities and interactions that were evident in videotaped field recordings but which were difficult to interpret—often because of poor sound quality or a lack of understanding of the interpersonal relationships and the levels of individual skills and knowledge that existed within the test groups. Having the teacher view the videotapes often provided valuable insights into individual behaviour and frequently provided explanations as to why students responded in certain ways to game activities or towards other players. A number of examples of these processes in action and how they influenced the outcomes of the project are described in greater detail in Chapter Five.

3.2. The JTF Research Questions and the Four Developmental Stages.

The development of the JTF game environment, its implementation, testing and data gathering was based on a four stage approach designed to answer the research questions arising from the literature review. These questions and the aims of this project are summarised below:
Can a computer based educational game be developed that encourages young people to physically interact with the natural environment?

Would the physical interaction with the natural environment reduce the amount of daily computer screen time engaged in by participants?

Taking into consideration the sophistication of many online gaming environments, what can we learn from their structure and design that can be applied in an educational context? Specifically, what kind of activities can we develop on this basis that would encourage young students to leave their computers and conduct more outdoor activities?

Would a game based simulation of an environment enhance the learning experience and educational outcomes?

What effective interactive strategies could be identified that would help achieve this outcome?

What other hardware could be used to play a role in data transfer, data collection and communication—such as handheld devices (mobile phones, Global Positioning Systems, Personal Digital Assistants, Digital Video Cameras, and Digital Sound Recorders)?

Stage 1. Researching and developing the game idea.

Following the literature review, preliminary discussions with teachers from the host school were undertaken to identify the areas and fields of study in which an educational game based on the author’s preliminary study and initial ideas might best be developed. Following further study in which Key Learning Areas were studied and Essential Learnings were identified in conjunction with the teaching staff, ethics approval for the project was sought and granted. Following this, several formal and informal discussions and surveys were undertaken with the target user groups (the children and the educators) that would be involved, in order to ascertain the level of experience and skills in computer use and computer or console gaming existing amongst the age group of school students being investigated and the nature and types of the games they were familiar with and most enjoyed. These results informed development of the first version of the game, including the narrative idea, the game plan and the game mechanics that would form the basis for subsequent versions of JTF.

Stage 2. Testing of the paper based prototype.

As noted earlier, design and refinement of the game was an iterative process, since player responses, feedback and learning outcomes determine both the experience of the player and the success of the game in achieving or addressing the aims and objectives of the project. JTF is developed through an ongoing dialogue between the designers, the design and the audience. In this way, each round of testing informs subsequent revisions and refinement. To
simplify the design process, test the game concept and gain initial feedback, the first prototype tested intentionally avoided the use of computers. Instead, a white board like metal tablet (25 centimetres by 32 centimetres in size), markable magnetic squares, marker pens and paper based game instructions were used to draw up the game world. By placing the squares on to the white board, the students were able to create an abstract model of the outdoor “habitat” they were required to investigate and manage. Students were observed whilst playing the prototype and these observations, post-game surveys and discussions with the supervising teachers were analysed and used to develop the next stage of the game following analysis.

Stage 3. Design and initial testing of the computer based prototype.

In this stage, the principal aim was the creation and testing of the first version of the computer based game prototype so that it could be used as a developmental “test bed” for subsequent testing and refinement.” This first version, a stripped-down version of the game, was used to test the game interface, debug the Action Script and trial early versions of some of the introductory animations (these were still works in progress) whilst gaining feedback on the visual style and character design. In this version, students observed some of the introductory animations, did their mapping and fieldwork on paper and returned to the classroom to enter data into the game grid on the computer. In addition, an early version of the map toolbox was made available, allowing students to look up additional information regarding their local area or bio-region and identify some of the plants and animals they may have encountered. Again, surveys, interviews, field observations and discussions were used to gain appropriate feedback and commentary and inform subsequent improvements and changes to content.

Stage 4. Multiple revisions and testing of the prototype and analysis of findings.

On the basis of the initial studies, the game was repeatedly revised to enhance effective strategies, improve the interface and user accessibility, update animations and improve content such as introductory animations, game flow and external links. Less effective or distracting elements were modified or removed on an on-going basis, based on feedback, surveys and observation. For example, one outcome of the stage three round of user testing showed that strategies based on role-play, positive motivation and game based rewards were essential in maintaining interest, but that these required on-going monitoring and response by the game program / game manager and needed to be initiated through some form of prompting or reminder system.

In this stage, the main aims and objectives of the study were to observe the various ways in which players interacted with the game and to draw some initial conclusions about the effectiveness of incorporating outdoor activities into game based learning, whilst continuing
to develop a working model / prototype within which this can be achieved. Again, interviews, surveys and observations were used to inform this process. Finally, the author sought to discover how such games might be successfully implemented into other areas of the primary school curriculum and, in this game specifically, to discover to what extent it had helped players learn about ecosystems and Australian wildlife and whether or not it had encouraged them to become more interested in nature. These findings, it is hoped, might inform future research into game based learning and its many and varied applications in the teaching and learning context.

3.3. Moving Forward.

The idea of using game based learning as a method of improving educational outcomes is not new. However, the researcher’s hypothesis that combining GBL with the acknowledged benefits of outdoor education and the challenge of taking on personal responsibility for the care, maintenance and improvement of a unique biotope might be like asking individuals to take on the task of caring for a pet or a friend—and thereby become more engaged in the game play and learning process—certainly opens up a range of future possibilities. What JTF superficially teaches is a basic understanding of biotopes, biodiversity and ecosystems, a prerequisite to being able to care for a given ecosystem and to keeping it balanced and healthy. What JTF teaches at a deeper level is the extent of the inter-relationship between all living systems and the need for co-operation, self motivation and independent learning. Most importantly, it seeks to instil a sense of just how small and fragile our own environment really is—and how everyone must take on some responsibility for how that environment is managed and protected in the longer term.

The next chapter discusses the making of the JTF game in detail. The chapter shows how the game structure, game story and game mechanics were developed and provides a deeper insight into the graphical user interface design and some of the programming that underpins the game itself.
Chapter 4


This chapter describes the development of the Creative Component of this research project—the design and production of an alternative form of computer game, which seeks to blend the benefits of computer based educational gaming with a range of strategies that encourage the gamer (and student) to move beyond the restrictions of the computer and the classroom and engage directly with the natural environment—in the process forming research groups, developing social skills and taking part in a range of low-impact, outdoor physical activities. In the playing of the game, it is hoped that the student gamers will learn about Australian native wildlife, science, the environment and sustainability issues and—above all—they might have fun in the process.

4.1. The Preliminary Design—Defining the Target Audience and Developing the Prototype.

The practical development of the first trial version of the Jumping the Fence game was based on a preliminary study designed to identify a suitable area of study to which the researcher’s project and ideas could be applied and tested. It was decided to structure the game and its educational outcomes, its visual design and language, as well as the levels of computer literacy required to play it so as to be relevant to Australian Year 5–7 students engaged in the standard Queensland primary school curriculum. The children in the sample that volunteered to participate in the study were typically between 9 and 12 years of age and were drawn from two composite year classes (grades 5-6 and grades 6-7)—which accounts for the wider than might be expected age range for such a trial. The testing of the game prototypes was done at the Sunshine Beach State Primary School in Queensland between 2008 and 2010 and was approved by the school. All student participants had signed parental permission and the study was undertaken under University of the Sunshine Coast Human
Research Ethics Committee approval EC00297. Twelve visits in all, of two to three hours duration, were undertaken in the process of testing the game prototypes, making observations and gaining feedback.

Following the initial visit to the school in which a preliminary survey of the students was undertaken, the first version of the game (already prepared in a draft form) was revised based on information obtained from the survey prior to its first trial. During the next eleven visits, the JTF game was gradually moved into a fully digital format which was repeatedly revised following each trial on the basis of videotaped activities, observations and student and teacher feedback, in order to improve the game flow and structure, address student comments and criticism and enhance both the educational and game based strategies, as well as to modify or remove less successful or distracting elements. For example, one outcome of the third round of user testing showed that strategies based on role-play, positive motivation and game based rewards were effective in maintaining the interest of the students, but that these required on-going monitoring and response by both the program driving the game and the game manager/co-ordinator (typically the supervising teacher). In addition, interactive design and database strategies that allowed the JTF software to better manage and provide access to the data sets collected by the players were continually developed and tested throughout the trial as problems were identified and programming issues were gradually resolved.

4.1.1. Essential Learnings.

The Queensland Studies Authority (QSA) is the statutory body of the Queensland Government responsible for providing and overseeing the “syllabuses, guidelines, assessment, reporting, testing, accreditation and certification services for Queensland schools” (Queensland Studies Authority (a). 2012). The QSA uses the term “Essential Learnings” (ELs) to describe the intended outcomes of K–12 education in Queensland which, according to Le Metais (2003) are “variously described as key competencies (Australia), essential learnings (Alberta, Canada), foundation studies (British Columbia, Canada), core objectives (Netherlands), essential skills, expressed as competencies/results statements (New Zealand), skills for success (Maryland, U.S.), goals for lifelong learning (Massachusetts, U.S.) and areas of applied knowledge (Wisconsin, U.S.) (Le Metais 2003 p.240). The QSA defines essential learnings as identifying “what should be taught and what is important for students to have opportunities to know, understand and be able to do” and divides them into nine Key Learning Areas (KLAs), including the Arts, English, Mathematics, Science and Studies of Society and Environment, or SOSE (Queensland Studies Authority (a). 2012).

Since the primary aim of the JTF game was to encourage students to engage with outdoor learning and physical activities and, in the process develop an understanding of environmental
and sustainability issues, as well as a knowledge of Australian wildlife, plants and habitat, the Studies of Society and Environment (SOSE) essential learnings, in particular those aspects of knowledge and understanding defined under the sub-heading Place and Space were identified as being most relevant to the author's project. In addition, the Science essential learnings under Life and Living and Science as a Human Endeavour were also identified as highly relevant, providing a valuable overlap between the two areas of study and a valuable means of demonstrating the inter-connectedness of academic disciplines. In terms of the outdoor learning component, the Health and Physical Education KLA provided the relevant ELs. Table 4.1 summarises the key ELs outcomes for the Year 5 and Year 7 KLAs addressed in this project.

### Table 4.1. ELs outcomes for the Year 5 and Year 7 Key Learning Areas (SOSE and Science) addressed in this project.

<table>
<thead>
<tr>
<th>Studies of Society &amp; Environment (SOSE)</th>
<th>Essential Learnings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Place and Space</strong></td>
<td></td>
</tr>
<tr>
<td>Environments are defined and changed by interactions between people and places.</td>
<td></td>
</tr>
<tr>
<td>Environments are defined by physical and human dimensions.</td>
<td></td>
</tr>
<tr>
<td>Interactions between people and places affect the physical features of the land, biodiversity, water and atmosphere.</td>
<td></td>
</tr>
<tr>
<td>Physical features of environments influence the ways in which people live and work in communities.</td>
<td></td>
</tr>
<tr>
<td>Sustainability of local natural, social and built environments can be influenced by positive and negative attitudes and behaviours.</td>
<td></td>
</tr>
<tr>
<td>Maps have basic spatial concepts that describe location and direction, including north orientation and four compass points, symbols and a legend or key. Maps have specific features to convey information, including latitude, longitude, eight compass points, scale and distance, a legend and shading and/or symbols.</td>
<td></td>
</tr>
<tr>
<td>Sustainability requires a balance between using, conserving and protecting environments, and involves decisions about how resources are used and managed</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Science</th>
<th>Essential Learnings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Life and Living</strong></td>
<td>Living things have structures that enable them to survive and reproduce.</td>
</tr>
<tr>
<td><em>Systems of scientific classification can be applied to living things</em></td>
<td></td>
</tr>
<tr>
<td>Survival of organisms is dependent on their adaptation to their environment e.g. animals use camouflage to protect themselves; plants in very dry areas may store water in modified structures</td>
<td></td>
</tr>
<tr>
<td>Different feeding relationships exist within an ecosystem e.g. producer, consumer, herbivore, carnivore relationships form a food web</td>
<td></td>
</tr>
</tbody>
</table>

| Science as a Human Endeavour | Science impacts on people, their environment and their communities. |
Scientific knowledge has been accumulated and refined over time, and can be used to change the way people live e.g. use of and changes to technology, including mobile phones and computers.

Ethical considerations involved in decisions made about applications of science e.g. preservation of wilderness environments to help protect endangered species.

Scientific knowledge can help to make natural, social and built environments sustainable, at a scale ranging from local to global.

Different cultures, including those of Aboriginal people and Torres Strait Islander people, have contributed to science and scientific practice e.g. Indigenous knowledge of flora and fauna makes contributions to scientific knowledge and the development of pharmaceutical products.

### Health & Physical Education Essential Learnings

#### Physical activity

Fundamental and specialised movement skills, movement concepts, tactics and strategies are elements of physical activity.

- Refining teamwork, tactics and strategies in a variety of contexts improves movement capacities, and physical performance, and enhances participation in physical activity.

- Regular participation in physical activity can enhance cardio-respiratory endurance, muscular strength and endurance, flexibility, and health and wellbeing

#### Personal development

Beliefs, behaviours and social and environmental factors influence relationships and self management and shape personal development.

- Assuming roles and responsibilities, experiencing leadership opportunities, respecting cultural protocols and differences and working well with others, develops positive identity and self esteem

- Identity and self-image are influenced by environmental factors, including the media, and social expectations of age, gender and culture

(Queensland Studies Authority (b, c, d and e) 2007)

It was deemed important to the researcher that the user group (students and teachers) should be involved from the earliest stage of the game’s design and practical development. A number of informal discussions between the researcher and interested teachers at the trial school were conducted in the lead up to the project in order to clarify the ways in which the design and structure of the JTF game might initially address specific aspects of the essential learnings in the identified KLAs. Given that schools and teachers are given considerable flexibility in how content is delivered and that different teachers have their own individual teaching styles, it was clear from the beginning that whilst certain prescribed content would need to be included, the game should be able to provide teachers and students with the ability to customise, edit and change content as needed. Early discussions focussed on answering the following questions:

- What specifically is it that needs to be taught?
- Who is the audience (their qualities, expectations, likings, gaming experience, learning skills etc)?
- What are the specific learning objectives embedded in the ELs?
- How might / could the game be used in the learning and teaching context of the school?
• Could the game be used without being integrated in the school curriculum—i.e., as an extra-curricula activity?

Based on the results of these discussions, the first, paper based prototype was developed in readiness for the initial student survey student and subsequent trial. The initial game used task cards, a number of booklets providing instructions, information and space for note taking, along with a printed map of the initial area to be studied. The next section outlines how the initial prototype was developed and some of the issues that emerged and strategies that were developed during the initial stages of the project.

4.1.2. Developing the Paper-based Prototype of the JTF game.

Results from the literature review and preliminary interviews conducted with the students and teachers at the primary school helped to build a picture of the type of games that the target audience were playing at the time. In addition, the author’s own children (aged 8 and 13 years at the time) provided valuable insight as to what was and wasn’t popular amongst their peers. Preliminary meetings with teachers at the test school provided specific information about how the relevant curriculum units were being delivered at the school and which aspects of the KLAs and ELs might be best addressed by the game itself. During the initial design process, the researcher also kept copies of the KLA guideline sheets at hand and created the initial game structure around those goals identified in the sheets and listed above.

As noted earlier, the main idea driving the development of the first draft of the game was to create a game world that was based on an existing natural habitat, ideally on the school grounds or in the student’s own backyard—since these two options provided an immediately accessible ecosystem for investigation. By mapping, interacting with and possibly modifying a real world outdoor area as an essential part of the game play, the students would naturally be fulfilling two of the researcher’s main aims—encouraging the children to leave the computer and spend more time outdoors whilst learning more about the Australian natural environment and the diversity of habitats it encompasses. The researcher also sought to provide the students with a viable scenario and story-line that required them to slip into one of three roles: a nature reserve manager, a scientist and an environmentalist, whose task it is to learn more about how the Australian environment is affected by change and what strategies can be developed to preserve, protect and restore it. Importantly, it was felt that students should learn about the relationship that humans have with their environment and how it is possible to live in harmony with it—and that there should be visible evidence of any outcomes that the game produced, long after the end of the trial.

Following one visit to the school, in which the author was being shown around the grounds by one of the teachers who had agreed to participate in the project, the teacher pointed out that nearly every primary school in Queensland would have a vegetable and herb
garden, as these were a popular learning activity amongst the younger grades but were often overgrown or neglected from year to year, especially over the summer months while students were on their Christmas holidays (in Queensland typically seven to eight weeks and the start of the wet season). The vegetable garden at this school in particular provided an excellent test area for the initial trial as it had been neglected for over two years and was totally overgrown by non-native plants and a large number of weeds. Whilst not every school might have such a garden, this seemed like an excellent opportunity to test out some of the initial ideas about the game and, in the process, perhaps rehabilitate both the garden and the surrounding land.

Since it was planned that the initial trial would be undertaken using a paper based game (in order to test out the gaming strategy), the researcher looked first to a number of board games that have have been played across cultures for many centuries, or which have been widely successful in more recent years, for inspiration. The Japanese game Go, along with Chess and Backgammon are perfect examples of classical board sized strategy games. Larger, but still manageable spaces, such as tables and sandboxes were needed for the 19th century activity of Wargaming, which served as both a military training technique and a social pastime amongst the upper classes—but which gradually filtered down to become a popular hobby during the 1960s and 1970s in a number of variations. These games in turn span off into fantasy and role playing games during the later 1970s, introducing the hugely inspirational game Dungeons and Dragons and, later, tile placement games such as Carcassonne, The Settlers of Catan and Warhammer, in which fictional landscapes are created and mapped by the players. Most of these strategy board games are rule-based simulations of real-world situations where the players depend on a combination of strategic thinking and luck. Most are relatively simple to learn and have a simple set of rules, although they leave a wide range of strategic options open to the player. With such games, social interaction amongst the players is a key element of both the strategy and the fun.

Suprisingly, initial interviews with the students revealed that some of these board games were still popular with the age group in question. When asked about their favourite non computer games, the following topped the list: Lego, swimming, dancing, camping, bike riding, cops and robbers (and other chasing games), supervised team sports activities and some board games, in particular Dungeons and Dragons and War Hammer. Most students were familiar with Chess and some had seen Backgammon, but these were more often played by parents or older relatives. That so many children were familiar with Dungeons and Dragons and the concept of role playing games (possibly because the game would have been played by their parents as teenagers and then by them with their children) suggested to the author that adapting the principles of role playing games might not be as problematical as first thought. Since these games are typically overseen by a Game Master, who controls and delivers the
story, the role of the teacher—as guide, administrator, content developer and arbitrator—could also be easily accommodated. In the same way that these games break up their world into a series of grids and tiles, breaking up the JTF game in small sections which interact to form a larger picture therefore became an obvious design and playing strategy. Requiring students to accurately measure and survey their outdoor “research” area and turn it into a 2 by 2 meter grid encompassing an area 8 metres by 6 metres (the original test game tiles) then map this area into the computer—along with making a detailed analysis of the plants and animals that live in each square, requires students to apply skills in maths, geometry, drawing, writing and teamwork as well as observational and communication skills. Children must think spatially and learn how to turn their complex three dimensional real world area into a simple two dimensional map that uses colours and legends for representation. At the same time the players are creating the very grid on which the game will be constructed and subsequently played. Several ELs from all three KLAs identified above are addressed in that one activity. Figure 4.1 shows several pages from the author’s notebook made at around this stage, illustrating how the game concept moved from developing an initial structure and identifying key relationships, to the use of a simple grid system as the basis of the game interface.

**Level Design.**

The paper based trial of the JTF game worked on the basis that, given the limited resources available to the author, only two levels could be effectively trialled in the study. The first level would be needed to get the player to an appropriate level of knowledge in relation to understanding the systems being studied and would then provide the background necessary for students to accomplish the missions and tasks required at the main level. In the initial draft of the project, it was anticipated that students would be required to review a series of introductory animations and pass a number of pre-requisite tests, each of which would introduce the students to the skills sets required for completion of the game at a higher level. In the paper prototype, the prerequisite information required to pass these tests was provided in the classroom by the teacher, who took on the role of explaining and testing the initial
To support this process, the children and the teacher were presented with a number of printed booklets that informed them about the roles and the tasks they would have to perform and the knowledge that would be required to fulfil them. Thus, students who would be assigned the role of Scientist received a handbook detailing the things that they might be required to know or deal with in the second level of the game and were asked to complete and pass a simple test prior to commencing the outdoor trial. Since this was only an early test, students were allowed to keep the handbooks with them during the playing of the test game. Additionally, these notebooks were later used to document their daily activities and the findings they made while playing the game during the trial. The paper notebooks acted as the equivalent of the computer based game database that was planned for the digital version of the game.

Included in the notebook was a printed table of the symbols that would be used in the production of the initial game map. This contained eleven basic symbols representing different types of insects, animals and plant categories which could be cut up and pasted onto their grid if the student chose to do so. The symbols were intentionally designed to be simple and generic, allowing them to be easily copied by the children if the legend was used up and non-specific enough to represent a variety of flora and fauna—for example a cat-like creature could be anything from a possum to a dog, “scrub” meant any shrub-like plant or undefined undergrowth. The aim of the legend at this stage was to act as a guide as to what the students might be looking for and thus make it easier for the children to assess their research area sufficiently. To make up the representation of their research, once the study area had been divided into a grid by the students, they were given a rectangular white metal game board that could be fitted with the 12 magnetic squares, each measuring 7.5 centimetres by 7.5 centimetres squares, equivalent to the 2 meters by 2 meters of their gridded study area. The tiles were magnetic and had a white, erasable surface which could be drawn on and then erased for re-use. The students were also provided with five colours of white board markers (orange, red, green, blue and black) which were used to draw onto the tiles any trees, shrubs, puddles, ponds, grass, animals, burrows, hollows, nests, hills and gullies or whatever else they found in each of the 2 meter by 2 meter squares. At the end of the session, the game board contained a basic representation of the current state of the area being researched and observed by the students—which, in later versions of the game could be transferred onto the computer back in the classroom (or possibly be entered directly into a tablet computer in the field). Students were also encouraged to take digital photos and sound recordings if possible as well as taking samples of leaves and plants to put into their diaries for later study and subsequent analysis of how their research area has changed during the course of the game. Figure 4.2 shows the initial legend used by the students and one of the magnetic game boards after the initial trial. Note the orange animal tracks leading from the bottom left of the board leading to the pool of water in the centre and exiting at the top right of the water. The quality of the
Determining the Graphical Style.

The paper prototype needed only minimal visual appeal and graphics were deliberately rough so as not to influence the students when it came to copying from the legend. The prototype only catered for testing the game idea and game play and providing instructions and key information relevant to each student’s assigned role. However, at the same time as developing the paper prototype, the author developed several rough character studies and presented them to the students to get some feedback on their opinions as to what the game characters should look like. From the start of the project, it was intended that the visual style of JTF would be influenced by the online computer games the children already liked to play, although the technical limitations of Adobe Flash (at that time the primary interactive and animation tool in use for web development) would also have to be taken into account, primarily due to its reliance on vector based drawing tools. Although Flash works well with bit-mapped graphics, vectors allow for faster and easier animation and create smaller file sizes, a necessity if the game was to be delivered and played using an Internet connection.

When asked about their favourite free online games, the following games were most commonly listed: BMX Freestyle, Fireboy and Watergirl—Ice Temple, Doodle2, Disney’s Club Penguin, Crash Bandicoot, Fancy Pants Adventure World, Samurai Sam, Sweet Tarts and Pirates. Aside from the slicker style of the Disney site, the visual style of most of the games was quite simplistic, with the animated characters being quite small (often no more that 15–20mm in height), often because the games were arcade style games in which the characters ran around a grid or scrolling landscape. As well, most games were aimed at children 8–15 and the drawing style often reflected the naive drawing style of adolescents. Figure 4.3 shows frames from four
games identified by the students, *Papa’s Pizzeria, Fancy Pants Adventure World, Bloons* and *Ice Temple*, all of which are made entirely in Adobe Flash. From the author’s own experience, it is clear that the limitations of drawing with some forms of vector-based software are mainly responsible for the basic, simple style of the animated characters. It is also interesting to note that the mid 2000s saw a number of highly successful animated television shows also using this simplistic style, such as *South Park*, Mondomin’s *Happy Tree Friends* and *Ren and Stimpy*. Baldwin, Daubs and Ludwick (2006) argue that the advent of Flash animation on the web created a new style in the field of animation known as *Flashimation*, which spread rapidly into television and, to a lesser extent into film:

Several threads of thought explain the evolution and culturalization of the new-media phenomenon known as Flashimation. Television animation, increasing access to and preference for the Internet, the technological restrictions of this new medium, and the availability of animation software itself have coalesced to produce a major change in the cultural reconceptualization and consumption of modern animation. Collectively, they explain a complex and layered transition from “kid-vid” cartoons to short and crude forms of sophomorically humorous animation produced specifically for an adult audience (Baldwin, Daubs and Ludwick 2006 p.143).

Whilst certainly avoiding the crude humour often associated with contemporary Flashimation, the visual style of *JTF* intentionally emulates a graphical style that the players themselves are familiar with in these kinds of games and animations, thereby requiring them to imagine more of the game world and the adventure they are involved with. In the player’s imaginary world, the research area could be anywhere in Australia from the Kimberlys.
4.1.3. Developing the JTF Narrative.

Koster (2003) made the case that a good story-line or narrative increases player motivation to succeed in a game and recommended that educational game developers make the story as relevant as possible to the topic being taught. He also suggested that each player or team should be given a high degree of flexibility in developing their own strategies in order to work through the narrative and that the achievement of learning objectives should not require the player to follow a predetermined path in order to do so. Prensky (2001) pointed out that simulations in themselves have the potential to become boring “in the same way that driving your car to work” or any other repetitious activity can quickly become dull, but that the solution to this was to ensure that learning and competition, through “goals, rules, challenges such as emergencies and ... narrative” are integral to the game design (Prensky 2001 p.3). Both role play and narrative are viewed by De Freitas (2006) as essential for the creation of believable “microworlds” within computer based learning games, since both “role play and narrative allow learners to suspend their belief and [thus] learn through problem solving and team working” (De Freitas 2006 p.37). To this end, an initial narrative was developed to underpin the JTF game and, as the game progressed and feedback was obtained, the story was revised and edited to suit the changing structure of the project and to better match the student’s experience and expectations of the game.

Royle (2008) observes that player engagement is maintained over a longer term when three conditions are satisfied in a computer game:

- The structure of the game provides motivation and the urge to solve problems for the
problem’s sake alone.

- The back story or narrative provides believability or authenticity of engagement.
- The characterisation makes the player’s role in the narrative believable so that the player can engage fully in the game (Royle 2008 p.2).

Addressing these conditions was instrumental in the development of the JTF game narrative and playing strategy. By assigning the students specific roles within the story context and allowing these to change as the story unfolds, the narrative requires the students to engage in acquiring and using a number of “facts, skills, and values in the service of performing [the role of] a specific identity” (Royle 2008 p.3)—in other words requiring the players to engage as an active participant in a community of practice. Royle believes that in the best examples, this would “mean [producing] real-time simulations that place players in identities and social situations as practice for a real-world professional domain, a sort of virtual apprenticeship that supplies the skills and knowledge required for a particular vocation” (Royle 2008 p.3). Given that these are primary school age children, and that the JTF game is merely a prototype, it is clear that it would be impossible to fully achieve this ideal state at this stage. However, the author believes that by delivering a believable back story and requiring the players to become “experts” in aspects of the essential learnings across a number of levels, sufficient realism can be developed to maintain sustained engagement. In this way, the game’s virtual content integrates tightly with the student’s real world experience and vice versa, whilst the narrative serves as a vehicle between the two spaces in which learning occurs. Hopefully, it inspires individual problem solving through promoting dialogue with peers, teachers and experts.

In the first draft of the story, students were asked to take on the role of wildlife managers, scientists and environmentalists who had been called in to help create a wildlife refuge for Australian native animals and plants in order to help ensure their survival into the future—in the face of emerging threats to their numbers and their habitat due to human influences and natural catastrophes. The narrative was created to encapsulate as many of the ELs outcomes for the Year 5 and Year 7 Key Learning Areas (SOSE, Science and Health and Physical Education) as possible, with the view to adding and refining them as the project moved forward. As noted earlier, the protagonist of the game is a young female kangaroo who goes by the name of Kangi.

Kangi is a very up to date kangaroo who spends a lot of her time in the wilderness of Australia, but who often comes into cities and towns to study humans and learn their ways. Kangi has many magical qualities, including the ability to speak to children and use a variety of modern communications tools (without having to pay for them!). Her mission is to explain to students just how vulnerable the Australian natural environment is and help them understand how they can help protect it and her friends. Her plan is to do this by teaching as
many children as possible about Australian ecosystems and biodiversity—and the threats that humans and introduced plants and animals are posing to the natural environment.

Kangi’s plan is to ask the children to become part-time wildlife carers and rangers, scientists and environmentalists in order to help protect her and her native animal friends (amongst them the possum, owl, koala and goanna families) some of whom are seen in Figure 4.5, which shows Kangi with some of her wildlife friends. She tells the students that by working together it might be possible to help to save the environment and for them to develop sustainable strategies to help the animals well in the future. But in order to do this, the students need to pass tests and demonstrate their knowledge of science and the environment (based on the outlined Effective Learnings) at a number of levels. Kangi makes it clear that only people with the right knowledge will be able to really help the animals, because only wise people can then pass on the right knowledge and thereby teach others correctly. For this reason, admission to each higher level requires passing a number of tests (usually six) based on what they have learned in playing each level of the game.

Kangi believes that the best way to learn is by doing (she believes in constructivist learning—although she doesn’t use that term!) and that humans need to start helping the wildlife by understanding and looking after their own immediate environment as soon as possible. For this reason, the main module of the game requires the children to work with an identified area of land in the school grounds, or at home in their backyard. Each “habitat” needs to be carefully mapped and the plants and animals in that area need to be identified and recorded. The children learn that in even one square metre of ground there can be millions of living things and that life ranges from the microscopic to the macroscopic. Students learn about the level of biodiversity by counting plant and animal species and comparing native to non-native species. As a group they are asked to develop strategies that will help improve the well-being of their habitat as well as strategies for keeping it in a healthy and stable state. If
the children run out of ideas, get lost or distracted Kangi and the game master (the teacher) are available to help them get back on track with suggestions, guides and further reading or related activities.

Kangi tells the students she and her friends in the bush are worried about their friends who already live close to humans, mainly because humans have moved into the environments where they used to live and have taken away the food sources and the trees and the places where they once lived. She tells them stories about individual animals and asks the students to tell her stories about what they see and find in their investigations, so she can pass back news to her friends in the outback. She also asks the students to help the animals nearby through tasks such as building nest boxes, growing plants and trees that provide food, recycling organic waste by composting and reducing the amount of “rubbish” they produce. She tells them how cats and dogs and feral animals kill and eat her friends or take over their homes and how some introduced plants take over from native plants, reducing the biodiversity of the entire natural habitat and, of course, the food the native animals and insects rely on. Kangi also tells them about the customs and beliefs of the Aboriginal and Torres Strait Islander people and how they related to the environment. Many stories are told supporting the overall narrative and learning activities and the students are asked to find more stories and to read them and share them with the group. Importantly, Kangi needs the children’s help to not only save the local plants and animals, but to provide information for her friends back home, who are missing their relatives and friends.

4.2. The JTF Game.

The next section provides an overview of how the JTF game was developed and some of the decisions and strategies that informed the developmental process. The game mechanics and gameplay, game flow and different aspects of the game components, tasks and planning are covered, along with discussion about some of the creative strategies employed throughout the project.

4.2.1. The Gameplay and Game Mechanics.

Game mechanics are the structures and rules that define how a game will be played. However, in more recent years the term has come to be used interchangeably with the term gameplay, with game mechanics more often referring to the programming that drives the behaviours of objects in the game world. As programming becomes more sophisticated and simulations more accurate, there has been an increasing need for sets of physics based rules to be introduced into the games (for example the speed an object moves in different materials, the effect of wind on a ball) and other forms of interactive elements to be embedded (such as the outcomes of interpersonal encounters, certain fighting strategies or even the weather) and it
is these rules that often underpin the outcomes of the gameplay in advanced computer games. Whilst certain mechanics are necessary for JTF to function effectively, it is useful to discuss these separately from the main body of the project, which is the design of the game and developing and testing of the concept of moving the game into an outdoor environment for a major part of the gameplay. For this reason, this next section will focus primarily on the design and gameplay features of JTF, while sections 4.3 and 4.4 will focus more on the rules and mechanics of the game.

Every ecosystem is by nature a complex system and, to fully understand how it works can sometimes take years of observation, analysis and comparison with other ecosystems. Odum (1971) provide a simple but useful definition of an ecosystem:

All ecosystems comprise living organisms existing in obligatory relationship with each other and with certain non-living components of their physical environment. Any biotic community interacting with its environment such that the flow and dissipation of energy results in a defined trophic (feeding) structure, the emergence of biodiversity, and characteristic material cycles between the living and non-living components may be considered an ecosystem . . . Two points from the above are particularly critical to interpreting ecosystem structure and function. First, a universal feature of ecosystems is the continuous recycling of nutrients between the autotrophic and heterotrophic organisms. Second is the generally high degree of interdependence, particularly causal linkages and obligatory relationships, among ecosystems components. Thus, while there is often minor spatial or structural separation between systems components in natural ecosystems (e.g., the vertical stratification between producers and consumers in forests and lakes), in functional terms, critical components are operationally inseparable from each other and the whole (Odum 1971 cited in Rees 2003 pp.2-3).

Clearly, understanding the basics of even a simple ecosystem involves a certain amount of pre-requisite knowledge before any meaningful study or game playing activities can be undertaken. JTF is intended to be a component of a teaching program rather than the means of its full delivery, so it was intended throughout the game design process that the game would be used in conjunction with the school curriculum and the teaching of the prescribed KLAs and Els. However, the introductory section of JTF requires students to pass a number of set quizzes and to demonstrate a body of related knowledge prior to commencing the outdoor activities. Although some material pertaining to this core knowledge was built into the prototype computer game's original database—playing the game also requires students to undertake their own research and become an “expert” in each of the roles they will be assigned. In addition, it is envisaged that the game will also encourage the school and the students to participate in field trips, interact with environmentalists, scientists and hear from various guest speakers such as indigenous lecturers, rangers and park managers as a key part of the
learning activities, thereby broadening the range of learning resources and activities.

The gameplay in JTF can be broken up into a number of key elements—mainly learning tasks, outdoor activities, group tasks and the acquisition and use of game points, that are intended to keep the gameplay enjoyable and engaging and, at the same time provide the player with a practice oriented learning experience which is set within a situated learning environment. Two elements also drove the initial gameplay design—that the game should be both fun and educational and that there should be a visible record of the activity left behind after the game had been played. Ideally, the students should be able to look at the place they had played the game and be able to see and identify a physical change or long term improvement. Table 4.2 lists eight of the key gameplay elements identified by the author as central to the JTF design and educational outcomes.

Table 4.2. Eight key gameplay elements informing the JTF design and learning outcomes.

<table>
<thead>
<tr>
<th>Gameplay Strategy</th>
<th>Purpose and implementation.</th>
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<tbody>
<tr>
<td>Introductory animations and quizzes.</td>
<td>Introduce students to their game roles. Prepare players for that role and provide a basic understanding of what an ecosystem is and how it works and how to assess levels of biodiversity, which are indicators of the health of an ecosystem. Introduce the game tasks, narrative and how the game is played. Introductory testing of knowledge. Students must pass the test to move forward in the game.</td>
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<tr>
<td>Role play.</td>
<td>Role play makes it easier for the players to become immersed in the game and engage with the game world and story. Students are required to take on a role they might not normally consider in their everyday lives. Many students are already familiar with role playing games.</td>
</tr>
<tr>
<td>Role specific tasks and game mode.</td>
<td>Players become an “expert” in a certain aspect of the learning and teaching scenario. Thus the “scientist” might be called on to identify a new bird or plant and determine whether or not it is “native” to the area. Students must develop specific skills that will help to keep the ecosystem alive and healthy.</td>
</tr>
<tr>
<td>Group tasks.</td>
<td>To encourage social interaction and team work. JTF is a game that has to be played in groups and requires communication between the players. This helps develop social and communication skills.</td>
</tr>
<tr>
<td>Indoor/Outdoor engagement.</td>
<td>Outdoor learning/activity is a primary objective of JTF. Having indoor and outdoor tasks allows for weather variations and provides additional flexibility to the game.</td>
</tr>
<tr>
<td>Resource management.</td>
<td>Identify and improve the health of an existing ecosystem within a manageable area and keep it balanced throughout the gameplay.</td>
</tr>
<tr>
<td>Earning and redeeming points.</td>
<td>To consistently motivate the players in their actions and produce high quality outcomes, especially during early stages when progress might be slow (for example in the weeks between planting seeds and seeing them germinate). Points are also tied to social activities such as mentoring and group work and reward players for their physical work—generating motivation for subsequent tasks. Points enable students to do additional tasks that improve the state of their ecosystem beyond the brief.</td>
</tr>
<tr>
<td>Winning Condition(s).</td>
<td>All players win when they work together, execute the given tasks and have visibly improved the health of the ecosystem they are caring for and receive one of a number of certificates or prizes (all vary). The game does not cease when a “winning state” is achieved as role swapping opens up the game to a new iteration. Because the game area is within a bigger system (the school grounds) students have a constant reminder of their achievements.</td>
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Ideally, the players become immersed in the gameplay of JTF when they assume the
role of a character, acquire their character’s skill set and knowledge and then tell their story and act out their assigned role. Throughout the game play, each player in the team is exposed to a number of relevant situational experiences that are matched to measurable learning objectives—such as gaining knowledge about biodiversity, ecosystems, food chains, water chains, carbon cycles and how a balanced ecosystem works. Through assessing a real ecosystem, judging it’s health and well-being and developing strategies for improvement or sustaining that the system’s health, players find themselves responsible for a defined area (ecosystem) and become familiar with the diversity of organisms, plants and animals that live within, are dependant on, or visit that system. As the players become more comfortable and experienced in their role, they gain knowledge and develop new talents and skills, allowing the player to further define the abilities of their role.

JTF’s model of teaching and learning is a semi-closed circuit model (Figure 4.6), where the research and learning starts in class by playing the introductory levels of the game on the school workstations. Students can work individually or in their teams at the initial stage, but as students are assigned their roles, each student moves to their own computer the focus on the learning tasks associated with their task in the game. In the field tasks, tablet computers or other mobile devices can be used for entering information into the game system, also the game can be played equally well using notebooks and paper. Each indoor and outdoor task is assigned by the game master or game system, but input from external sources (student research, new knowledge from guest speakers etc.) can also enter the system.

Figure 4.6. Semi-closed circuit model (indoors>outdoors>indoors...).
Much of JTF play involves fulfilling tasks and solving problems. In the fully developed version, tasks or missions are usually assigned by the game system (allowing for the game to be played by students in their own time at home) although these can be over-ridden by the game master (teacher) as necessary. Tasks fulfilled result in the player being rewarding ECO points which can be redeemed for real and virtual items, such as tools, building materials or plants needed for improving the well being of their system. It is also through tasks that much of the game's experience is delivered. The tasks require the player to work both individually and as part of a group towards one goal (improvement of their ecosystem) learning through completion of each task and being motivated through the acquisition of the points. Tasks are linked by a common theme, with the next quest triggered by the completion of the previous, forming a task chain. To provide background knowledge, the game's content library contains a range of basic information about native and non-native animals as well as native and non-native plants and information about the six most common biomes (bio-regions), including coast/mangroves, rainforest, dry sclerophyll forest (bush), arid zones (desert) and river and reef regions represented in text and image format. However, as new information is discovered, this can be added to the secondary database included in the game. The teachers using JTF are required to carry out any initial research specific to their own variation of the game and prepare any extra explanatory material, as well as decide on suitable areas for the sites to be investigated and or regenerated by the students.

The semi-closed circuit model requires a seamless integration of hardware and software systems that can support both desktop computers and future mobile learning that takes place outside the class room. As noted earlier, data input, mapping and information retrieval in the field is ideally suited to the use of mobile devices. For this reason, the game engine for JTF was built on software that could be easily transferred from PC work stations to mobile devices that support the free Adobe Flash player. The high degree of inter connectivity is intended to create “a pervasive environment that allows the learner to be independent from a specific geographical location and provides [the] digital augmentation” (Rogers et al. 2005 p.1) that younger audiences have come to expect as the norm. It must be noted at this point however, that the rapid changes in technology that have occurred since the project was first commenced have seen a shift away from Flash (which was ubiquitous at the time the project commenced) to web and browser based delivery technologies independent of proprietary solutions. HTML5, CSS3 and Java are (at the time of writing) set to become the new standards as they offer powerful, flexible and open-source programming options supported by most web browsers, regardless of platform or device. Future iterations of the game would naturally be moved in this direction.
4.2.2. The JTF Game Flow

Crawford (1997) states that an important element in constructing a successful computer based learning game is the use of *self-adjusting flows*, where the learner/player is involved in determining the outcome of the program within its intuitively designed rules (Crawford 1997 p.53). By using role play as a key activity throughout the game, JTF enables each player to act and react in ways that allow them to move around, explore, make decisions and take responsibility for their team’s study area in their own time and at their own pace. The final outcome of the game primarily depends on the decisions made by the players as individuals and as part of a group, whilst the intervention of the game master (the teacher in most instances) allows the game to be constantly modified in real time according to the needs of the learners, changes in weather and any other external variables that are identified. As well, the closed circuit model of the game (moving between indoors and the outdoors, gathering and inputting information, completing and receiving tasks) shown in Figure 4.5 allows the learner to self manage their movement within the game by constantly providing feedback on their activities from the game system, the game master, peers and the environment itself. In this way, the action of the game and the pace and type of action is set by the group and the game master themselves, rather than by the system. The game flow is intended to be as flexible as possible and can be divided into twelve inter-related core activities that repeat as often as the game is played (usually three times).

- **INTRODUCTION**
- **LEARNING TASKS QUIZZES**
- **SITE IDENTIFICATION & INVESTIGATION**
- **PLANNING AND DEVELOPING STRATEGIES**
- **ROLE ALLOCATION & RELATED LEARNING**
- **IMPLEMENTATION**
- **COMPLETION OF INDIVIDUAL ROLE RELATED TASKS**
- **GAINING POINTS FOR THE TEAM**
- **WHOLE GROUP ACTIVITIES**
- **REDEEMING POINTS FOR TOOLS, PLANTS, ETC**
- **CHANGING ROLES**
- **NEW TASKS**

Figure 4.6 illustrates this process and provides a brief description of the kinds of activities that are undertaken in each of the above activities.

4.2.3. The Introductory Animations and the Six Quizzes.

The introductory animation introduces the students to Kangi (the game guide) who familiarises the students with the game narrative and presents the subsequent animations and tests, which look into the uniqueness of Australian fauna and flora, the differences in
Players form groups of three & watch the animated introduction.

Players learn about ecosystems and biodiversity. TEST 1.

Players learn about native and non-native species. TEST 2.

Players learn about the role of wildlife refuge managers. TEST 3.

Players learn about the role of Indigenous Elders. TEST 4.

Players learn about the role of Indigenous students. TEST 5.

Players learn about the role of the Environment. TEST 6.

SCENARIO BASED TASKS:

Players advance knowledge through completion of a number of learning tasks or games given to the group by the game system. Each game or task address different aspects of the identified ELs in the two KLAs. Examples might be:

- Sustainability game
- Mapping game
- Weather and climate quiz
- ATSI culture and history research task.

JTF begins at any one of the 3 role and understanding on role rotate. Students will have to change role by the system.

Players are rewarded by gaining access to the next level. They receive a score and can then print the map template and move their map onto their school grounds.

Players receive their findings in detail on the printed map, and in their notebooks (or portable digital devices) looking for such evidence such as animal signs, tracks, native and non-native animals and plants, soil conditions etc. as the presence of bugs, roots, sand, etc.

Players reposition the classroom / computer.

As students take on the role of the team leader they may be responsible for planting, roads, wells, impoundments, hideouts, and choosing new team leaders. This is determined through the team's abilities and points scored. Where they choose their findings, using the map, notes, and digital recording devices which are shared with the group. Merit points are awarded for the team's success and the group approved.

Players note their findings in detail on the printed map, and in their notebooks (or portable digital devices) looking for such evidence such as animal signs, tracks, native and non-native animals and plants, soil conditions etc. as the presence of bugs, roots, sand, etc.

Players reposition the classroom / computer.

Players continue to work on improving their chosen environment. Enter into the diary or blog area mode.

Players transfer all information gathered during the outdoor activity to their virtual map using the symbols available through the game's tool box. They may engage in environmental activity related to their chosen KLA and mapping symbols.

Players continue to use the environment map by adding icons or deleting icons. Entries in their diary or blog are made.

Players are rewarded by gaining access to the next level. They receive a team name and are given a secret password.

Players are rewarded by gaining access to the next level. They receive a team name and are given a secret password.
ecosystems and how ecosystems work. The introduction also educates the players about threats to the ecosystems which are caused by humans, who have introduced non-native animals and plants and how these humans and their poor management practices have subsequently caused erosion, pollution, urbanisation and loss of habitat. The introduction leads to three learning games and supporting tests, which use multiple choice questions to test the skills needed for assessing the game area, in preparation for playing the game. Once the three tests are passed the teams are split into their roles, and each student then studies the relevant learning content associated with their assigned role. In fully playing the game through to its conclusion, each student will play each of the three roles and thereby cover all of the introductory learning. Throughout the game, each player is encouraged to conduct further studies and research related to their assigned roles in order to broaden their knowledge and skills in solving environmental problems. In brief, the six learning areas and tests cover the following areas.

- What is an ecosystem and what makes it a balanced (or unbalanced) system? How can this be assessed? (Figure 4.8 top left).
- Which Australian animals and plants make up some typical Australian ecosystems? Which (if any) of the six most common biomes, does the student’s school or home fall into? What are the characteristics of the different biomes and where can they be found? (Figure 4.8 top right)
- What common plants and animals do not belong to the natural Australian ecosystems and how do these affect those existing systems? What can be done to overcome the problems caused by introduced species? Can some live in harmony? (Figure 4.8 bottom left)
- What is role of a wildlife reserve or park manager? What qualifications and experience might be needed to undertake this role? What needs to be done to maintain and improve a reserve and yet keep it open to the public? (Figure 4.8 Bottom right)
- How does the work of scientists contribute to our knowledge of ecosystems? What do scientists do when they study ecosystems? What qualifications and experience might be needed to undertake this role?
- What exactly is an environmentalist? What are the many ways they contribute to preserving and protecting natural environments and habitats? What qualifications and experience might be needed to undertake this role?

Figure 4.9 shows two pages from the working storyboards used to create the introductory animations and explanatory learning modules. On the left a page from the What is an
Ecosystem? animation is shown and on the right a page from the Australian Flora and Fauna animation (these were the working titles at the time). Appendix A also shows six pages from the animation storyboard. Passing the initial four tests gives players access to the next level where they are given a password to allow entry. The players also receive a certificate that states what their role is in this particular iteration of the JTF game. In the paper based prototype, these roles were assigned by the teacher but in later versions it is done automatically but can be over-ridden by the game master. All roles must be played to complete the game and attain maximum points.
4.2.4. The Main Game Level.

The main game level consists of a simple graphical user interface (GUI) which provides players with access to the interactive game map (a 36 square grid) which matches their game area, access to the game library and the native species and non-native species identification options. Buttons on the main level screen link back to the introductory quizzes and tests, provide information about my Role, provide access to the ECO points centre the Fun Stuff and other games section, and the Archive (and help) section, which also shows previous states of the ecosystem. The main level screen also contains the Save / Load function which allows to load previous game maps versions into the game or to save and archive the current version for future reference. The print function allows the user to print out a blank map or previous map in Adobe PDF format. Once the students begin to save their map into the JTF archive, a pop up window (the map/library tool) appears, containing a menu showing icons representing a range of insects, animals, plants, scats and tracks. The player can select items from the library and place them into their relative positions on the blank squares—in this way they produce a detailed map of their project area within the JTF computer game. Clicking the blue square button (+) adds an icon to the square being mapped. For some items (such as birds or animals) multiple clicks are possible to record numbers, for example, two bush turkeys might be added to a particular square. The map legend also contains icons for ecologically critical and ecologically balanced areas. Future versions will include an option to include prominent geological formations and land elevation or slope and a Bio-region Finder, which would allow the player to find information about their bio-region by accessing a detailed map. The map/library tool contains the following items:

- Visual information, such as animals scats, tracks and other traces
- Representations of native animals and non native animals
- Representations of animals plus the food they eat
- Representations of native plants and non native plants.

Figure 4.10 shows the main level user interface and the map/library tool ready to input data onto the map. Note the archive, save/load and print buttons on the main user interface are dimmed to avoid confusion.

Main Game Level: Choosing and Assessing the Ecosystem.

Following a briefing by the teacher, including a discussion on health and safety, the group goes outdoors to identify an area which is suitable for the game. As far as possible, the area should have rich variety of plants, such as plants, shrubs and trees to ensure a higher level of diversity and increase the possibility of animals being present and thus give the players more to do in regards to making observations and species counting. The more there is to see and watch the more interesting and motivating it will be for the children playing the game. Since many Australian animals are nocturnal or very shy, the map/library tool provides
images showing a range of native and non-native animal footprints and tracks which can be used to see if those animals live or trespass in the chosen area. An important indicator for identification of an animal is the animal’s excrement (scats) and information about animal excrement is also provided through the map/library tool. Findings made by the players not covered in the game database will need further research and the players must then use relevant resources on the Internet or in the school library.

Surveying the Research Area and Associated Tasks.
In consultation with the teacher, each team selects and surveys a 6 metre by 6 metre area on their school ground that will be their research area. If the selected site is particularly sparse, the areas could increased proportionally to increase the available density of plants and animals—the prototype JTF games works on a six by six grid of undetermined size. The size of the area selected and gridded will naturally be determined by a number of local factors. Ideally, teams will work with adjacent areas in order to maximise the overall area studied by the class as a whole and also so that the project contributes to the improvement of a larger contiguous area. The students then undertake a number of predetermined tasks. Additional tasks may be added by the game master as required.

Task 1: The players identify an area on their school ground or other location which offers a suitable variety of plants, shrubs and trees. The advantages and disadvantages of selected areas are discussed.

Task 2: Using timber pegs and string (white sports ground chalk powder can be used to prevent children from tripping and injuries), players mark out a square area of 6 metres by 6 meters. Where possible, a tape measure is used to define the heights and lows (elevations) of the marked area.
**Task 3:** The 6 meter by 6 meter area is then divided into 1 metre by 1 metre squares to conduct the animal and plant count (inventory).

**Task 4:** Players note their findings in detail on the printed map and in their notebooks (or portable digital devices) looking for such as evidence such as animal scats, tracks, native and non-native animals and plants, soil conditions such as the presence of logs, rocks, sand, etc. Anything not available in the JTF database is photographed or drawn and notes taken to assist in later identification. Where possible, samples may be taken for later study.

With all the findings noted and recorded on the area’s paper-based map, the players return to the computer to transfer all the information into the game grid, and save the map to the system archive. Over time, the chosen area (the ecosystem) will change gradually, so changes are documented on different maps which can be called up for comparison to provide a better overview of the current status of the ecosystem. Archived photographs and notes also support this review, but students do this outside of the game at this stage, due to the large file sizes digital photographs and scans can generate. Figure 4.11 shows two students from the first playing of the paper prototype game beginning to mark out their chosen game area.

![Figure 4.11. Students mark out the game area in preparation for the initial survey.](image)

4.2.5. **Example Learning Tasks—Site Identification and Investigation, Planning and Developing Strategies.**

It is important for the players to posses a basic understanding of what an ecosystem is and how it works prior to commencing the field activities. This section dicusses in detail how the Ecosystems and Biodiversity learning task was developed and implemented in the introductory animation and through subsequent stages of the game.

**Background Research and Learning.**

An initial on-line reading was given to the students to provide an overview of what constitutes a sustainable ecosystem. This reading, *The Ecosystem Sustained*, was taken from
the US Department of the Interior’s Bureau of Land Management educational website and provides an effective introductory reading at the appropriate reading level for the student age group. In normal play, teachers will specify their own readings at this stage (this one naturally has a North American approach and uses some examples Australian student may be unfamiliar with). An example from the illustrated text is provided to give an indication of the style and depth of the reading:

Ecosystems exist wherever plants, animals, and people have an interdependent relationship within the context of their physical environment. For purposes of study we can draw an imaginary circle around communities at different scales to examine the relationships of elements within the circle. When doing this it is important to remember that small ecosystems are nested within larger ecosystems. This means that what happens at one scale affects what happens at every other scale, with varying degrees of impact ... Biological diversity, or biodiversity, is a key part of healthy ecosystems. It refers to the variety of plants or animals within a single species, the variety of the species themselves, and the variety of ecosystems. Diversity strengthens the potential of populations and species to respond or adapt to changing environmental conditions. Since plant and animal resources provide products and processes important to agriculture, medicine, industry, art, and music, plant and animal diversity also affect human welfare (Smith, Brook and Tisdale 2009).

The reading emphasises that relationships between elements in an ecosystem are not only highly complex, they can be difficult to see straight away and so the study needs to take place over a long period of time, reinforcing the idea that it is necessary to record and study the system over many weeks (or even months) to identify all the elements of the system and to observe change effectively.

Further readings can be used to introduce students to content dealing with other elements of aspects of an ecosystem. For example, the CSIRO website provides information about the carbon cycle and change over time as part of its CarbonKids program, which is an educational resource “designed to introduce young Australians to the science of climate change” developed by CSIRO Education (CSIRO a 2009 p.1). The reading covers all aspects of the carbon cycle from the atomic structure of carbon, its importance to all living things, through photosynthesis and respiration to decay, dissolution into water and the creation and burning of fossil fuels. The role of carbon in the biosphere, lithosphere and atmosphere is covered in a clear, concise and easy to understand way and, like most publications in the series provides teacher’s notes, activities and links to further readings. The Australian Government’s Department of Sustainability, Environment, Water, Population and Communities’ Water for the Future website contains extensive information and learning resources at a number of educational levels, including an extensive collection of material on the water cycle in both
Text based resources are not the only content suggested. Gulliver Media’s ten part educational documentary series *Living Landscape—An Australian Ecosystem Series* is a series of online videos which run for between 15 and 22 minutes each and which deal primarily with ecosystems from an Australian perspective. Developed in conjunction with Education Queensland the series was initially aired by the Australian Broadcasting Corporation in their *For Schools* series. Episodes include: *Urban Ecosystems, Rainforest Ecosystems, River and Riparian Fringe, Mangroves and Wetlands, Arid Inland Ecosystems* and *Remnant Ecosystems*. Where students have access to tablet computers and wireless networks within the school grounds, it would be entirely possible for students to watch appropriate episodes in the field. Unfortunately, at the time the game was developed, neither tablet computers or school based wifi networks were commonplace, but resources such as these, in conjunction with streaming video will broaden the learning possibilities of games such as *JTF* significantly.

It is important for the students playing the game to be familiar with some of the learning content provided by the teacher, built into the game and included in the test prior to their initial assessment of the game site. Awareness of the types of ecosystems they are examining, the cycles that drive them and the environmental factors that influence them will help the children better understand what is going on within their own study area and to recognise any changes (good or bad, past or future) to the overall state of their allocated area. Understanding how their own ecosystem works provide the players with the knowledge that could help them intervene and take action if their own system becoming unstable or unhealthy. However, understanding that some changes take place over very long periods of time, (especially if the environment is extensively damaged or significantly changed) is essential to the game play. For this reason, it is essential that the locations chosen are carefully selected and capable of showing some change over the period of time the game will be played—since children in the age group *JTF* is intended for may not be capable of appreciating very minor improvements unless they can be readily observed. If they end up with the impression that it is difficult or impossible to improve an unbalanced system, they may well experience frustration and could easily lose their motivation.

**Planning and Developing Strategies.**

The *Bio-Region finder* will help the players to define which kind of plants, animals and soil conditions they might find in their game area and point them to other more detailed
resources where needed. Strategies and tasks associated with this stage of the learning are
designed to assist students in considering how they might understand, analyse, plan for and
improve the biodiversity and health of their allocated area. The following types of preliminary
activities take place at this stage:

1. Identify and research the ecosystem predominant to where the game is being played.
   If in an Urban environment, consider the possibility of the area containing Remnant
   systems. List what animals and plants would normally live and grow in the region and
   what you might expect to find in the site analysis.

2. Identify which non-native plants and animals might found be in the study area. List
   why they might be found there and whether they might be classified as problem plants
   or animals (weeds and feral animals) or beneficial plants and animals (i.e., vegetables in
   the school garden, fruit or shade trees, native and honey bees).

3. Match plants and animals and consider what interdependencies might be observable.
   Remember many native species are nocturnal. What outside knowledge might be
   available—are there guest speakers, rangers, long term residents or other experts who
   might be able to provide information?

Students also plan and develop strategies for further work, such as:

4. Identifying where plants, rocks, nest boxes, permanent water might be placed to
   provide animals and plants more living spaces and food.

5. Preparing a written strategy for bringing the area into balance and keeping it balanced
   over time (short term and long term).

6. Identifying and preventing erosion if present—research and implement erosion
   protection strategies.

7. Clear area from rubbish and other materials that have negative impact to the
   ecosystem, such as fencing and other harmful materials.

8. Taking photos, making videos and keeping records of animals and plants at all stages.

9. Measuring and recording rainfall over the duration of the project.

10. Keeping a personal diary and noting down daily activities associated with the project.

Those tasks come together to help the students develop an understanding about what
ecosystems are, how they work and what is needed to maintain them in a healthy balance.
However, because JTF is based on role-play, different aspects of these tasks become the
responsibility of each member of the team—although all work together towards the
common objective. One of the goals of the game is to challenge players to take on roles and
demonstrate skills that are outside of their day to day experience and, in the process, learn to
deal with the unpredictability of the outside world. Even in an urban environment, unforeseen
events such as new species moving into the area (grasshopper plagues, domestic animals), the
real but unfortunate possibility of vandalism, extreme weather conditions (droughts, floods,
storms etc.) can all influence the game’s outcome in unforeseen ways. Planting a tree will not always guarantee it will grow, building a nest box does not mean an animal may choose to live there. What these outcomes do deliver is flexibility and unpredictability in the game and a naturally branching game structure. According to Smith and Mann (2002) even simple branching in a game structure produces the requirement for the community of learners to seek the relevant intelligence themselves, thus making the players themselves part of the game mechanics (Smith, and Mann 2002 pp.5-6). The next section discusses the three roles that the players undertake during the playing of the JTF game during each round of play.

4.2.6. The Three Roles and Role Specific Tasks.

The three roles the players take on for the game are those of a Wildlife Refuge Manager, Environmentalist and Scientist. In each roles the students are allocated and carry out role specific tasks. Barab, Gresalfi and Arici (2009) observe that role play is an important strategy in fostering transformational play. Transformational play is integral to Dewey’s vision of learning, in which he argues “that education should be about giving learners motivation and expertise to act in problem-filled contexts where applying that expertise makes a difference” (Barab, Gresalfi and Arici 2009 p.5). Allocating players individual roles within each team requires players to individually acquire and expand their own knowledge and skill set in relation to their role within the game and to apply that knowledge as they would in real life. To support this process, the teacher, as game master reacts in real time to the gameplay scenario in order to help the story unfold, motivate the players with positive feedback and help them if they suffer setbacks in their roles. The “position briefs” for three player roles in JTF are as follows:

**You are the Wildlife Refuge Manager.**

You are to take on the role of Wildlife Refuge Manager. Here is the job description:

To take on this job you will have studied business, management and human resources management. You have a good knowledge about managing staff, operating a business and leading a team. You will know how to identify problems and you are able to work within a given budget. You will also have the knowledge to promote the refuge to the media and to the public. You have chosen this profession because you love to manage and work in a refuge that aims to preserve the natural environment.

Being a refuge manager requires you to research sources that teach you how to manage a natural reserve. You also need to gain skills in identifying issues that would threaten the business aspect of running your refuge. You need to develop people managing skills, just like a film director leads the production team, including actors and actresses. You will be in charge of developing a management plan that states:
• how the refuge is to be managed,
• how the natural features of the park are to be protected and conserved,
• operations that need to be carried out to protect the park; and
• what activities (i.e., access by other students and teachers, school facility manager, council staff etc.) might need to be regulated—and how this will be done.

You can use your school library, the Internet or expert help (such as your teacher) to gain the knowledge to fulfil your role. You will work with and give recommendations to the Scientist and the Environmentalist who will also be part of your team. Specific tasks for you to tackle in your role as Wildlife Refuge Manager will include:

**Task 1:** Research and find out what a nature park manager does.

**Task 2:** Develop a plan on how you, as a manager, will protect and conserve the natural features of the park.

**Task 3:** Indicate how you plan to manage access to the park area by other students and teachers that are not involved in the park managing activities.

**Task 4:** Identify how you might obtain funding for the running of your park.

**Task 5:** Together with the environmentalist and the scientist, you will write a report on the existing ecosystem you are working with. How can this ecosystem be improved? What needs to be done to bring the system into a stable, balanced condition?

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You are the **Environmentalist**.

You are to take on the role of Environmental Campaigner. Here is the job description:

To take on this job you will be able to work as an educator who teaches people about the environment and the importance of conservation. You will also know a lot about the wildlife protection laws and campaign development and have media related skills, such as writing for the news, radio and TV and the Internet. You will be responsible for sending out e-mail newsletters and running a small web site. You should be able to recruit and organise volunteers to support and promote the Wildlife Refuge and will encourage new people to become active with your campaigns. Some experience working with politicians and political parties is desirable.

Being an environmental campaigner requires you to research sources that will teach you how to organise and run campaigns that create awareness for the environment and sustainable living. Your focus is on the protection of the ecosystem and the wildlife that make up the refuge. You will be in charge of developing a campaign that involves:

• informing people about the refuge and why it is so important,
• educating people about the natural features of the park and why these need to be protected and conserved,
• what they can do to help and how to get involved; and
• production of email letters, media releases, posters etc. to promote the refuge.

You can use your school library, the Internet or expert help (such as your teacher) to gain the knowledge to fulfil your role. You will work with and give recommendations to the **Scientist** and the **Wildlife Refuge Manager** who will also be part of your team. Specific tasks for you to tackle in your role as Environmental Campaigner will include:

**Task 1:** Research and find out what an environmental campaigner does.

**Task 2:** Identify the plants and animals that make your reserve special. You might also have to talk to the other groups and their members to find out what grows and lives on their squares to do this effectively.

**Task 3:** Discuss with your group how you could tell other people about your reserve. Document your plans in the group booklet.

**Task 4:** Identify the people you want to ask about supporting and helping maintain and run the reserve.

**Task 5:** Together with the refuge manager and the scientist you will develop an action plan to educate and inform people about the ecosystems in the park and how they can help improve the refuge and their own environment? Produce a poster or design or other information graphic that shows what needs to be done to help bring the game location into a stable balanced condition.

**You are the Scientist.**

You are to take on the role of Scientist. Here is the job description:

To take on this job you will have studied an aspect of science that deals with the environment. Parts of your studies may have been in zoology, botany, geology, chemistry and microbiology. You will have a very good knowledge about ecosystems and biospheres. You will know how to identify problems within those systems and what measures must be taken to keep them in balance. You have chosen this profession because you love science and you love nature and you are passionate about conserving the unique natural habitats of Australia for the future. You will know that human beings have to work together and act quickly to save the environment. This means you will need to work in a close relationship with environmentalists and refuge managers to help the environment.

Being a scientist you need to find information about the kinds of the plants and animals names that might live in your game area’s ecosystem and what their role in that system might be. You also need to gain skills in identifying threats and dangers to the system, such as pests, weeds, soil problems, pollutants and other threats. You will need to be able to teach your team members about what to look for and what any issues might be. You will be responsible to your team for:
• identifying the plants and animals that exist in the game area and the kind of ecosystem it might be classified as,
• educating your team members about how these interact,
• identifying non native animals and plants as well as beneficial plants and animals; and
• making recommendations and helping develop a plan to improve the health of the area allocated to the team.

You can use your school library, the Internet or expert help (such as your teacher) to gain the knowledge to fulfil your role. You will work with and give recommendations to the Environmentalist and the Wildlife Refuge Manager who will also be part of your team.

Specific tasks for you to tackle in your role as Scientist will include:

**Task 1:** Research and find out what a scientist does.

**Task 2:** Identify the kind of ecosystem your game area is and research the plants and animals that might be found in it. Inform your team about the positive and negative roles they might play in the game area.

**Task 3:** Identify any areas that are not balanced and find the reasons for the problem.

**Task 4:** Provide scientific advice and make recommendations on how to deal with those problems.

**Task 5:** Together with the refuge manager and the environmentalist produce a report detailing the health of the ecosystem that makes up the game area. How can it be improved? What needs to be done to bring the system into a stable balanced condition?

### 4.2.7. Rewards and Motivation in JTF.

Rewards are an important tool in any game to stimulate motivation; to keep the player in the game and create a state of flow. In addition, the pursuit and gaining of rewards is a key motivator in improving learning and retention (Gentile et al. 2007 p.28). Different combinations of possible rewards motivate players (Yee 2006 p.7) and provide psychological reinforcement (Morris 2003 p.23). Dondlinger (2007) comments on the importance of rewards as a component in the design of educational games: “there is widespread consensus that games motivate players to spend time on task mastering the skills a game imparts… [A] number of distinct design elements, such as narrative context, rules, goals, rewards, multisensory cues, and interactivity, seem necessary to stimulate desired learning outcomes.” (Dondlinger 2007 cited in Derryberry 2007 p.5). The following types of rewards are build into the JTF game to foster motivation and stimulate continued interest and engagement with the game.

**Earning points.**

The primary means of providing rewards is through the allocation of game points which players earn for all solving problems and completing tasks. At this basic level, all students are
able to earn a set number of points (at different times) on completion of set learning tasks and in-game activities. The points can be redeemed for items needed to further maintain and improve the student’s allocated ground, such as gardening tools, plants, building materials, soil improver, compost boxes, rain water harvesting systems and so on. Additional points can be earned by undertaking activities above and beyond those allocated for required tasks and, to allow for flexibility, these types of activities can be decided by the game master and the players prior to and during the game play. A list of such activities might include:

- Finding new information and sharing it with the group
- Demonstrating skills or techniques, such as propagating plants
- Showing initiative, such as starting a compost system
- Extra effort, such as spending free time clearing weeds
- Team work, such helping other teams complete tasks requiring more than three players
- Mentoring other players or teams
- Inviting or organising guest speakers.

Game points can be given to individuals or teams and can be decided on by the game master during the game to reward individual effort or, at the end of each session by the group as a whole. To ensure all players understand what these additional points are rewarded for, a poster should be made up and displayed prominently in the classroom and all students should have a copy of the list. After redemption, the points will be stored in the game database and can be called up for later comparison with other groups. If JTF is rolled out as an online network game as is hoped, the points database will help build positive competition between the remote groups, providing further motivations and incentives (perhaps an inter-school competition).

**Indirect Rewards.**

Rewards do not necessarily have to take to form of “real” tokens such as points. The best games provide rewards through being fun and giving pleasure. A sense of achievement or the ability to say “I did that” is often a reward in itself and it is hoped that one outcome of engaging students in outdoor learning is the development of a sense of achievement, self-confidence and personal satisfaction. Although the outcomes of the game are discussed in greater depth in Chapter Five, the following comments made by the students in response to playing the trial game provide some insight into the less tangible rewards the game provides:

“The single learning games, such as finding the right animal and matching the correct scats, tracks or traces is fun.”

“Seeing the plants grow and getting more animals attracted is fascinating.”

“Building nest boxes is fun and putting them into the trees is fun too.”

“Having ownership of an area with living things is cool.”

“Collecting points and getting stuff for the project is exciting.”
“The unexpected tasks given to me in my role are challenging.”
“Seeing other group’s ecosystem is great.”
“Planting things makes me feel good.”
“Talking to other kids about the project and game makes me feel good.”

Creating the unexpected.

If a game becomes too predictable it can quickly become boring (Crawford 1997, Horn 2008). One way to reduce predictability is introduce unexpected challenges and an element of randomness. For this reason, the game is designed to allocate unexpected tasks and challenges to individual players or to allow the game master to create or allocate a briefing or a new scenario to different groups. For practical reasons, some of these challenges will only occur within the virtual habitat modelled in the computer game system—such as an unexpected bushfire, flood or water shortage that needs to be managed by the players. The skills learned through tackling those environmental disasters will create additional awareness amongst the players about these issues and will hopefully help them to understand and later develop an interest in protecting their real world environment from natural disasters.

Tunable Game Parameters.

Tunable game parameters allow the players and the game master to engage with and adjust the game structures, settings and rules to match the required learning outcomes in real time. In JTF, every game is based on the environment in which the game is played and on the information about each player’s allocated grid as it is entered into the game by the player using the map/library tool. However, the players are also able to edit some settings to change the game experience and test hypothetical scenarios, as well as being required to change roles on a semi-regular basis. In this way, the tasks that are automatically assigned to the players are somewhat randomised. Other tunable options in the game are updates. Players are required to constantly update the status of their site and update the site map, which in turn determines how the game responds with task allocation and the provision of challenges. Lastly, players can freely decide on what they will redeem their points for, and what further changes or improvements they will work on. This introduces greater freedom to plan the management of the project and adds increased variability to the game outcomes.

Losers, Winners and the End of the Game.

Playing JTF is about fun, learning, building social skills, taking responsibility for the natural environment, awareness building and about outdoor activities. For this reason, JTF can be played as long as there is an interest in looking after the designated ecosystem. There are no losers in JTF and no real winners—both the players and the land on which the game is played benefit, especially if the space can be passed on to the school, the local community
or wherever the game is played. Whitehead (2007) argues that in an effective learning game, players may become emotionally attached to the outcome of the game. It is hoped that at the conclusion of the game JTF will leave the players with a positive attitude and a broader understanding of their environment, based on the rewarding experience of seeing a tangible and long-lasting reminder of the beneficial impact their game playing has had on just a small part of their local surroundings.

4.3. The GUI, Sound and Visual Style of JTF.

The hardest part in achieving a high level of engagement with any computer game is to balance what Prensky (2001) calls “eye candy” with effective and meaningful game play. Prensky defines eye candy as being the overall visual appeal which the graphic design and the visuals themselves create. However, because players control and interact with the game events via the Graphical User Interface (GUI) it is also essential that the design of the game’s interface must be as clear as it can be made and all controls should be as intuitive and readily accessible as possible. Because JTF is designed to appeal to children between 8 and 12 years old, the design of the GUI is intentionally colourful and the available buttons and their labels are relatively large in size to enhance visibility and ease of use. Where text is needed in the interface, it is kept simple and short and uses a widely available, clean sans serif typeface (Arial) to maintain a clean and easy to read appearance. The JTF interface uses ten consistently placed buttons to give access to key game functions: the game archive, the game library containing information about native and non-native species, introductory test games, my role, fun stuff and games, eco-points, archive, save/load, print and, most importantly, the help menu. To reinforce the help menu, Kangi (the game’s virtual guide) is always located on screen next to the help menu and, if the player gets lost, they can click on the very prominent Kangi icon to get help from anywhere in the game. The user interface is fully scalable, since it is based on Adobe Flash vector graphics, so it can be scaled to suit all common computer screen sizes. The minimum screen size necessary to be able to interact with the games interface is 600 by 400 pixels, which is suitable for most portable touch screen pad computers.

The overall look and feel of JTF is intended to convey a sense of being positive and friendly and not overly sophisticated—the idea is to suggest that this is a game made specifically for primary school age children and with the actual input of that age group, as can be seen in Figure 4.12, which shows the GUI and the map space following input of animal and plant data. For this reason, the characters, objects and scenery are cartoon like and two dimensional—no shading or shadows are used, a strategy that also helps work around some of the limitations of working within the Adobe Flash environment. ActionScript 3 and XML are used to add the necessary interactivity, although the animation is intentionally basic, since the author has sought to create a consistent and coherent style that does not overwhelm or
distract from the need for players to use their own imagination. In this way, the story remains more believable since the players themselves are filling in the gaps and therefore becoming more immersed in the game. Tognazzini (2010) points out that every game interface requires the player to become familiar with it in order to learn how things work and what the different graphical items stand for, or are used for. The shallower the learning curve the easier the game is to learn and to play, although sometimes a steeper learning curve can also act as motivator in games because it awakes the player’s inner sense of needing to explore. In the case of this project, the developer wanted the player to learn as quickly as possible how the graphical user interface worked, in order to get the players started and engaging in outdoor tasks as soon as possible.

4.3.1. Sound.

Sound enhances the user experience, adds another dimension to what is being observed and allows the designer to provide additional levels of meaning or ambience to the production. As well, it provides immediate feedback and reinforcement when certain actions (such as clicking a button) are performed. The thoughtful use of sound produces several other subtle, but valuable outcomes:

- it builds user expectations,
- it sets a pace or tempo to the production,
- it adds explanatory content and
- sets up an ambience.

Figure 4.12. The Graphical User Interface, with filled in map.
Modern audiences expect sound as a matter of course and, even in the days of silent movies, a piano or organ player would accompany the film in order to add an additional layer of meaning to the images on screen. Unless a production has the additional depth that sound can add to it, for example by contributing spoken ideas, adding a musical soundtrack, creating an ambience in a game, or providing user feedback, the user may quickly become tired of it. On the other hand, if the sound that is there is of poor quality, or is too loud or soft, is distracting or inappropriate, the players or the audience will also quickly switch off or move elsewhere, as Thompson (2007) notes: “Sound is a very important factor in game design and can be very effective in conveying information......and setting a mood” (Thompson 2007 p.121). In designing JTF the author sought from the beginning to establish a positive and thoughtful audio experience for the game by using a mix of electronic instruments and animal sounds to create an ambient non-distracting soundscape. Thus, the overall atmosphere created with the sounds and music used in JTF is intended to suggest a natural, fine weather outdoor soundscape, which takes the player away from the computer to the Australian outdoors through the use of pleasant, slow beats mixed with native birds, frogs and cricket sounds. Naturally, this ambient sound changes to reflect events in the game.

Kangi is the only character in the game that speaks. The voice overs were recorded by an eleven year old boy (even though Kangi is female) in order to reflect the age group of the players and to suggest the notion that Kangi is able to speak to them as equals and thus make it easier for the audience to connect emotionally with her. In addition, a range of environmental sounds and atmospheric audio tracks were created specifically for the project, including:

- wind in different strengths,
- flowing water, rain, splashing sounds,
- a wide range of animal sounds,
- alien space ship sounds,
- footsteps and crushing dry leaves,
- music for the title screen and main menu,
- theme music for the introductory animations.

There is also a wide range of custom sounds that give feedback to the user whenever certain actions or events occur, such as clicking a button, warning and alert sounds (such as wrong answer, right answer etc.) or to set the mood for upcoming situations, such as imminent dangers to the ecosystem (fire, flood, storms and so on) or to provide positive feedback when students save or protect animals or plants, gain points or pass tests.

4.3.2. The Game World and it’s Visual Style.

In playing JTF, players move to and fro between the game world, which is intentionally two dimensional and the real world which is, obviously, three dimensional. The design
challenge is to make the game world believable enough for the target audience to overcome
the obvious disconnect between the two worlds and to make it as easy as possible for the
players to move conceptually from one to the other. Fortunately, even when the simulated
world is abstracted (such as in reading a map) consistent design allows users to readily adapt
to the system once the conventions used in the representation are understood. As Thompson
(2007) points out: “on a subconscious level, humans accept a certain form of architecture
and have a feeling for [the represented] space even if it is big or small” (Thompson 2007
p.100). In other words, the scale of objects and the form by which they are represented can
be considerably changed, as long as a consistent system and style is used. Figure 4.11 (above)
shows how stylised two dimensional icons and a basic grid are used to represent the three
dimensional world in which $JTF$ is actually played out.

Whilst most of the game is played using a bird’s eye view of a flat, two dimensional
grid, the six introductory animations utilise a simplified form of perspective in which the
world and its objects are scaled as they recede from the viewer, using a simple single point
perspective. This technique is well suited to the animation technique used in Flash, which
allows elements from a library of graphic objects (symbols) to be used multiple times, to be
moved and animated (by “tweening”), edited and resized within the same screen space. A
tree, for example, can be saved as a symbol, and placed multiple times into a scene to build
an open woodland, with trees being made smaller as they recede into the distance and being
lightened through changes to the brightness and contrast to simulate aerial perspective (the
fading and shift in colour due to atmospheric effects as things move further into the distance).
The tree can also be flipped to give a mirror image and stretched or widened to give variety.
In this way just a few tree or grass symbols can be used to create a wide variety of shapes and
sizes and simulate distance and complexity, as can be seen in the two animation frames shown
in Figure 4.13. The use of simple perspective and limited colour was considered necessary
to provide a more “familiar” world space in which information about the environments,
plants and animals and player roles, as well as key concepts and ideas are being presented.
The boundaries of these six different introductory worlds are clearly defined and limited by natural boundaries such as rock walls, lakes or rivers in order to limit the size and complexity of the environments that needs be represented and described in the introductory stages of the game. Similarly, the animations are linear in nature and lead logically to the test questions necessary for progression into the first of the outdoor learning activities. This somewhat limited approach is important because the six animations deliver the teaching of essential knowledge needed to play the game and the content needs to be delivered simply and clearly.

### Interaction.

Interaction is necessary to help build motivation and engagement. The goal of a good game based learning application is to engage the player quickly as possible by requiring interaction at a number of levels. In the classroom, getting the students engaged is of further importance because of the number of distractions that are a natural part of the classroom environment and, in part because many pre-teens have limited concentration spans. For this reason, the introductory animations and learning content were limited to between 15 minutes and 10 minutes. *JTF* offers four levels of immediate interaction:

- interaction between the player and the graphical user interface (GUI) of *JTF* via the computer or screen keyboard, mouse, and speakers/headphones,
- interaction between the player and the physical game environment,
- interaction between the players and,
- interaction between the teacher/game master and the player.

All of these interactions are determined to some extent by the way in which the students interact with the game's navigation system. The next section discusses the ideas behind the navigation system and it's development and implementation.

### 4.4 JTF’s Navigation System.

From the outset of the design process, it was determined that ease of use, clarity of graphics and simple control systems of *JTF* should be a major priority. User interaction with the game would be limited as far as possible to familiar processes such as clicking buttons, dragging and dropping objects and typing text in order to minimise the requirement to learn new skills specifically for playing the game. The player uses a standard computer keyboard for entering text and the left mouse button to click on graphic buttons to trigger actions, place icons and navigate through the GUI.

As in normal design practice, the author started the process by producing a set of preliminary sketches and refining these to eliminate unnecessary elements and unclear options. Several dummy interfaces were developed based on the preliminary interface and were tested on a group of five student volunteers from the test group. In one such test, shown
in Figure 4.14, the students were asked to fill in the grid map with content from the game tool box. In this prototype, the user filled in the squares using a drag and drop system to move the content from the tool box into the relevant grid square. This process took the students quite some time, mainly because the target area was relatively small and the object being dragged was often inadvertently “dropped” (often landing in the wrong square) and precise hand and mouse coordination was frequently required. In addition, the tool box invariably obstructed part of the map and required the user to move it out of the way, again adding the possibility of error to the process. This resulted in some obvious frustration amongst the test subjects, which the developer wanted to avoid. Since the drag and drop function did not actually enhance game play or simplify data entry, it was clear that a more effective method should be designed. Instead, a two step method was created for adding content to the grid. Firstly, the user selects the target square, which highlights it as being ready to receiving content (eliminating the possible misplacement of elements). The plant or animal to be placed is selected in the tool box and the plus button is clicked to add the object to that square. Multiple clicking allows for multiple objects to be added and these appear in the selected square. This method turned out to be faster and more efficient and the trial users responded positively to the improvement when it was retested. This process of user testing and retesting reflects the interface design methods recommended by Kieras (2009), who argues for eliminating any unneeded complexity which slows down interaction or which requires the completion of multiple steps to achieve a simple outcome. The revised tool box in a later iteration (including animals and more complete descriptions can be seen in Figure 4.15

*JTF’s interface is embedded in a ShockWave Flash (.SWF) file. SWF is a file format used*
to deliver multimedia content (including audio), vector graphics and Action Script content and, at the time the project was commenced, was the predominant means of delivering animation and interactive content on the Internet. The Flash player is free and can be used as either a browser based plug-in or as a stand alone player. Importantly, the player is available for all platforms and runs on a wide range of portable and desktop devices, giving it great flexibility and making it ideal for school use, where the cost of software can sometimes be a deciding factor in determining whether learning software is adopted for classroom use.

To best leverage the capabilities of the Flash player, JTF’s graphical user interface was developed according to the Goals, Methods and Selection Rules (GOMS) model proposed by Card, Moran and Newell (1983) and cited by Kieras (2009). The GOMS model requires a designer to identify the steps involved in addressing three key areas of any project, and is summarised below:

**Goals**
identifying and defining the goals a user should be able to accomplish with the available system tools,
identifying what basic actions the user is required to perform in order to achieve those goals.

**Methods**
determining the minimum sequence of operators (procedures) the user must follow to
accomplish each goal,

**Selection Rules**

identifying the optimum of many potential methods the user might use to accomplish a goal, given a specific situation or task.

In addition to considering the actual structure of a navigation system, the ease of use, legibility and accessibility of the interface must also be taken into account. In other words, the designer must consider not only what it does, but how it does it and how easy it is to do it. Fitts’ Law is often used as a model to describe the efficiency with which a user can interact with a computer interface, describing the time to move from one position to another on an interface as a function of target size and distance (Tognazzini 2010). For this reason, the positioning of navigation bars and buttons was carefully considered and buttons associated with similar or related functions were grouped together and made as large as possible (keeping in mind aesthetics and the desire not to make the interface appear overly simplistic or childish) and located directly to either side of the main content, or at the immediate bottom, top, or corners of the GUI in order to maximise accessibility. Different versions of the interface were tested on small groups of volunteer students and teachers throughout the iterative design process and in each case the design with the best outcomes in terms of user acceptance, accessibility and execution times was chosen.

### 4.4.1. The JTF Screens in Detail.

The following section briefly discusses some of the design elements and attributes of the key screens that introduce some of the different stages and levels of the game and provides an overview of the design strategy used throughout the development of JTF. Figure 4.16 shows the Opening Screen shown when the game is loaded, the subsequent Welcome Screen, a scene from the Introduction animation and a sample from an early Test Page associated with the first introductory learning animation *What is an Ecosystem?*

**The Opening Screen.**

The opening screen establishes the visual style of the game and explains in graphical style that the game is set in Australia and that it is an educational *wildlife* game. Here the games thematic colours of green and orange are first introduced. The designer chose these colours for several reasons, firstly because they are natural colours that occur widely across the Australian environment, secondly they are broadly analogous colours that provide a harmonious, yet distinctive contrast and a pleasant, calming appearance and, thirdly, they are quite similar to Australia’s national sporting colours (green and gold) but slightly less contrasting. When the opening screen appears as the game is fully loaded, a silhouetted kangaroo jumps from the left side of the screen over the title of the game to the right, giving
new players their first indication of the theme and creating a directional movement inviting the player to enter the game. The subtitle, *A Wildlife Game for Wild Kids* provides further clues as to the nature of the game and the audience it is aimed at.

**The Welcome Screen.**

This is the second screen (Figure 4.16 Top Right) which the player will see when the game is started. There are two options *I am new*, and *Go to game log in*. If players have already played *JTF* there is no need to go through the six introductory test quizzes again—the *Go to game log in* moves directly to the login screen and the main game level. The jumping kangaroo from the previous screen is re-used to maintain a visual connection between the two screen and build familiarity with the visual theme of the game. The two buttons are leaf shaped, in keeping with the natural theme of the game and are large in size to maximise their visibility and to encourage the players to interact with them. The screen contains a brief two paragraph set of instructions explaining the function of the two buttons, set in the sans serif typeface *Verdana*. The colours are a darker green than the previous screen with a dark ochre red being used for the text.
**Introductory Movie Screen Example.**

This is the first screen of the game itself and is the introductory animation (Figure 4.16 Bottom Left) which begins when the player selects the *I am new* button. The two minute animated Flash movie explains the purpose of the game, how it works and what the player is expected to do and is narrated by Kangi the Kangaroo guide who also guides the players through the game provides help if needed. The Kangi icon also represents *HELP* button that can be found on each screen throughout the game. The background of the animation is an abstract, dotted pattern, so that Kangi can not be immediately associated with any particular location or environment. In addition, the pattern distracts the players from their real world (sitting in front of the computer) and introduces the virtual world of the game, in which Kangi tells her story and guides them through the game. Kangi is holding a mobile phone in her paw, which will later play an important role during the game.

**Test Quiz Screen Example.**

Figure 4.15 (Bottom Right) shows an example of a test question from the introductory learning animation What is an Ecosystem? one of six animations and quizzes that help the players prepare for their roles in the game and become aware of the basic knowledge required to commence investigating the game environment. Each of the six animations starts with a unique soundtrack and animated animal paw prints multiplying on the page to suggest an invisible animal moving around the screen, before Kangi appears and explains the aims and goals of the learning content and subsequent test. Kangi also explains and delivers the content by outlining how certain natural aspects of the environment work and the roles of the Scientist, the Wildlife Refuge Manager and the Environmentalist. Kangi holds her mobile phone, on which she displays short animations which illustrate the various concepts. After having viewed and listened to the educational mini-lectures the player can then press a START THE TEST button which takes the player to the questions. Questions are in multiple choice format—if the correct answer is given the player moves on to the next question, if the wrong answer is given the player has the option to try again or re-visit the learning materials. To provide some minor reinforcement, when the right answer is given the player hears a cheerful animal sound, if the wrong answer is given a quieter, less cheerful animal sound can be heard, although students can choose to turn off the sound during the test if this is found to be distracting. These screens also have a few decorative graphics such as yellow flowers and butterflies to enhance the positive nature of the tasks. In keeping with Fitts’ Law, the answer buttons are large are clustered together for ease of access, but sufficiently far apart to prevent accidental selection. Maximum contrast for the buttons is achieved through use of a contrasting dark red that stands out clearly from the bright green...
**JTF Main Level Screen.**

The main feature of the *JTF* main level screen is a tiled map made up of 36 squares representing the 6 meter by 6 meter outdoor area which the players survey and care for in the course of the game (Figure 4.17). The players first see a load/save window floating above the grid. When first played, the player needs to save a map into the game's archive to initialise the map screen. If the player has already created a map the player can retrieve the map by loading the current map from the archive. However, the map archive stores all previous versions of the map to provide the option to compare previous states of the game habitat as recorded through the maps. By doing so, the players can see if their actions are succeeding or failing in improving and caring for the game site (i.e., whether they are improving their ecosystem or not). Naturally, not all strategies put into action by the student teams will be successful—"learning by failure" (Fraser et al. 2009) is an inevitable aspect of the teaching and learning strategy applied in *JTF*. However, when the occasional problem occurs, the game master (teacher) is presented with the opportunity to explain and help the students to understand what went wrong and students can be encouraged to analyse the problem and propose solutions based on their research. The teacher may also assist the students in their online and library research so that they can develop a better understanding of using these resources and applying their findings. This directed learning is one reason why the role of the game master

![Main level screen with map loader. The map is part of the game's tool box.](image)

*Figure 4.17. Main level screen with map loader. The map is part of the game's tool box.*

/ teacher cannot be fully substituted by an artificial intelligence integrated into the game system.

The main level screen shown above has three rows for three groups. The prototype version of *JTF* used in the project was designed to work initially with three groups of three players (total 9 players) playing simultaneously. For testing purposes, it was decided that three
groups playing the game at the same time would be most manageable and would still allow the groups to compare their areas, share information, learn from each other and collaborate if they so chose. Where larger class groups were tested, two or more games were run simultaneously. Future classroom games will allow unlimited numbers of teams.

The Game Tool Box.

The game tool box is shown above as Figure 4.14 and contains the following features:

- Visual information, such as pictures, animal scats, tracks and other traces.
- Tables of native and non-native plants and animals and brief information about them.
- Tables of animals plus the food they eat.
- Charts of native plants and non-native plants (plus parts of plants such as fruits, seeds, bark, leaves for identification purposes).

The tool box contains representations of what the player would or could find in the ecosystems associated with the local area and can be added to by the players. In class, the game master (teacher) uploads additional content into the tool box before the game starts to demonstrate to the players how the game library works and how the game library is used for transferring findings from the game area on to the virtual game map. Since the game area is likely to be in a developed area, the players will need to do further research following assessment of their own outdoor area. Players can record their findings as drawings, photographs, diagrams and text in the various placeholder boxes in the tool box. Students can design their own icons if none are available in the game system. The data is then displayed in the tool box on reopening and each item is represented by an icon that can then be added to the map by clicking on the blue plus symbol. Above the tool box are four tabs providing access to four categories of information:

- Background: includes water (creek, pond, puddle), rocks, sand, soil types and gravel.
- Plants: trees, shrubs, smaller plants, grass, fern, other plants.
- Animals: mammals, birds, reptiles, amphibians, insects, worms, other animals.
- Field Content: listing miscellaneous items found in the area. This may include things like logs, rubbish, eroded areas or any obvious features that impact on the area.

As each tab opens, the look and feel and operation of the subsequent screen remains identical.

Proposed Features.

The following features were proposed to enhance the game play, learning and research tasks. To prove the original hypothesis those features were not necessary and therefore are not fully implemented in the current version of JTF but are instead represented by placeholders. The researcher believes that it is worth while to mention those features because they are part of the game structure and game mechanics. The ideas for those features were derived from the
findings of the literature research and the feedback given by students.

**Bio-Region Finder.**

Although there is a learning animation (What is a Biome?) dealing with ecosystems and explaining what they are and where they are found, students suggested that in a future version of the game a Bio-Region Finder located at the bottom of the grid might help in identifying the kinds of plants and animals they might expect to see in their initial survey and as the game progresses. It is envisaged that the Bio-Region Finder would enable players to search for their bio-region by postcode or by selecting their region on a map of Australia. Future versions of the game might be played in an online environment which would allow the use of Google maps or even Google Earth in association with the Bio-Region Finder. Satellite images and aerial photographs would allow students to gain a better overview of their project area in the context of the larger surrounding region.

**Task Assignment Screen.**

In the present version of the game, tasks are created by the game master and allocated at intervals during the game to add diversity and keep up the momentum of the game and the enthusiasm of the players, especially when students start to become distracted or are experiencing delays. Completion of tasks also allows players to gain extra points, which can be redeemed for equipment and materials. An element of randomness could be introduced by having a number of mini-tasks sent out to different groups via an automated system (for example using e-mail notification in the online version of JTF) or, when players log on to JTF, a pop-up window assigning a new task might appear. The game database will keep a record of which teams have completed which tasks and ensure students do not receive the same task twice and are not disadvantaged or advantaged by the total number of points they are able to earn. Once a task is successfully completed, a summary report will be saved and stored in the archive for later referral. Prepare a management plan for an extreme event, such as a bushfire, flood or drought.

- Arrange a guest speaker to talk about a relevant topic (assigned by the game master)
- Arrange a joint task between two or more groups to achieve a larger objective.
- Prepare an educational poster presenting information about a relevant topic.
- Give a talk or demonstration to the group.
- In your role as a Scientist, Wildlife Refuge Manager or Environmentalist, give a talk on an allocated topic.
- Make a short video or podcast about your project and present it to the group.
- Set up a website for your team or about the project.
- Invite a wildlife carer or ranger to talk about their work and perhaps bring animals in
to visit the school.

- Help organise a field trip to a relevant place, such as a museum, reserve or zoo.

**ECO-points Tally Screen.**

In the present version of the game, Eco points are tallied on a chart in the classroom. Students have suggested that having these available in the game would make it easy to keep a track of how points they have accumulated and work out how many are needed for their planned “purchases” of tools, materials, plants etc. when they are at home or outside.

### 4.5. Behind the Interface—the Technical Implementation of JTF

Because of the length and complexity of the program code that was created for JTF, this section will mainly discuss some of the strategies and processes that informed the design and production of that part of the project, as well as describing some of the problems encountered and the solutions provided. The full (and ever imperfect) code can be seen in the Appendix B. Readers may also download the game and view the code and the game in context (and at their leisure) if they so wish.

The game system underpinning JTF can be divided into a “back end” that manages the data flow (data input and output) that occurs between the players, the game master and the pre-loaded game features which make up the “front end”, which comprises the graphical user interface and associated animations and sound. To ensure the compatibility of JTF with basic level school computers and most mobile devices, the author decided to chose what was at the time the most popular software and scripting tool for developing the game application, Adobe Flash. Figure 4.18 shows a simplified description of the game model and the connection

![Figure 4.18. The JTF Game model in simplified form.](image)
between data input and output and the indoor and outdoor game activities.

4.5.1. Data Entry and Information Access in JTF.

Adobe Flash runs on most mobile computer devices (although until 2011 it was excluded from iPhones and iPads) and is therefore an ideal development platform for mobile applications. Because the Flash player is free, future version of JTF can be readily transferred onto a variety of mobile devices giving JTF the ability to be played both outdoors and indoors. Key to Flash's versatility is the object-oriented programming language ActionScript which shares much in common with the closely related and widely used JavaScript. Originally developed as a scripting language for controlling simple animations, ActionScript has been continually refined in the past decade to increase its functionality and improve it's ability to work with other forms of media including video and audio as well as providing a reasonably powerful level of database support. Because JTF also needs to have a content management tool that allows the players and the teacher/Game master to change quizzes, set up quizzes or load data into the JTF species database, as well as play and control animations and tests, it was clear from the start of the project that Adobe Flash and ActionScript provided a highly suitable and versatile package with which to develop JTF.

In the initial states of programming the developer planned to use ActionScript 3 to build the graphical user interface (GUI) plus the six intro quizzes, but for data entry and data management it was considered that a MySQL database using PHP dynamic web scripting (PHP originally stood for Personal Home Page) along with ActionScript version 3 embedded in SWF files would allow data to be easily entered, stored and called on demand. PHP is web based scripting language that can be embedded in a Hypertext Markup Language (HTML) file and, as such, may constitute a part of an Extensible Markup Language (XML) document. The advantage of XML is that it is both human and machine readable, whilst MySQL is an

![Figure 4.19. The relationship between the core game elements, the database, the interface and the computer.](image)
open source database management system used widely across the World Wide Web. Figure 4.19 illustrates the relationship between these elements as was originally planned.

Figure 4.6 shows in diagrammatical form the game flow as it happens in JTF and, as noted earlier, the playing of the game and the student’s interactions with the interface is intended to be as flexible as possible. The Figure illustrates this process and provides a brief description of the kinds of activities that are undertaken in each of the activities associated with the game. As noted, the game can be divided into twelve inter-related core activities that repeat as often as the game is played (usually three times). Figure 4.20 shows in more specific detail the functional elements that make up the game flow and the interface itself in the form of the flow chart and interface plan used by the author during the design and programming of JTF. As can be seen, several planned functions (such as the Geological and Hydrological buttons, the System Health and Role Manager tools) have not been implemented in the version used in the school study. This is in part because of the complexity of the additional programming required to implement these functions and the fact they were not necessary components of the actual game play or the project’s more specific aims. However, the flow chart and interface plan can be used to provide a reference for the next section of this Chapter, which looks more specifically at some of the coding and technical solutions that are hidden behind the interface and game play. For interested readers, the full code for the interface and game elements can be found in the Appendix B.

4.5.2. Developing the Code—Some Challenges and Solutions.

The following code illustrates the author’s first approach at integrating a PHP script calling data from the MySQL database into a simple SWF file. The SWF file in this example contains the data that makes up one square in the grid of the game map. Each data element is assigned a variable such as myVar. The SWF movie clip has code attached that loads the Universal Resource Locator (URL) using the loadVariables() function. The PHP script located at the URL then loads the data to the map, which is then read by the SWF file and passed back to the square in the grid with the variable name myVar, as shown below.

```php
<?php
$y = "icon_grass.jpg";
print $y;
print "myVar=$y";
?>
```

MySQL table named files:

```
<table>
<thead>
<tr>
<th>filename</th>
<th>ground</th>
</tr>
</thead>
<tbody>
<tr>
<td>myfile</td>
<td>icon_grass.jpg</td>
</tr>
</tbody>
</table>
```

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To allow multiple files to be placed into the grid the author then developed an array that addresses all the squares on each of the three grids in the trial game and each level of the grid information as entered by the players. However, because the game application is based on the use of multiple layers of information for each game square, the idea being that the players would build their virtual map from the bottom layer to the top layer, starting with information about the terrain, soil type, position of water and so on, then adding information about plants, trees and ground features, the planned approach turned out to be much more complex than anticipated and did not work well once multiple layers started to interact on the map grid.

Figure 4.20. The flow chart and interface plan used by the author during the design and programming of JTF.
The solution to this challenge was to work directly with ActionScript 3 and create an XML object which then points to a second XML file—for example animal.xml. All files are subsequently stored in an hierarchical order, with this order (the arrays) mimicking the layers of the grid and thus enabling the data to be called and displayed as layers within the SWF file. Every animal or plant or object is assigned a unique identifier (ID). The following XML table illustrates how this system works. For simplicity, the organisation of the XML structure is similar to that used in the database where the content is also stored in tables.

<table>
<thead>
<tr>
<th>Id*</th>
<th>name</th>
<th>track</th>
<th>sdescription</th>
<th>longdescription</th>
<th>native</th>
<th>kind</th>
</tr>
</thead>
<tbody>
<tr>
<td>101</td>
<td>Koala</td>
<td>koala.png</td>
<td>The Koala is...</td>
<td>Lorem ipsum dolor...</td>
<td>yes</td>
<td>Koala</td>
</tr>
<tr>
<td>102</td>
<td>Kangaroo</td>
<td>oroo.png</td>
<td>The Red Kangaroo</td>
<td>Lorem ipsum dolor...</td>
<td>yes</td>
<td>Kangaroo</td>
</tr>
<tr>
<td>103</td>
<td>...</td>
<td></td>
<td>...</td>
<td>...</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The identification of each object in the table is achieved by using row numbers. For example, Kangaroo in the Table of animals in row 2 is assigned to the ID number 102. This is why the ID number is placed at the beginning of each single object:

```xml
<animals><id>102</id><name>Red Kangaroo</name><image title="Red Kangaroo">img/animals/redkangaroo.png</image><track>img/tracks/redkangaroo.png</track><sdescription>...
</animals>
```

In a more readable manner, the sequence is as follows:

```xml
<animals>
  <id>102</id>
  <name>Red Kangaroo</name>
  <image title="Red Kangaroo">img/animals/redkangaroo.png</image>
  <track>img/tracks/redkangaroo.png</track>
  <sdescription>
  ...
</animals>
```

When the above script is executed, Flash evaluates the request and looks for an object within the tree structure of the XML file, looking into the animals folder and retrieving the kangaroo data object (kangaroo, plus description, image, icon, sounds etc.) and then displays it at the required location (grid) in the specified layer (in this case layer no.2). If all fields of the type 'animals' are called and displayed into the grid one might get:

Koala
Red Kangaroo
Grey Kangaroo
Wallaby
...

...
By saving all the data entered into the JTF game database as XML files instead of an MySQL database, this strategy enabled the author to save the data in arrays which were both easy to understand and troubleshoot throughout the development process.

The following ActionScript was developed to enable the player to jump from one scene to the other within the animated learning activities by pressing a movie clip button.

Scene 1:
   **On the Actions layer on Keyframe29:**

   ```actionscript
   stop();
   start2_mc.addEventListener(MouseEvent.CLICK, start2content);

   function start2content(myevent:MouseEvent):void {
       gotoAndPlay(30);
   }

   function unloadcontent2(myevent:MouseEvent):void {
       //my_mc.removeChild(myLoader);
       start2_mc.gotoAndPlay(1);
   }

   **On the Actions1 layer on Keyframe30:**

   stop();
   var myLoader2:Loader = new Loader();
   //var myURL:URLRequest=new URLRequest("game2.swf");
   myLoader2.load(new URLRequest("game2.swf"));
   myLoader2.addEventListener(MouseEvent.CLICK, unloadcontent3);
   addChild(myLoader2);

   function unloadcontent3(myevent:MouseEvent):void {
       myevent.target.unloadAndStop();
       removeChild(myLoader2);
       gotoAndPlay(1);
   }

   Another challenge for the game developer was to embed the biome information into an external swf file in text and image format. The following ActionScript code illustrates how the problem was solved.

   Code embedded in the Arid Biome swf called via a button click from the Australian Biome map screen:

   ```actionscript
   stop();
   import fl.controls.TextArea;

   var aTa:TextArea = new TextArea();

   aTa.move(35,160);
   ```
Arid Inland

Arid and semi-arid regions are home to a variety of native animals that have evolved to survive in harsh dry conditions.

Mulga Tree

Mulga is a low shrub that grows in relatively infertile clay soils. Mulga is a very hardy tree and can live up to 200 years. The mulga relies on seedling regeneration and it needs rain in summer, winter, and the following summer. In arid areas that does not occur very often. In the past it happened every ten years but now with climate change the periods in between are growing longer. Mulga trees are threatened by rabbits and by cattle stock. After heavy rain other plants also grow, and rabbit numbers increase.

Quizzes.

*JTF* requires the player to go through six introductory tests where they demonstrate essential knowledge necessary to commence playing the game and to analyse and plan for the habitat they have been allocated by the game master. On each of the respective question screens are three to four possible answers to chose from. The following code represents the three possibilities that make the animation jump to three different key frames where the information related to the question is repeated and a true or false state occurs (correct answer or incorrect answer). From that screen the player can then return to try again or go forward to the next question of the quiz.

**Question Screen**

```actionscript
stop();
sixthA_btn.addEventListener(MouseEvent.CLICK, sixthanswerA);
function sixthanswerA(event:MouseEvent):void {
goToAndPlay(5);
}
sixthB_btn.addEventListener(MouseEvent.CLICK, sixthanswerB);
function sixthanswerB(event:MouseEvent):void {
goToAndPlay(10);
}
```
Wrong Answer Screen

The above examples provide a brief overview of the ActionScript code and some of the mechanics that inform JTF's game play and interface. As noted earlier, the full Script can be seen in the Appendix B and the game can be downloaded from: <http://www.tnt-media.com.au/jtf/> for those who wish to play the game or explore this aspect of the project further.

4.6. Conclusion.

JTF was developed with the help and input of the students and teaching staff at Sunshine Beach Primary School in Queensland. The design process applied in the development of JTF is an iterative process, where each stage from the game idea, paper prototype, art work and animation sequences through to the essential outdoor activities was tested with the input and help of the game’s intended audience.

The game tries to provide a different type of learning tool by balancing computer delivered academic content with opportunities for students to learn by doing and to learn from their own failures and, in doing so, to allow them to make a connection between what they learn from the virtual experience and the accomplishment of applying this learning to a real-life scenario. JTF allows the player to freely explore and experiment with the natural habitat and, as the game play progresses, they must adapt to the way the environment changes and also change their strategies. The players need to constantly re-adjust their expectations and interactions based on the causes and consequences of each interaction as a group and as an individual. For this reason, collaboration is an important element in playing JTF and in turn this helps develop the social skills that children need to develop to become successful as
an adult. Most of the tasks performed by the players are practical tasks because the developer believes that most of the learning occurs while people are performing practical tasks which are related to learning objectives. To test these ideas, the next stage of the JTF research project was the implementation of the game into a real life teaching situation within a school. The procedures and some of the outcomes of the testing and implementation of JTF are discussed in the next chapter.
Chapter 5

Gameplay and Observations During Trials and Game Development.

The testing and development of JTF was done with the co-operation of the teachers and students of Sunshine Beach Primary School, on the Sunshine Coast in South East Queensland between October 2008 and July 2010. The first study group consisted of 12 primary school students aged between 8 and 10 years old and the second study group consisted of 25 primary school students of the same age group. All students were volunteers for the project and all had been given signed parental consent to participate, as required in the Ethics approval. Students could withdraw from the project at any time without penalty and parents could remove students if they so desired—as is normal in such processes. All students have been de-identified in this study and are referred to by the numbers they were allocated and which they wore during each of the trials.

The first study was divided into two parts. In the first visit, the students were asked to fill in a questionnaire that helped the researcher build a profile of the students so that the researcher could develop and customise the initial game concept on the basis of the student’s preferences and the identified requirements of the teachers and the curriculum. The second part of the study allowed the researcher to test the initial game prototype with the students, gain feedback and make appropriate improvements. The outcomes of the trials were interpreted and discussed with the students and teachers and these revised findings informed subsequent changes to the game prototype. The findings and observations made during this stage of the study are discussed in the first part of this chapter.

The purpose of the second study was to test and refine the computer based prototype within the school setting. As before, after each trial the students were asked to fill in a feedback questionnaire and the results were discussed with the students and teachers and
then used to further improve the prototype. The findings and observations from both sets of studies were then used to ascertain to what extent the game fulfilled the researchers initial proposals and research topic. These findings are discussed in more depth in Chapter Six.

5.1. The First Test Trial (Commencing October 2008).

In the first visit, students were given two questionnaires (at the first visit and at the last visit). In addition, at the start of the study they were given a numbered and colour coded A5 notebook, in which they were asked to note down their daily computer usage for the duration of the study and to use this notebook to document any findings and observations they made while they were engaged in the outdoor activities associated with the JTF project. The first questionnaire (26 questions) was intended to provide background information which would help the researcher to gain a better understanding of the audience, their computer skills, time spent playing computer games (and which were favourites amongst the group), their preferred learning styles and their general interests and hobbies. The first set of test trials took place between the 23rd of October to the 23rd of November and comprised six visits to the school. At the last visit, the students were given a second, follow up questionnaire consisting of 18 questions designed to get further feedback on the game. These questionnaires are available to the reader in Appendix C.

5.1.1. The First Visit (Duration 1 hour).

The first visit involved two main activities. In the first activity, the teacher read out and explained the questions on the questionnaire and answered any queries the students had as each was asked. The students filled in the sheets as each question was asked and the group moved on only when all students had finished each answer. These were then collected up before the second activity began. In the second part of the lesson, the teacher explained to the students what the JTF game was about and the basic rules and gameplay required to play and answered any questions as they arose. No mention of the research aims (i.e., can we encourage students to engage more in outdoor activities and promote better communication and cooperation through the use of such games?) was made in this briefing in order not to influence the student’s later behaviour. In addition, the teacher handed out the notebooks and other materials necessary to play the game and to document the student’s findings.

The 12 students were divided by lottery ticket into three groups, each group being allocated one of the roles—Wildlife Refuge Managers (blue), Scientists (red) and Environmentalists (green). Based on their roles, each child was given an individual, coloured number which was pinned to the back of their uniform, as can be seen in Figure 5.1. This number allowed the students to know what roles others were playing and also helped the teacher and researcher to identify the students later when the video material was reviewed.
and analysed. Four teams of three players were then formed, made up of one of each of the the three roles. As can be seen, the children have been de-identified using a pixelated filter applied to their faces. To avoid any external interference with the trial and the students, only the game master (teacher) was allowed to communicate with the students.

![Figure 5.1. Colour coded student identification numbers indicating the student and their role.](image)

**Observations.**

The students were clearly excited about being part of the game trial. However, it was clear that they had expected to start playing the game straight away and that they were somewhat disappointed about the fact that they were required to fill in a survey form first. The students spent quite some time thinking about and reflecting on the questions asked in the questionnaire. Some had difficulties in understanding some of the technology related questions and needed clarification about terms such as GPS, MP3 and text editing. Several were unclear about the difference between computer games and computer gaming platforms, and when asked about their favourite computer games they answered with Sony PlayStation or Xbox. Towards the end of the survey, the students started informally discussing computer games with each other.

Some were clearly surprised to learn from their fellow students that they had access to computer games that would have been rated R18+ in other countries. (Currently the position in Australia is that games rated above MA15+ elsewhere are not given a classification and so cannot be imported or brought into the country. Some game companies get around this by having their R18+ games rated as MA15+ specifically for the Australian market or by submitting cut down versions for Australian censorship approval). Several students were overheard arranging to swap games at a later time, including the R18+ games. The supervising teacher, who had eavesdropped into the conversation about the R18+ games asked the students who claimed to play them games if their parents knew about it, and where they got the games from. The students indicated that their parents “did not care” or know
about what computer games they were playing and that they typically got the games from older siblings and friends living in the neighbourhood.

While the teacher was busy explaining why they had to wear numbers on the back of their uniforms and getting the children into groups it became apparent that some students were not happy with their allocated groups—not because they did not like the roles they were given—but because they did not like the colours that were associated with the groups. Some students objected that they did not like the colour blue and wanted to be in the group that had red numbers on the back of their uniforms (the Scientists), whilst other did not like green and wanted to be in the blue group. It took quite some time for the teacher to sort out this problem and some persuasion to convince some students to accept their role. Following the allocation of the roles and numbers, students went outside as a group under the teacher’s supervision to explore the school grounds and identify possible sites for the game to be played. Overall, the students were well behaved, but clearly excited about being away from the classroom and being engaged in a novel activity. No site was identified in the first visit, although several possibilities were identified.

Following the class, the supervising teacher pointed out to the researcher that one of the students (Child No.7) had been diagnosed as having attention deficit hyperactivity disorder (ADHD) and another student (Child No.3) was mildly autistic and was frequently isolated and withdrawn from the other students and was also very passive in providing any response when prompted.

5.1.2. The Second Visit (Duration 1.5 hours).

Following a briefing from the teacher that included Health and Safety requirements, expectations about behaviour and a rundown of the activities to be covered in the session, the students moved outside to undertake a second survey of the school grounds to select the most suitable location for the game, based on the observations they had made in the previous trial visit. The researcher video-taped the students and teacher throughout this exercise and the tape was later reviewed with the teacher. Specifically, it was hoped that the video and audio recording would help identify some of the ways in which individual students worked with other class members as well as their allocated groups, thereby helping the author identify any regular, existing patterns of collaboration amongst students—as well as identifying any new interactions that might develop in the future. In addition, reviewing the videotape would reveal difficulties and problems encountered in playing the game and reveal how the children worked together to solve problems and master allocated tasks. Three key tasks were assigned, in consultation with the teacher, for completion in this session:

**Task 1:** Students revisited the preselected areas in the school grounds identified as being potential game sites. Students were encouraged to look for an area on the school grounds
that had the greatest variety of plants, shrubs, trees and (if visible) animals.

**Task 2:** Having identified the optimum site, students selected and marked out a 12 metre by 12 metre square, which would define the entire game area for this test. As part of the initial survey, students used a tape measure to estimate the height or depth of any elevated or depressed areas. All measurements and details were recorded in the student’s notebooks.

**Task 3:** The students used timber pegs and thread to divide the main square first into four, six metre by six metre squares (one per team) and then each team divided their own square first into two metre by two metre squares and then into a one metre by one metre grid. Once all squares were gridded, the grid was marked out permanently using white chalk powder (to avoid a trip hazard) and the pegs and string were removed for safety reasons. When all tools and equipment were collected and put away, the students undertook a preliminary survey of the area, noting any significant objects or features in their notebooks for referral in the next visit.

**Observations.**

The exercise began in the classroom with the students discussing as a group which areas they thought would be most suited for the research. A small number thought that the football field would be ideal because it would be easy to survey and mark up and they could also run around and play games while doing the research. Several students pointed out that the football field would be boring, because the only plants growing there would be grass and some weeds and there would be little chance of finding any animals.

 Others students suggested that the school’s buffer zone already had plenty of trees and shrubs and that these might have native animals already living there. Although the teacher agreed this was indeed a good idea, he objected to the proposal because the buffer zone was already classified as a “no go zone” for the students, due to it being too close to a very busy road and was also thought to be a potential habitat of poisonous snakes (a particular hazard in Australia, especially in the warmer months). The students finally decided to use the school’s run down and abandoned vegetable garden, because they thought that there would be a greater variety of plants and therefore a higher level of biodiversity available for study. This decision was supported by the teacher who also took on the role of the game master. However, the class visited each of the suggested areas in turn to make on the spot comparisons before the vegetable garden was finally decided upon.

 During laying out and gridding the boundaries of the research area, the teacher frequently reminded the students to avoid tripping over the thread and to be aware of the the spiky pegs. The students were largely left to work out the measurements and divisions themselves
and the students seen to be struggling were observed to be frequently assisted by others. All of the students were involved in pegging out the larger twelve metre by twelve metre grid, although some had little to do or chose to watch and give advice. Students frequently improvised, especially when the tape measures or tools were in use—some used their feet for measuring and paced out the distance, assuming that one large step would be approximately equivalent to one metre, whilst one or two simply estimated, based on the measurements they had already seen being made. Figure 5.2 shows four video stills from this visit. In the top left we can see students examining the vegetable garden prior to the final site being selected, top right shows the area being gridded using the string and pegs, with the game master providing some advice. Bottom left shows the teacher distributing tape measures, pegs and string to the different teams prior to their marking up and documenting their own allocated area. Bottom right shows one of the students improvising by using her feet to measure out the grid.

The students indicated to the teacher that they liked being outdoors, as it was a beautiful day and some children who were waiting to help measure up the area started dancing and playing jumping games. Two girls started to use the gridded area to play hopscotch, however the teacher asked them to stop, pointing out they would trample the plants and damage their research area. The two girls blushed and seemed slightly ashamed of their actions. Once the whole area had been prepared, the students wanted to know what would happen next.
The teacher told them that next week they would assess the area looking for animals and plants and traces of animals that may be present. The children became excited and wanted to continue with this straight away, however the time available for the session was finished.

5.1.3. Third Visit (Duration 1.5 hours).

During this visit the children were given the magnetic boards and tiles, coloured pens and a copy of the map legend and given instructions on how to use it to record the animals and plants they identified within their designated research area of the school grounds. Again the researcher videotaped the children’s activities and took notes for later analysis. Three tasks were allocated for this session and a homework research task was also given for follow up.

Task 1: Children were given the rectangular white metal game board that could be fitted with the 12 magnetic squares. The students used the coloured pens to draw trees, shrubs, puddles, ponds, grass, animals, burrows, hollows, nests, hills and gullies found in the 2 meter by 2 meter squares, using the legend to help them to identify animals and plants and as a drawing guide for the map. The students placed the magnetic squared tiles onto the white game board which became a 2-dimensional representation of their research area.

Task 2: The students assessed the overall health of their study area by counting the different plant species and animal species living in the area (species count). Areas with less species were marked with a red symbol and the areas with more species with green symbol.

Home Work Task: The students were asked to research and find native tree and plant species by using the school library or the internet which bear fruit, flowers and have leaves that are a food source for:
A: Lorikeets and parrots.
B: Koalas.
C: Humans.

Observations.

As expected, the children found that some areas in their allocated space contained a greater diversity of species than others and these were marked as either red areas or green areas. The game master also asked them to looked out for signs indicating an imbalance of the ecosystem such as dead plants, dead animals, rubbish, waste, erosion or any other thing that the students thought were a problem. The children noted these findings on their maps and in their notebooks as areas that might need special attention.

All of the students, including child No. 7 and child No. 3 took part in assessing the research area. Child No.7 was quite excited, but spent only a short time identifying plants,
although he found several animals. After less than five minutes he claimed to have finished his task and then left the research area and started climbing on some nearby trees. After this he searched for a spot on some rocks close by and sat alone to transfer his findings onto his white tiles as shown in Figure 5.3, top left and top right. When asked, he indicated that he had not made any notes in his log book. His drawings on the tiles were quite difficult to identify, even though they were copied from the examples on the map legend and they seemed to be rushed. After some time (about 10 minutes) his team members joined him at the rock to discuss the health of their research area and exchange their observations and findings. Whenever child No 7 felt that he was becoming agitated or restless, he put his hands on his head for several minutes (Figure 5.3, centre left) and stood still, a technique taught to all students in the school as a method for calming down and focusing attention when needed. Whilst all three students were involved in discussions at the rock, child No. 7 showed no signs of unrest (Figure 5.3, centre right).

Child No. 3 remained next to his allocated square throughout the entire visit, even though the other students moved around considerably and visited each other in their squares to see what interesting findings were being made (Figure 5.3, bottom left). All of the students (except No.3 who hardly spoke or reacted) seemed to adopt their roles very quickly and slipped into them and acted out their roles with some enthusiasm. They communicated frequently and shared their group findings with other groups on a regular basis whenever something interesting was found. Worms and faeces seemed to hold a particular interest and several exclamations such as “come here, look what I found—it’s a worm!” or “Here’s some poo, what poo is it?” were recorded. Frequently not only group members responded. During most of this visit the students worked independently and the teacher did not need to intervene unless specifically consulted for help. However, two incidents between players from different group members were observed.

Child No.12 (playing the role of Environmentalist in his group) was verbally abused by child No.7 (who was in a different group). In response, child No.4 threw a small stone at child No.7 and asked him to shut up, after which both students walked away from each other (Figure 5.3 bottom right). Child No. 12 was then comforted by child No. 9 before both returned to their area and continued their study as a team. Child No. 7 then said something to child No.10 (a member of his own team) who immediately took him aside and told him off. Following this, no troubles between child No.7 or the other children taking part in the trial were observed.

Some children were clearly proud of their findings and showed off their discoveries to other students and directly to the author (Figure 5.4 top left). At the beginning of the exercise
several children expressed some anxiety about being bitten by insects and handling with insects, plants and soil. Some repeatedly tried to remove dirt from their hands by rubbing them against each other (Figure 5.4 top right) but after some time most were quite happily taking soil samples, collecting worms and sitting on the ground amongst the plants, with little evidence of concern (Figure 5.4 centre left and right). Some children later came up with the idea of collecting soil and leaf samples to take home or to their classrooms for later study and identification, as many plants were not listed in the game legend or the booklet. This demonstrated both initiative and a desire to gain a better understanding of the plants and weeds which grew in their research area. The researcher also provided the students with three digital cameras during this session which also allowed them to take photographs for their records (Figure 5.4 bottom left and right).
Towards the end of the session the students discussed their findings with their peers and the game master (teacher). The teacher asked the groups if they thought the area could be thought of as being healthy and in a state of balance. Some children explained that it wasn’t in balance because because of the large number of weeds and the lack of native plant varieties compared to the nearby buffer zone, which was a combination of remnant bushland and previously landscaped areas consisting of mainly native plants and some introduced weeds. The students suggested that the buffer might be more suited to the project if one of the key aims was to encourage wildlife back into the area. As noted earlier, the buffer zone adjoined a busy road and was an official no-go zone for students, but they were clearly correct in their
assumptions. At the end of the visit, the children came to the conclusion that improving the
health of their allocated area would also be of benefit to the environment in the longer term
as cleaning up the area and restoring vegetation would also benefit wildlife. Overall, most of
the children seemed to be fully occupied during the third visit and the one and a half hours of
the third visit passed quickly. Some of the students did not want to leave and said they would
have preferred to continue their research and discussion, however school had finished for the
day and so this was not an option.

5.1.4. The Fourth Visit (Duration 1.5 hours).

By this stage, the students were becoming quite familiar with their allocated game area,
but several weeks had passed since the last visit. October and November are late spring in
Australia and, in the semi-tropical environment of South East Queensland where the school
is situated, it is a period of extensive growth as the weather warms considerably. The area
surveyed just a few weeks ago had changed considerably since the start of the project and
there had been quite a lot of plant growth, especially amongst the weeds. Some of the marked
areas were no longer clearly defined and some work was needed to redefine the area and renew
the chalk lines. During this visit the children again worked with the magnetic game tablet and
conducted a new survey of their designated research area. Again the activity was videotaped
and notes were taken for later analysis.

Tasks 1 and 2 were a repeat of those set in the third visit, although the students were
asked to be much more accurate and comprehensive in their recording of the plants and
animals found and to detail any unusual or notable findings in their notebooks, including ways
in which the environment had noticeably changed since the last survey. However two further
tasks were added:

Task 3: Each group was asked to give a brief oral presentation to the class detailing the
team’s findings. All gameboards were combined together to provide an overview of the
whole area. Groups made amendments to their white boards where information had
been missed.

Task 4: Each group commenced preparing a report on the state of the ecosystem in
their research area (Figure 5.41, Figure 5.42), noting their findings and observations
and making recommendations as to how the area could be improved and what might be
needed to move it towards a more stable and balanced condition. This report would be
due at the start of the next game trial.

Observations.

The children used whatever colours they preferred to draw the plants and animals and
were not asked to identify places in their study area which were healthy or unhealthy. Most
students were quite arbitrary in their choice of colours and seem to enjoy liked colours for pleasure. Even so, as long as the icons were recognisable and of an appropriate size to allow multiple icons to be drawn on each tile, the system worked well and assisted the students in identifying and recording the animals and plants they found. Because they were encouraged to copy from the legend, the students tended to use the same or similar icons when they drew animals and plants on their tiles, but invented their own for elements not indicated on the legend (these were then usually adopted by other members of the team).

Notably, in this trial, Child No.3 (who in the past had tended to remain alone) started to interact positively with the members of his own team as well as other group members and made his way on to their research areas on a number of occasions, where he often stood and watched without speaking for several minutes at a time. He also organised a pencil for himself by searching the researcher’s bag without being invited, as shown in Figure 5.5, top and centre left. According to the teacher, this was quite unusual behaviour for this student.

A number of the students were able to readily identify some of the weeds growing in their areas due to pre-existing knowledge gained from home (Child No. 10—shown in Figure 5.5 centre right) or, because they had done research in the library or on the Internet earlier (Child No.12). Some students were guided by the teacher, who had already done background research as part of the project, but this advice was given only when students specifically asked for help. Figure 5.5 (bottom left) shows the teacher explaining to one of the teams (off camera) the difference between weeds and non weed plants. As the game progressed, each team gradually filled in their game boards and appeared to show pride when they added their tiles to the game board (Figure 5.5 bottom right). There was some discussion about where the tiles should be placed on the board, but with the help of a compass and a demonstration of how to use it provided by the teacher, the children were able to understand the relationship between the gameboard and the real terrain. Once their whiteboards were complete, many of the students could be seen smiling and several verbally expressed happiness regarding their achievements.

Towards the end of the session, one student from each team was asked to volunteer to give a verbal presentation on behalf of the team to the whole group. During these discussions the students came to the conclusion that study area was far from representing a healthy biotope, in that it showed a lack of biodiversity, due mainly to the fact that that the area was now mainly covered by weeds. This was because the original native plants had been cleared when the school and land were first developed, and any remaining native vegetation had been removed to make room for vegetables and herbs. Because the soil had been cultivated during that time but had been neglected for the past two years, this provided an opportunity for
introduced and invasive weeds to begin growing in the study area. In addition, because the area had been neglected, rubbish had begun to accumulate.

The students suggested a number of activities for the next session that might improve the area, such as removal of rubbish and weeds and replanting a variety of native plants suitable for the area. Based on the class discussion, the students used the last 15 minutes of the visit to begin their reports, with many of the students using the findings documented in their notebooks as the starting point for the reports and recommendations. Figure 5.6 shows one of the student teams discussing their findings amongst each other (top left) and one of the volunteers presenting to the group. In the centre left, one of the players can be
seen removing a plastic bag from her allocated study area whilst centre right one of the teams begins to produce their recommendations. The bottom two images show examples of draft reports produced by some of the teams.

To conclude the visit, the students were asked to submit a list of the native plants they had identified as a result of the previous visit’s homework task (to research plants and trees that are food sources for birds, koalas and people. In consultation with the teacher, a number of appropriate trees identified by the students were later purchased by the researcher for a planting activity during the fifth visit.
5.1.5. The Fifth Visit (Duration 1.5 hours).

In this visit, the students worked entirely outdoors and were engaged in weed clearing, rubbish removal and planting the native trees and plants that had been purchased by the researcher, based on the plants identified by the students as part of the tasks given during the third visit. The plants were distributed by the game master (the teacher) according to the best locations for them within the game area, but also ensuring that all students were given approximately the same number of plants. The students were required to read and understand the planting instructions attached to the plants before identifying the most suitable location within their allocated area. Students were also encouraged to consult with other teams so as to ensure that the whole area was taken into consideration before any planting commenced. The students were encouraged to ask themselves the following questions before starting to plant:

- Have you had any experience in planting trees and plants from pots?
- What do you need to do to give the plant the best chance of success?
- What instructions and advice does the label give?
- In what ways do you think these plants will be suitable for your area?
- Can you recall some of the things you found out when your team made the list of relevant plants? Why are these plants good choices?
- What animals or insects might be attracted by the fruit, leaves or flowers of your trees?
  Can this plant provide a food source for people?

At the end of the session, the teams were asked to give a short verbal report (as a group) on their activities and findings during the day’s activities.

Observations.

On their way to the research area from the classroom, the children passed the outdoor school basketball courts which, as in many state schools, are bitumen surfaced (Figure 5.7 top left). Children Nos. 5, 11 and 9 pointed out that it would be better to replace the bitumen surface with plants, since they believed that many children did not use the basketball courts simply because they were too hard and they would hurt themselves badly if they fell. Worse still, for a large part of the school year the black surfaced courts were too hot to play on, and so became a wasted space that could be re-cultivated and turned into a year round habitat for plants, animals and people—just like their research area.

On arriving at their study area, the students spent quite some time clearing and preparing the area and thinking about where to plant the trees and frequently asked the teacher for advice. At one stage, the teacher suggested that perhaps the best place might in fact be the buffer zone, in case future classes decided to resurrect the former vegetable garden—in which case the trees and other plants might then be removed. This suggestion provoked a
quite unexpected and rather emotional response from the class—the students did not like the idea of a neglected and renovated area of the grounds being again disturbed or damaged. Child No.7 was particularly upset (Figure 5.7 top row right) about this suggestion and pointed out that he and other students were already committed to their allocated area and wanted to see how the trees and plants would change and improve it. Child No.3 (Figure 5.7 second row left) spoke out at length about the effort that was involved in planting a tree, the effort involved in getting a shovel to dig the holes and finding a spot that had just the right prerequisites for the specific tree species—and then regularly watering and caring for the tree after it was planted. Many students in the class then questioned the value of the project if there was no assurance that their efforts would not be respected in the future. The teacher reassured the students that every effort would be made to ensure that the project work would not be interfered with in the future.

Because the actual planting process did not always require input from all three team members simultaneously, many students found themselves with little or nothing to do for periods of five to ten minutes at a time. As a result, many students formed improvised groups and spontaneously started to invent games based on the class activity. For example, Child No.11 used a fallen branch to balance on and claimed to be mimicking balancing like a possum and within a few minutes several other children were following her example (Figure 5.7 second row, right). Meanwhile, Child No.9 was showing physical affection towards the trees that were about to be planted, holding one potted tree tightly to her body and repeatedly caressing the tree and its leaves (Figure 5.7 third row, left). Throughout the planting exercise, children from all groups worked together in deciding where to plant the trees and in swapping jobs, with students moving in and out of the activities as they became tired or completed a task and there was frequent mixing of teams. Students from one team would frequently help another team and it became quite difficult at times to identify which students were in which teams.

During the planting session, Child No.12 was bitten by a “jumping ant” on her back, (these ants produce a nasty bite and the pain can last for several hours and sometimes days) however, she did not complain a lot. After a few minutes of scratching and rubbing her back, the incident was soon forgotten because her team’s next tree needed to be planted and the activity occupied her so much that she was effectively distracted from the sting of the ant bite (Figure 5.7 third row, right). Another incident that occurred shortly after this is also worth noting. Even though the teacher had reassured the class that their work would not be interfered with in the future, Child No. 3 selected a spot in the buffer zone for his allocated plant and explained his reasons for picking this particular spot to the other children. It was quite clear he was expressing happiness whilst speaking and, as a result, the other students
decided to let him plant the tree in his chosen spot—and assisted him to do so, which enhanced his positive mood even further (Figure 5.7 bottom sequence).

Figure 5.7. Students in tree planting exercise. Students improvised games and felt strongly about where trees were planted.
In reviewing the session, the teacher pointed out that since the research trial had started, child No.3 seemed to have become more active and involved in the project related activities, suggesting that he never had seen Child No.3 so alive and happy. In addition, he noted that although Child No.7 was naturally physically active, jumping up and down on rocks, climbing trees and balancing on fallen branches, Child No.7 was generally calmer and more collected whenever he was involved in activities such as noting down plant and animal species and planting trees. The teacher also noted that when child No.7 presented his findings to the group, that his sentences were more complete than before.

5.1.6. The Sixth Visit (Duration 2 hours).

During the last visit the A5 diary / notebooks were collected from the children for further analysis and a feedback questionnaire was handed out and filled in by the students. To conclude the session, an informal discussion with the students was held to seek feedback and discuss the project, including asking the students to make suggestions about what they would like to see in a future version of the game and what they enjoyed (or did not enjoy) about the current version. After the class, the researcher then met with the teacher to discuss the project in more depth.

Observations.

In the teacher interview, the teacher noted that a number of students had expressed disappointment that the game trial had come to an end. Most of the students had expressed interest in being asked to play the game again once it had been developed into the fully online version and were keen to know when that stage of the project would be completed to a stage ready for testing. In the class discussion, several students said that the game had been a big change to their normal class routine as it gave them an opportunity to be outdoors doing something other than “phys ed” (physical education) classes.

On at least two occasions during the discussion the group expressed concerns about the possibility of their research area being neglected in the future and becoming once again overgrown by weeds, or that the school would reactivate the school garden and clear their work. The teacher pointed out that this would be very unlikely since the garden had become overgrown because there were no volunteers to look after the school garden, and that planting it with native trees would also mean that the new garden area would be able to look after itself. The students said they wanted to go back to the research area and the buffer zone on a regular basis to see how it changed and how well the trees were growing. They asked the teacher to make up a watering roster for the trees so that everyone would take it in turns to look after the wellbeing of the trees and plants. The children also said that they were keen for the researcher to come back and to test the final prototype with them.
After the class discussion, the teacher expressed mixed feelings about both the trial and the game. He believed that the project was successful pedagogically and would also like to see the game implemented within the school’s curriculum but, on the other hand he expressed concern over the amount of time the paperwork, gaining of parental permission and school bureaucracy that had to be dealt with took in order to get permission to take the students outdoors. As was also noted in the literature review, the teacher mentioned that over the past few years it had become increasingly difficult to take students out of the classroom—even on to the school grounds or on excursions because of health and safety and other legal concerns. He also mentioned that teachers “these days” already had limited time for classroom preparation and marking and there were also other demands increasingly being made on their time (such as professional development requirements), all of which made it difficult to keep up with “normal” teaching.

5.1.7. First Trial Conclusion.

Following the conclusion of the first trial, the diaries, questionnaires and feedback were analysed and the video material was reviewed summarised and archived for later study. On the basis of the initial study, the JTF gameplay was revised to improve the content, planned interface and other strategies designed to improve the students’ understanding of environmental issues and systems. At the same time, some less successful elements were removed, based on both feedback and observation. During the following months the working computer based prototype was further developed (as discussed in Chapter Four), based on the findings of the first trial in readiness for the next round of testing.

5.2. The Second Test Trial (May 2010).

The primary aim of the second trial was to see how the students engaged with the JTF application itself, as well as the intended educational outcomes of the game. As in the first trial, the students were first asked to participate in an introductory questionnaire and then undertook a number of exploratory outdoor activities. As before, a composite class (Grade 5-6) consisting of 17 male and 8 female students aged between 8 to 10 years old was used as the trial group. All participants had access to a personal computer at school and were computer literate. Most participants were also quite experienced in computer gaming. Also as before, the class teacher monitored the students and acted as game master, in order that the students would not be influenced by the researcher during the trial.

To suit the time made available by the school, the second study was completed within one month and involved six visits to the school. On the basis of feedback that had been made to the principal of the school regarding the outcomes of the first visit, the principal
asked the researcher to work specifically with a class that consisted of a greater number of
students with special needs, mainly students that were identified as having Attention Deficit
Hyperactivity Disorder (ADHD). For this reason, the researcher was asked not videotape
the class activities, although a few deidentified photographs were deemed permissible to
document some of the activities. Thus, most of documentation in this part of the study was
done by observation, note taking and through questionnaires and discussions. The request for
the author to work with a special needs class was somewhat unexpected, but it did suggest a
potential outcome or benefit of the project that had not been considered by the researcher in
the planning stages.

5.2.1. The First Visit (Duration 2 hours).

The students were introduced to the game by the teacher and given some basic
instruction in how to play and the user interface, after which they were allowed explore
the computer game at their own pace. The students accessed the game prototype on the
classroom computers and within a short time were watching the short animated tutorials and
attempting the introductory test quizzes. Both the teacher and the researcher were available
to assist and answer any questions the students had on a one-to-one basis as the students
played. Afterwards, a questionnaire was handed out to the students to collect feedback on
their reactions to the game and the game design.

Observations.

Even after the introduction, some of the students were under the impression that JTF
was a conventional computer game and would be played entirely indoors like the computer
games they were already familiar with and, for this reason, some disappointment about
having to go outside at a later time was expressed to the teacher. The teacher told the students
to be patient and to give the game a try and see what happened. Since there were only six
computers available in the classroom to access the game, the teams had to share computers
and take turns. This caused considerable unrest because every student wanted to play at the
same time. The game master (teacher) spent some time in allocating times to each group and
deciding who should go first, second and third within it. Three of the groups co-operated
quite well in sharing their computer and worked quickly through the introductory games.
These groups also answered the questions as a team and discussed the answers in depth
before making a selection and, by working as a team, scored the highest and finished the tests
earlier than the less co-operative teams.

Some of the students quickly detected a pattern in the possible answers for the tests that
made many of the correct answers predicable—the correct answers tended to be longer and
more involved than the wrong ones. This gave the students considerable pride in detecting the
pattern and pointing it out to the teacher (as well as slightly embarrassing the author!). After the students had finished watching the animations and going through the six introductory tests they were then asked by the teacher to explain in their own words what a biotope is and what bio-diversity means and how biodiversity might be measured. On the basis of the very positive student response to this trial, the teacher decided to make biodiversity the topic of several science classes over the next four weeks, as well as encouraging the students to participate further in the game based tasks and research activities. This decision meant that the students would be further engaged with the topic in class as well as during the playing of the game, a decidedly positive outcome.

5.2.2. The Second Visit (Duration 2 hours).

Following the health and safety briefing and a short discussion about the activities planned for the session, the students proceeded to the area identified earlier by the teacher as suitable for the this set of trials. The primary aim of the session was to survey the game area and to divide it into the eight, six metre by six metre squares that would become the research areas for each of the teams. Given that a much larger area was involved, the majority of the class time was allocated to the measuring and initial assessment exercise.

Observations.

Most children clearly appreciated being outside and away from the class room. During the first few minutes after arriving at the game area, many of the group were quite excitable and jumped around playing “catch me if you can” before settling down to their task. The teacher allowed them at least ten minutes to run around and burn off excess energy, pointing out later that since a large proportion of the class were ADHD students they benefitted from engaging in some sort of physical exercise before being asked to concentrate on a given task. To ensure safety, however, the teacher suggested that those students who wanted to run around should move to a nearby area that had only a few trees and which consisted mainly of lawn.

Once the activity commenced, some of the students said that they might not find enough animals and plants at the suggested site and that, as a result, the activity would become quickly boring and suggested the group move to a small paperbark grove not far from their class room. The students in favour of this move argued that they could then watch the area from the classroom window and make sure that no other students from other classes would interfere with the area and destroy the line markings or work they had done. The vigour with which this argument was put suggested to the author that these students were already feeling protective about the project and the environment they planned to study and improve.

The teacher told them that the paperbark grove was to be cut down in a few weeks to make room for a new hall being built for the school. He also told them that the former
principal had planted the trees with a team of students as part as an outdoor education program 15 years ago (the former principal was the school’s founding head) and that many of the staff were quite sad to see it go. After hearing about the tree clearing, one girl began crying and was comforted by several of her friends. Once the crying had subsided (after just a few minutes) the students suggested that the buffer zone would present an excellent study area instead, as they knew that a lot of native trees grew there and that animals were also seen there on occasions. As in the last study visit, the teacher pointed out that this was a “no go zone” due to school safety regulations— and confided later to the researcher that he agreed that it would have been a great place to trial the game, but that with so many of the class being ADHD it was certainly not a good idea to use the area.

Unlike the previous group, quite a few of the students had obvious difficulties with measuring and working out the size of their areas and subdividing them into regular one metre by one metre squares. The game master suggested finding a straight stick and trimming this to the length of the smaller squares to use as a ruler for their measurements and in this way they could lay out the area without needing to use tape measures and work out the correct numbers. Using this simple method streamlined the whole process and the students encountered only a few difficulties in marking up their study area after this. In the wrap up discussion, several students discussed the problems they had in making accurate measurements and getting their areas approximately square and, as a result, the teacher indicated to the students that he wanted to prepare some lessons on measurement and area for next week’s classes. An activity in the field had led naturally to the need for a maths related lesson on measurement and space and, before it was given, the students already understood the need for such knowledge in real life and its immediate relevance to their own activities. Finally, in preparation for the following visit, students were allocated their new role in the game and were then asked to prepare a list of plants found in their research area and local ecosystem that provided food and shelter for native wildlife. These were to be submitted to the teacher before the next visit.

5.2.3. The Third Visit (Duration 2 hours).

As in third visit in the first round of testing, the students spent the session studying their research area and identifying the soil types, features, plants and animals in each of the gridded squares, producing a detailed list of what they found on a paper template. Once the activity concluded, the students returned to the classroom and entered the information collected on the paper map into the computer based game map. Figure 5.8 shows an example of one team’s initial work and the appearance of the map after the data was entered into the game.
Observations.

While the students were surveying the outdoor area, one group came across a golden orb spider a tree which was part of their research area. (Golden Orb spiders, *Nephila Plumipes*, are one of the area’s largest spiders and have a very strong and sticky golden yellow web). One girl inadvertently came into contact with the web and was so frightened that she screamed and broke out in tears. Two boys from her group used a branch and gently moved it to another tree away from the area. The girl was comforted by some of the another girls and quickly calmed down. One boy suggested that they should have killed the spider because that is what his father always does with them. The teacher held an impromptu lesson and explained the role of spiders in an ecosystem and pointed out that although some are harmful to people, they should not be afraid of them, but should leave them alone if possible. Having discussed the role of spiders in the ecosystem, the class asked several questions and then returned to their work and, as a group, seemed much calmer and less agitated.

Figure 5.8. The game map as filled in by students in the field (top) and after data is entered into JTF.
Although the students were encouraged to make drawings during the survey, it was noticed that almost all of them used short written descriptions rather than illustrating what they saw. This may well have been because a legend of symbols was intentionally not provided for this trial, in order to encourage the students to rely on their observational and drawing skills rather than just copying pre-drawn graphics or icons. As a result, students less confident of their drawing skills may have chosen to take what they thought might be the easiest option. On returning to the classroom they then spent quite some time investigating the tool box and library of the computer version of the game, looking up information about some of the things they had seen and listed using the built in images and text based descriptions. Where plants or animals were not included in the toolbox, students were encouraged to use the Internet to look up and identify what they had seen. To examine how intuitive the interface of the game was, the students were largely left to themselves to become familiar with the game and work out how to get the symbols and photographs representing their findings from the toolbox on to the digital map of the game. Only when specifically asked did the teacher or researcher assist in these activities.

The students generally seemed to find it quite difficult to work out the technique for filling in the computer map, indicating that either clearer instructions needed to be incorporated into the game, or some form of demonstration (animated in-game or delivered by the teacher) might be necessary in future versions. However, several students mastered the process relatively quickly and were soon busy with helping other students with the task and demonstrating how elements were moved and placed. These students were rewarded with a small number of eco-points for their team at the end of the session. Three of the teams indicated they were having difficulties in reading their own or another other student’s handwriting and that this was partly responsible for slowing them down and making the process of identifying plants and animals in the game toolbox more confusing. It seemed clear that providing the students with a legend containing icons (as was done during the first trial) would have eliminated or reduced this particular problem. Also, in future, if the students are able to use mobile devices such as tablet computers, they will then have the ability to enter their findings directly into the digital version of the game map and use cameras to capture their own images where none are already available.

As before, the children had to take turns in entering the data collected in the research area. However, on this visit there was far less rivalry and restlessness evident in the room, primarily because the students were clearly working cooperatively as teams rather than having to wait for their turn—as one student entered data the other team members were kept busy making suggestions, translating their own maps and comparing them with the findings of the other team members, whilst actively discussing (and debating) the differences. Only one
child lost patience and became overly disruptive and was immediately given "time out" by the teacher. Only when the other team members had finished transferring their findings onto the map grid was the “time out” student allowed to transfer his own findings.

Several students had taken photographs using the digital cameras provided by the researcher and asked him to transfer some of these into the tool box for use in the next visit. Unfortunately, when the researcher viewed the photographs after the class had finished, it turned out that almost every image was either completely out of focus, did not make sense or was not related to the topic. It seems clear that future versions will require some sort of central repository where an editor (the teacher typically) can review images uploaded by the students before they are included in the tool library. In addition, a short lesson on taking clear photographs would have been of value as part of the preparatory learning. Within the school environment a mentor, such as a student from a higher grade or a parent volunteer might take on the role of editor or tutor.

5.2.4. The Fourth Visit (Duration 2.5 hours).

At the start of this visit the students discussed a number of strategies that they could use to improve the environmental balance of their game area and then spent some time comparing their on screen maps with those of the other groups, in order to develop a better understanding of the area as a whole. Considerable discussion took place concerning the dominant type of ecosystem that made up the study area and some of the students decided to do more research into ecosystems on line, as it was quite clear the research area could not simply be classified as being just one type of system. Following this discussion, each group identified a number of tasks that they wanted to do during the session, such as weeding, rubbish removal, aerating soil and planting—and a list of activities was made up for that day’s session. Additional game based tasks and problems had been planned earlier by the teacher and were presented to the students by him during the course of the class, especially if individual students were seen to be becoming distracted or disruptive.

Observations.

As the class was about to start, it was noticed that one child was sitting at her desk with her head on her arms crying. The teacher approached the child and asked why the student was so upset. The girl revealed that her cat had to be put down by the vet that day because it was very ill and couldn't be cured. This news quickly spread throughout the class and one student pointed out that perhaps it was a good thing the cat was dead, stating that he had learned from the JTF game that cats often harm native wildlife. This further distressed the crying girl and she needed to be calmed down by the teacher. Once she had stopped crying, the teacher asked the class if they knew how to keep pets and at the same time protect the
native wildlife. Several students provided answers and cited JTF as the primary source of their knowledge, which seemed to settle the crying girl.

The discussion stopped at this stage and the class made its way outside to the research area. Because some clearing of the paperbark grove had begun the week before, the teacher had gained permission for the students to take any suitable rocks or logs from that area that could be used for recycling as landscaping or creating nesting holes or compost materials, as long as they were carefully supervised at all times. The students went first to the cleared site and identified a number of items they thought might be useful and brought back to the research area those items that could be easily carried. Several students were distressed by the obvious effects of the land clearing and spoke out about the damage to the environment and the wildlife it had caused.

Shortly after their return to the study area, a large black and white butterfly flew into the area and, after some minutes of fluttering around, landed on a vine that was growing on one of the trees. Most of the girls in the groups were quite excited by its activities and quietly followed it around for most of the time it was flying. After it had settled, a number of the students carefully approached the butterfly and were able to witness it laying a number of tiny yellow eggs on a leaf of the vine. One girl said that based on its size, it was probably a Richmond Birdwing butterfly (*Ornithoptera richmondia*), because she knew her mother had planted a special vine to attract them as they are now an endangered species. The teacher said the Richmond Birdwing would have a bright red and yellow body and fairly large yellow and white patterns on the underside of its wings and that this was probably a female of a different species. He also explained that the female was commonly confused with those of several other species and that the girl’s mistake was a very easy one to make. The class decided to look up the Richmond Birdwing on the Internet when they returned to the classroom. It turned out that the vine growing on the tree was a Monkey Rope vine (*Parsonsia straminea*), common in sub-tropical eucalypt forests with good rainfall and that the vine is the host plant for the Common Crow (*Euploea core*) butterfly. The students learned that the egg would eventually grow into a colourful caterpillar which would then become a shiny metallic silver or gold coloured chrysalis. The class was quite excited by this finding and asked if they could go out every day to see if they could find the chrysalis before it turned into a butterfly.

Based on the lists made by the students after the second visit, the researcher had organised a number of potted native plants and shrubs, and these were distributed equally amongst the teams by the teacher based on the student’s planned improvements and the suitability of the plants for the different parts of the study area. These plants were placed in position ready for planting by the students and some time was spent discussing how high and
wide each would grow and how to prevent them from interfering with their neighbouring plantings and how they would relate to the existing plants. After this, the students discussed where some of the rocks and logs they had gathered might be used, thinking about them as both landscaping features and potential habitats.

The students showed great enthusiasm during this session and decided to have their morning tea break in the research area, where they mingled together discussing the improvements and changes each team had made to their area. After the break the teacher the students were a little restless and so the teacher initiated a “slithering like a snake” competition in a nearby grassy area; with the first three students arriving at the end of the course winning extra gardening tools and plants for their teams and all students earning a number of eco-points based on their level of participation. Having burned off some pent-up energy, the students were again ready for the planned activities. The gardening tools and plants were distributed evenly amongst the groups and the students started planting and clearing straight away with great enthusiasm. Once all the plants had been planted and watered in and the majority of the rocks and logs had been placed, the students were given new paper map templates and were asked to resurvey their area for existing plants and animals that had not been observed or were not present the first time—as well as adding the changes and improvements they had made during the present session.

As the session drew to an end, the students took their maps inside and again transferred the changes to a new version of the digital map on their computer for later comparison and analysis. This time they appeared to have fewer difficulties in creating their maps and completed the task in considerably less time, an outcome which the researcher ascribes to minor improvements made to the interface based on the previous visit’s verbal feedback and the student’s greater familiarity with the interface. The two hours of the visit had passed very quickly and, in the wind up discussions, the students were clearly pleased with the overall outcomes of the days activities, in particular having witnessed the butterfly laying an egg. The teacher told the class that he would prepare a lesson for the following week on the life cycles of different insects and would show them how the egg would develop into a caterpillar and then into a pupa and what then happened inside as the caterpillar changed into a butterfly. As before, an unpredicted experience in the research area had led naturally to need for a science class, with the students already primed and ready for the proposed learning activity.

Several students asked whether the photographs taken in the last visit had been incorporated into this version of the game and the researcher explained the reasons why they had not been used. The students asked the teacher if he would help them to take clear photos of the butterfly, the egg, caterpillar and chrysalis to put into the JTF library so that they could
use these in their maps in future. Because this was not yet possible with this version of the
game the students were quite disappointed, but were able to use a “generic” butterfly image
already available in the JTF tool box, but adding their own descriptions and field notes. This
limitation was a clear indication to the researcher that it was essential to implement the
content upload tool for the players (or at least the game master) as soon as possible in order
to enhance and improve the game experience and the long-term learning value of the game
itself. To end the sessions, students again changed roles, each taking on the role they had not
yet played in readiness for the next visit.

5.2.5. The Fifth Visit (Duration 2 hours).

This was the last activity-based visit planned for the study and several fairly minor
improvements had been made to the game interface in the preceding week which the
researcher was keen to trial. Unfortunately, there had been insufficient time to develop the
content upload tool to stage where it was fully ready for implementation, so this feature was
not available for testing in this session. Unlike the first round of testing, the time between
the fourth visit and this visit was only one week and, consequently, not a great deal of change
had occurred to the research area during this limited time that could be recorded on the
game map. Even so, there were still many incomplete tasks left over from the previous visit,
including clearing weeds and rubbish, whilst some plants still remained unplanted and quite a
bit of the landscaping was still unfinished. Other plans, such as building composting systems,
nest boxes and water storage ponds had not yet been commenced, so there remained plenty to
do. However, before the outdoor activities began, the students needed to finalise the updating
of their maps and their planning of the day’s activities. As previously, the game master had
prepared several tasks for completion should students become distracted or had finished their
activities early.

Observations.

To begin the session, the students finished updating their second computer based maps
with the alterations, new findings and improvements they had made to their research area
the previous week and spent some time discussing as a group what had been done by each
team and what benefits to the ecosystem each group’s activities might have in the future.
Having finished their work on the computers, it was quite clear the students did not want to
stay in class for further discussions but were keen to get outside as soon as possible, so the
discussions in class were not overly long.

However, once the group had moved out to the study area—a process that entailed a lot
of running, jumping and high spirits—the majority of the students settled down and became
clearly engaged with the discussion, with most students listening and contributing ideas
and information without prompting. The teacher questioned the students extensively about what they had learned about biodiversity and ecosystems to see if their answers were more sophisticated or better informed than previously. Quite clearly, more students were actively contributing to the discussion and answering questions than previously, an observation later supported by the teacher’s comments following the lesson. One student mentioned that it was important to have more native plants growing in the area that would attract native animals, because these were a source of food and shelter when many introduced species were not. The teacher asked if planned biodiversity would be good for re-establishing ecosystems and more than half of the students raised their hands and said yes, triggering some questions about what was meant by “planned”—an indication that the question was being thought about at a deeper level.

Most of this last session was taken up with the planned activities identified by each group and, as tasks were completed and inspected by the game master, small numbers of eco-points were given to each team by the game master, based on the complexity of the task, the success of the task resolution and their knowledge and understanding of what they were doing and why. For example, students were questioned in relative depth about all aspects of the landscaping they did and the plants they planted, including such matters as how much water it required, whether it was drought tolerant, what animals might eat its leaves, fruit or flowers or might use it for nesting or shelter and how big it might grow. Throughout the session the students were relatively quieter, engaged and frequently very busy, although a few occasionally became a little loud and excessively boisterous. The teacher, experienced in dealing with the students and personalities in the class, quickly assigned new tasks to these distracted students and re-engaged them in new, more directed pre-planned game activities. As in the last visit, the last twenty or so minutes were given over to updating the game map on the classroom computers and in a short follow up discussion with the group and teacher as a whole.

In a later follow up discussion, it was pointed out by the teacher that the students had become quite attached to the study area and felt a personal sense of responsibility towards it—if not a sense of ownership or connection. Many of the students had found their own personal places to sit in their assigned research areas and the teacher had noticed that they returned to this personal spot every time the class went to visit the study site. Interestingly, there were never any fights or disputes about these spots—each student found their own as if by instinct and all of the others seemed to naturally respect it. Unfortunately, how long this state of affairs might have lasted remains unknown. It was also noted by the teacher that the students were also very concerned about what would happen to the area after the JTF project ended and, for this reason, the majority of the class wanted to continue working on the project even after the last visit by the author. Others had suggested that next year’s class could
take over and even extend the research area and thus keep up the work into the future. One boy had said the whole project would die out if no-one maintained it or that one day it would just be destroyed in the same way that the paperbark grove planted by the school’s founding principal had been, which caused considerable dismay amongst the group.

During the course of the study, a number of students asked both the teacher and the author if they could take a copy of the JTF prototype installed on the school’s computers home and play the game in their own backyard with friends and siblings. Many students wanted to show their parents what they were doing and learning at school and wanted to share the experience with their family. One student mentioned to the teacher that he and his parents were discussing the project every day at home and that he had started his own study area in the back garden and his father was helping him build a possum nest box for one of their trees. Another student said that his family were planning to visit a nearby national park on the weekend and had arranged to talk to the ranger about the park and learn more about the native plants and animals that could be found there. Another student had talked about the project at home and her mother had suggested that they collect and preserve leaves and flowers to make a herbarium so that they could research and assign names to the plants and later classify them botanically. They had already begun this project and were conducting online research at home to find the correct names of the plants in their own garden and to locate more in-depth information about them. The idea of independently creating a herbarium using real plant specimens suggests that a much deeper level of learning will be evidenced by the student on this topic in the future. In addition, the commitment of the parent to this project indicates that this learning is being supported and reinforced outside of the classroom—and this is a positive outcome indeed.

The above examples also demonstrate that it is important not to rely too much on virtual representations of the natural environment and the real world in an educational context. Being physically engaged with the real world is essential to learning and it is often through the engagement of multiple sensory pathways that many forms of learning occur. For example, haptic input is essential in building motor skills and refining certain bodily responses, smell is intimately linked with memory and, as Pavlov demonstrated, even sound can trigger certain primal responses. The importance of haptic experiences to the study group was supported by the observation that the majority of the students seemed to particularly enjoy digging in the dirt with their bare hands and many asked the teacher if they could take off their shoes while outside (unfortunately this was against the school dress code and health and safety rules). In the same way, it was also noted by the researcher that some of the students not only smelled the plants and soil they were studying, some were also overheard later discussing the different tastes of these things with their peers. Fortunately for the researcher, no poisonous plants were known to be present in the study area!
5.2.6. The Sixth Visit (Duration 1.5 hours).

A printed feedback questionnaire was handed out and collected during the session, after which a one hour debriefing session was held with the students and teacher to seek group and individual feedback and discuss the project, once again asking the students to make suggestions about how they thought future versions of the game might be improved and what they enjoyed (or did not enjoy) about the current version. After the class, the researcher again met with the teacher to discuss the project and outcomes in more depth. The teacher was also asked to write down (as he thought of them) any further ideas or comments that might occur to him in the following days.

Observations.

This session was originally planned as an entirely indoor activity and, although the class had been briefed on the planned activities before the visit, the students clearly exhibited signs of restlessness and were not keen to fill in the questionnaire. Several asked if the class was going to move out to the research area at some stage. Since the weather was fine, the teacher agreed that the discussions and feedback session could take place in the research area, but only once everybody had filled in the questionnaire, which seemed to satisfy the majority of the class. However one or two of the more active students continued in their restlessness and several children clearly rushed answering the questions in order to go outside as quickly as possible.

At the research area the students gravitated to their usual places and seemed quite happy to discuss the project and the things they had done during the visits. In retrospect, moving outside worked particularly well, as the children were calmer and took obvious delight in showing the researcher (and their classmates) the things they had planted and improved at first hand. Several students pointed out how much their plants had grown in the few weeks since they had been planted and were able to name the plants (using their common names) and discuss some of the roles the plants played in the ecosystem and which animals and birds used them as a food source. Some discussion about the game itself took place and the majority of students were quite positive about the experience, although a few said they would have liked to have spent more time using the game on the computers as well. Several thought more animations and more “fun” activities could have been built into the game interface to make it more like some of the games they played at home. A few students started to talk in depth about their favourite games, but as this was moving away from the main subject of the discussion, the teacher interrupted after a few minutes and brought the class back on topic. In terms of the role-playing function, opinion seemed to be that it was very important in the earlier weeks, when the research and analysis was being done, but not as important once the actual planting and improvements to the study area got underway—mainly because
everyone was sharing the work and there was no real need for specialist roles. Only a few students indicated they did not like spending a lot of time outside, but these students also agreed that they had enjoyed the project and felt more comfortable about being outdoors and interacting with “the bush” after a few days playing the game. A number of students expressed disappointment that the project had come to an end so soon.

After the class, the teacher spoke with the researcher and shared his opinions and observations. Overall, the teacher thought that the students were much better behaved and more keen to learn after a session playing the game, suggesting that they were individually more collected and disciplined after having been outdoors engaged in doing something other than physical education—which sometimes left them in a more excitable state afterwards, depending on what they had been doing in that class. The days allocated for the visits were always Mondays and, since the students had just had two days off, the classes were normally “crazy” on that day. However, since introducing and playing JTF he had noticed a definite improvement in almost all aspects of the class’s behaviour, as well as improvements in attention span and other positive behaviours in a number of individuals.

The teacher mentioned that some children now showed a much higher interest in Australian wildlife and nature after being involved in this trial and this had transferred into other science study areas as well. The class had also asked if they could continue working on improving the area and playing the game for the rest of the term—using both the outdoor component as well as the indoor component. He had also discussed the positive effects the game had on the students with a colleague and mentioned that his colleague was keen to trial the game with his own class, they also wanted to put the game onto a number of lap tops and take it to a forthcoming one week school camp, where the students would be engaged in a range of outdoor activities such as tree climbing, canoeing and trekking.

Even though the timespan of the second set of visits was considerably shorter that the first round, the outdoor area the students had worked with looked very different compared to the first visit five weeks earlier. The students had clearly put a huge amount of effort into the project and the change was a visible and obvious reminder to the students of their achievement. The teacher suggested that more games of this nature could be used at primary school level, not only for teaching environmental related topics but also other topics such as English and Mathematics. The teacher also made several other suggestions as to how the game could be extended, pointing out that collaboration with the woodwork teachers would allow the students to design and build nest boxes for birds and mammals and perhaps even hives for native bees. Other objects, such as garden seats could also be built as projects and could be used for making the research area into a recreation or study area, whilst art classes
could use such an area for outdoor drawing and nature studies. The teacher suggested that a more advanced version of JTF could also be developed for use in high school, where biology and other natural sciences were an obvious area of application.

At the end of the visit, I said good-bye to the students and thanked them for their participation and the good time I had working with the school and the students and for their co-operation throughout. The students asked if I would be able to return and play the game with them once it was finalised and all aspects of it were working.

5.3. Conclusion.

This chapter has described the observations made during the two game trails and ten visits made during 2008 and 2010 at Sunshine Beach Primary School. The different stages and activities trialled during these visits were discussed in brief and the observations made while the children were interacting with the game (both indoor and outdoor components) were reported in more detail. Given the dynamic nature of the class activities, and the way in which the students studied, interacted and moved about—as primary school children do—many observations may seem to be rather unspecific in many ways, with terms such as several, many and a few providing an overall sense of number rather that a specifically quantifiable value. However, as my supervisor puts it, “analysing children in action is like attempting to herd cats”. Nevertheless, the author believes that these observations provide a qualitative sense of how the students responded to the JTF game and provide some idea of how the game and game flow worked in application. The teacher’s comments and observations also provide some insight into how the game was experienced from the pedagogical and behavioural side of the learning equation. The chapter has focussed on the way the children executed their given tasks, their social interactions and what learning happened during the game play; how they took on their given roles and how they worked as teams in smaller and larger groups. However, in order to better draw a more conclusive outcome and determine the success or shortcomings of JTF, these observations need to be balanced out by an interpretation and analysis of the results of the questionnaires. These findings are discussed in more depth in the next Chapter.
Chapter 6

Findings and Outcomes.

This chapter describes the data analysis and findings of the research conducted with the two study groups. The initial questionnaire produced preliminary data that allowed the researcher to design and customise the game based on the identified needs, abilities and experience of the students and teachers involved in the project, based on earlier discussions held with the participating teachers. The second part of the study involved testing the initial prototype with the students and observing student responses and interactions during the playing of the game in order to test and improve the gameplay and game mechanics. In the second series of visits, the students worked with the computer based game prototype as well as participating in the outdoor activities. As with the first visit, the observations made during the testing of each game iteration were used to improve and enhance the game for retesting in the following visit. Final feedback at the end of the visits was gathered in form of a final questionnaire and informal discussions with the students and teachers. This chapter presents the findings of the two main studies and outlines the findings and interpretations of the data collected during the study. Full versions of the surveys and questionnaires not presented as Tables in this Chapter can be found in Appendix C.


The first questionnaire was designed to build a profile of JTFs possible target audience on which the game could be based. Questions from the first survey examined:

- Gender and age.
- Availability of a mobile phone.
- Computer usage and associated behaviours.
- Favourite computer games.
- Game console usage.
- Play, physical activities and interests.
- Individual learning patterns and behaviours.

Twelve copies of the questionnaire were collected after the first visit. Five female and seven male students participated, eight students were eight and nine years old, and four students were between 10 and 12 years old. Only one student possessed a mobile phone and had only limited access to services other than the telephone (mainly text and camera), suggesting that if mobile phones or other mobile devices were to be extensively used for playing JTF in the future, they may need to be provided by the school.

Eleven of the students had access to a computer that was connected to the Internet at home—and all had access through the school, which would enable them to conduct research online. This finding supported the researcher’s initial idea of requiring players to use the Internet to research content pertaining to environmental issues than rather providing all of the requisite information within the game. Self-directed learning skills, especially in conducting research are important developmental tools and are essential as they move into higher grades and eventually into high school.

Eleven students reported they liked playing computer games, whilst the twelfth student was ambiguous—stating verbally that given the option between sport and the computer, sport was preferred. The average time that the group spent playing computer games per day was one and a half hours, half an hour less than the time recommended by CSIRO (2010). However, the CSIRO screen time also includes watching TV and surfing the Internet for recreational purposes and, when these activities were added to computer gaming time, all students exceeded the recommendation. Two children stood out in regards to the time spent playing computer games. One student claimed to play computer games for 4 hours per day and the other student claimed to play for 3 hours per day. Favourite computer based games (including online games) included Club Penguin, Save the Sheriff, and Sims2 whilst four students indicated they had no favourites because the played so many different games it was hard to choose. In terms of least favourite games, six students said they could not nominate a game, three nominated Roll On, Hit the Ball and On the Run as being too difficult and one nominated Battlefield (too violent) and one student did not answer the question correctly. All of the students surveyed had a play console connected to the home television. When asked about their favourite console based games three students (all male) nominated the Halo series (M rated) and Grand Theft Auto (R 18+ rated) as their favourites, five students indicated they had no favourite game and two students stated they had no favourites but preferred the Nintendo Wii games because they required active physical movement. (The Wii had only been released a year earlier in Australia).
Eleven students liked to play outdoors on a regular basis whilst one student like to play outdoors only occasionally, thereby supporting the idea of using outdoor learning as a core activity in JTF. In response to the question about what kind of activities or games the students engaged in while outdoors, the majority of children stated they liked to be physically active, playing sports and other games where they could move around. Nominated games included many children's classics, such as Cops and Robbers, Tiggy (tag), Football, Handball and other ball games and, as might be expected, bike riding. These preferences were also mirrored in the student's hobbies and interests, with seven nominating sports and outdoor activities and five students nominating indoor activities as their hobby, including playing Lego, stamp and card collecting, collecting posters and playing a musical instrument (two students). In terms of why they chose their hobbies, eleven students said that fun was the main factor and one answered that she thought it would help in her career choice of becoming a musician.

In terms of playing computer games alone or with others, seven students preferred to play with others, three preferred to play alone and two responded that they played sometimes with others and sometimes alone. Although the sample numbers are small, the response to this question did suggest to the author that the majority of the students in the test group were open to the idea of playing a computer game as a group. Only one member of the survey group indicated they did not like to play other types of games such as board games or Lego but gave no indication as to why.

The second part of the questionnaire consisted of eight questions intended to find out about the group's preferred learning styles as defined by Gardner's (1983) Multiple Intelligences theory. Although Gardner's original proposition included only seven intelligence types, he acknowledged that these were not necessarily the only intelligences and there has been considerable debate as to what others should be included ever since. The inclusion of Naturalistic and Existential intelligences into the original seven is still being debated, although the former now seems to have been largely accepted amongst educators. In this project, the researcher wanted to facilitate student centred learning within the JTF concept to cater for the different learning styles implied in Gardner’s multiple intelligences theory as far as possible, so some indication of what types of learners may be encountered in the study was deemed to be of value. The eight intelligences and the associated learning styles surveyed for were:

- Verbal/linguistic learners.
- Logical/mathematical learners.
- Visual/spatial learners.
- Bodily-kinaesthetic learners.
- Musical learners.
• Interpersonal learners.
• Intrapersonal learners and,
• Naturalistic learners.

Table 6.1 shows how the students responded to questions about their preferred learning styles. Students were encouraged to ask questions throughout the questionnaire, especially if they needed specific briefing about how to answer this part of the survey. Students who were uncertain were characterised having given a no answer. Note that the numbers given to students in this table correlate to the numbers students were given in the field observations videotaped after the fourth visit.

<table>
<thead>
<tr>
<th>Table 6.1. Preferred Learning Styles based on Gardner’s Intelligences.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Student.</strong></td>
</tr>
<tr>
<td>In your own time do you like to:</td>
</tr>
<tr>
<td>LINGUISTIC. Read books or comics, write, speak and have conversations with your friends and family?</td>
</tr>
<tr>
<td>LOGICAL / MATHEMATICAL. Do tests and puzzles that have numbers involved, or ask you to recognise patterns and relationships, timeliness or solve problems through logic?</td>
</tr>
<tr>
<td>SPATIAL / VISUAL. Paint and draw pictures, including some that you imagine (mental images)?</td>
</tr>
<tr>
<td>BODY / KINESTHETIC. Play with blocks (Legos) and build things, dance, or play active sports and games?</td>
</tr>
<tr>
<td>MUSICAL. Express yourself through music and dance, or by composing, playing, or listening to music?</td>
</tr>
<tr>
<td>INTERPERSONAL. Play cooperative or team games, work on group projects and discussions, or take part in plays or role-playing games?</td>
</tr>
<tr>
<td>INTRAPERSONAL. Work by yourself on projects, reading good books, keep a diary or spend time alone thinking about things?</td>
</tr>
<tr>
<td>NATURALIST. Exploring nature, making collections of things and then identifying them and grouping them?</td>
</tr>
</tbody>
</table>

Given the small sample size, it is difficult to extrapolate any overall characteristics predominant in the class, but several things stand out quite clearly. Children Nos. 1, 8 and 10 answered yes to all questions, which suggests they were not really thinking through their responses or were trying to appear highly motivated (or please the teacher / researcher).

Either way, it is not possible to make any individual assumptions about these students. Child No. 12 was very specific about his preferences and indicated that his learning intelligences lie clearly in the musical and interpersonal domains. Children 2, 3 and 6 answered “no” to three of the intelligences and, interestingly, all three answered “no” in the linguistic domain—which is odd, given that answering and interpreting this part of the questionnaire required exactly these skills. Musical intelligence was the least preferred of the eight learnings (overall five
students indicated a “no” in this category) followed by linguistic and logical / mathematical (both with four “nos”). The spatial / visual and body / kinaesthetic learning styles were preferred by all of the of the students other than student number twelve, closely followed by interpersonal, intrapersonal and naturalist learning with two “nos” each.

In general, it appears that the sampled group enjoyed creative activities, such as painting and drawing, building things and engaging in active games and sport, working sometimes alone and sometimes in teams and groups and, to an equal extent, being outdoors and engaged with nature. The students as a group were less interested in musical expression, or in linguistic and logical/mathematical pursuits, although a small number clearly identified themselves as being so inclined. Individuals naturally varied in their preferences for different learning styles, but aside from Child No. 12 who was quite specific, the majority were most comfortable with activities that involved spatial, visual, kinaesthetic and body related activities.

Based on this initial study, it was decided that the first stages of the game development should focus on developing activities and content that would address the predominant learning preferences of the participating students. Learners with a preference for a visual/spatial learning style were accommodated for by the inclusion of the six animated introductory games, in which Kangi the kangaroo guide explains in a number of colourful scenes what the players need to know in order to begin playing the game. The graphical user interface of JTF is designed to cater for these visual/spatial learners through the use of a landscape metaphor, and by requiring the students to create their initial maps by drawing the plants and animals they identify on paper before transferring them to the computer. Detailed observation is required in order to produce a drawing with sufficient accuracy to allow for the plant or animal to be recognised when working with the game interface and the photographic representations used in JTF. Whilst some students produced written descriptions in the second trial of the game, it was found that this was not as effective as using drawings when the students returned to the classroom, since many students had not provided enough information for a reliable identification. Visual / spatial learners also benefit from the fact that most of the game play occurs outside, in what is sometimes an unfamiliar and complex environment in which a large amount of visual stimulation naturally occurs. The “Fun Stuff” and games section of the main JTF game also provides players with opportunities to improve their observational and artistic skills by asking them to take part in a team drawing competition, where players share they paintings and drawings with other students playing the game—either at the same school or in other schools.

Perhaps the most well catered for of the learning types in JTF would be the students who prefer bodily-kinaesthetic learning (in the first test sample this was all but one student).
It would be fair to say that most eight to twelve year old children enjoy being active and exploring their environment and the author’s observations of the students in both test groups seemed to suggest that they enjoyed being outside and away from the classroom enormously. The fact that many students improvised their own games and activities when not actively busy with predetermined tasks assigned by JTF was a strong indication that the students were keen to engage in physical activity and interact with their environment. JTF particularly sets a number of tasks that require players to work with construction materials, plant trees and shrubs, collect rubbish, place hollow logs and rocks into the game area and play games requiring balance and co-ordination, such as hopping like a kangaroo or balancing like a possum on a wooden bar.

Interpersonal and intrapersonal learning are also central to JTF. On an interpersonal level, the players are required to take on and change their roles between being the park manager, a scientist or an environmentalist and are required to work together as a group to investigate, research and propose strategies for surveying and improving the health of their ecosystem. Each team member has the chance to present their findings and ideas and discuss their proposed strategies with fellow team members, the class as a whole and with the game master (teacher) as required. Intrapersonal learning is accommodated for by allowing students to create independent tasks and maintain an their own JTF diary, in which the player individually documents their daily activities and findings and undertake self-reflective analysis of their own progress. Although the diary can be shared with others and in future versions could be based on a personal blog, students are encouraged to maintain some private, self analytical content relating to their personal interests and learning. Students are also encouraged to explore their environment by making collections of objects, keeping a herbarium, and making detailed sketches and drawings or taking photographs and recordings whenever possible.

Aside from musical learning (five students indicated they did not particularly enjoy musical activities) linguistic and logical/mathematical learning styles were least popular amongst the students, with four out of twelve students in the first test group answering no to having a preference for these learning styles. Obviously, the skills associated with both these types of learning are a necessary part of daily life and the acquisition of both literacy and numeracy skills is an integral part of every child’s education. JTF seeks to make these forms of learning more relevant to the students by requiring them to apply the relevant skills in a practical situation. Measuring, surveying and mapping, calculating areas and counting the numbers of individual species all require the application of logical/mathematical reasoning, whilst researching, producing reports and giving presentations all require the use of linguistic skills. The six introductory tests necessary to commence playing JTF require the application
of linguistic skills and the application of logic from the very beginning of the game. To accommodate musical learning, the FUN Stuff section of JTF contains a simple game that asks players to mimic certain animal sounds, but this is only a very minor part of the game and it is hoped that more in this area will be developed in future versions.

6.1.2. Questions and Findings, First Trial.

At the end of the prototype game trial in October 2008 the students were asked to fill in a questionnaire consisting of 18 questions related to their experience with the game prototype. In association with the author’s observations of the game being played, the results of that questionnaire provided some feedback on what aspects of the game had worked, what did not work and what else needed to be added to the game from the student’s own perspective. During the six weeks of the game trial one student dropped out of the research study and so only eleven copies of the questionnaire were collected. In the informal discussion following collection of the questionnaires, the students were asked if they had enjoyed playing the game and if they would like to play it again in the future, to which all answered with a resounding yes (this is the first question and is not shown in Table 6.2). Table 6.2 shows the student’s written responses to the printed survey conducted during the last visit. As before, incomplete answers or uncertain answers (such as I don’t know) are classified as being in the negative range and are shown in pink on the table.

Question 2. What aspects of the game did you like the most?

Children Nos. 2, 5, 6, 7 and 8 (three male and two female) were perhaps the least responsive of the group, providing mainly yes/no answers and typically less than two very brief comments, although all students other than student number two responded to the question “What aspects of the game did you like the most?” Five students specifically stated that planting trees or other plants was primarily their most favoured activity, whilst five (including three of the former) referred directly to either exploring or looking after the environment as being something they particularly enjoyed. Children Nos. 1, 4 and 11 specifically mentioned planning or learning new material as important to them. In general, physical activities such as planting and exploring, followed by caring for and maintaining the environment came forward as being the most enjoyable aspects of the game amongst this group. In the informal follow up discussion, it was quite clear to the author that the students were highly conscious of the fact that once they had planted their new trees and improved their allocated spaces that they would need to provide follow up care, making sure that new plants got watered on a regular basis and that weeds would not return and kill off the small plants before they become established. The tree planting and clearing work demonstrated that the students were clearly able to plan, take responsibility and think about the future of their project. Having seen the destruction of other areas on the school grounds, several students wanted to know what might happen to their
Table 6.2. Student Responses to the First Trial Survey. October 2008.

<table>
<thead>
<tr>
<th>Student Number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>What aspects of the game did you like the most?</td>
<td>Planning the game.</td>
<td>Na.</td>
<td>Exploring the park.</td>
<td>We learnt new things and had fun.</td>
<td>Planting trees &amp; planting in the environment.</td>
<td>When we were planting.</td>
<td>Planting the plants.</td>
<td>Looking after the environment.</td>
<td>Looking at the plants, researching, meeting new people, learning about the environment, getting reeved.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you think that the game encouraged you to become more interested in the natural environment and ecological systems?</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
</tr>
<tr>
<td>Did playing the game at school encourage you to spend more of your own time outside than you would normally?</td>
<td>Not really.</td>
<td>No.</td>
<td>No.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>No.</td>
<td>Yes.</td>
<td>Yes.</td>
</tr>
<tr>
<td>Did you enjoy working in a group? What did you enjoy about working with your group?</td>
<td>Yes.</td>
<td>My group members were sometimes annoying.</td>
<td>Yes.</td>
<td>Meeting new people.</td>
<td>Yes.</td>
<td>That all the work wasn't just for me.</td>
<td>Yes.</td>
<td>Everything.</td>
<td>Yes.</td>
<td>Making friends and not working with the same people.</td>
<td>Yes.</td>
</tr>
<tr>
<td>Do you think you need the computer or a mobile device to play the game?</td>
<td>Yes.</td>
<td>No.</td>
<td>Yes.</td>
<td>No.</td>
<td>Yes.</td>
<td>No.</td>
<td>No.</td>
<td>Yes.</td>
<td>No.</td>
<td>No.</td>
<td>Yes.</td>
</tr>
<tr>
<td>How could you benefit from having access to a computer that is connected to the Internet in finding out more about things you discovered in the game?</td>
<td>Yes.</td>
<td>Use it to do research about plants and animals.</td>
<td>Yes.</td>
<td>I think it would help allot better.</td>
<td>Yes.</td>
<td>I think it will be good.</td>
<td>I think so.</td>
<td>Yes.</td>
<td>I think so</td>
<td>Yes.</td>
<td>Yes.</td>
</tr>
<tr>
<td>How do you imagine you could use a mobile device such as a mobile phone, a GPS device or a computer notebook in this game?</td>
<td>Yes.</td>
<td>I can not imagine.</td>
<td>Yes.</td>
<td>GPS can help you navigate, computer notebook you can write on that instead of paper.</td>
<td>No.</td>
<td>Na.</td>
<td>Yes.</td>
<td>It would be good.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
</tr>
<tr>
<td>Do you think something was missing (i.e., clearer advice, more structure) in the game? If yes, what was it that you felt was missing?</td>
<td>No.</td>
<td>No.</td>
<td>No.</td>
<td>Yes.</td>
<td>More information.</td>
<td>Yes.</td>
<td>Na.</td>
<td>Na.</td>
<td>Yes/No</td>
<td>Yes.</td>
<td>Yes.</td>
</tr>
<tr>
<td>Did you think you would play the game in the future if it was available in your school or at home?</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
</tr>
<tr>
<td>What would you change about the game if you were the game designer?</td>
<td>The plants should be native plants unless they are part of the game.</td>
<td>Nothing.</td>
<td>I will make it so that the kids have more freedom.</td>
<td>Nothing.</td>
<td>I don't know.</td>
<td>Nothing.</td>
<td>Yes.</td>
<td>Make it more active.</td>
<td>I would make it more free to roam.</td>
<td>Need to get more out there.</td>
<td>Na.</td>
</tr>
<tr>
<td>Do you think that playing this game at home would encourage you or your friends to spend more time outside exploring the natural environment?</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes/No</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
</tr>
<tr>
<td>Do you think that the game helps to bring you together with other children?</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes/No</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
</tr>
<tr>
<td>On a scale of 1 to 10 (no fun = 1 lots of fun = 10) how much do you think that the game was fun?</td>
<td>6</td>
<td>8</td>
<td>5</td>
<td>7</td>
<td>10</td>
<td>8</td>
<td>10</td>
<td>7</td>
<td>9</td>
<td>10</td>
<td>8</td>
</tr>
</tbody>
</table>
project if the school were to expand and space for another building was needed, showing that they understood the balance between the needs of the natural environment and the pressures of their own requirements for living space.

**Question 3. What parts of the game did you not like?**

Four Children, Nos. 6, 7, 10 and 11 indicated there were no parts of the game they did not like. Two students (Nos. 4 and 5, both female and who worked as part of the same team) indicated that being scratched by sticks or trees (which is difficult to avoid when being outdoors) was an issue to them, whilst two others (students two and three, both male) noted that the tree planting exercise was their least favoured activity, although they did not indicate why. Child No. 1 said that “when we did nothing” was a factor he disliked, whilst Children Nos. 8 and 9 (males) indicated that writing notes and counting plants and animals were an issue for them. Interestingly, both of these students said that the hands-on activity of planting trees was something they most enjoyed and later (in question 15) both of these students indicated that greater freedom to move about and more physical activities would help improve the game.

In retrospect, it would have been useful to ask more specific questions on this topic, such as why some students did not like activities such as tree planting or surveying their areas of study, though the two responses dealing with being scratched by sticks and, in the next question the concern about spiders, may have something to do with this. In addition, it may well be that not all students were engaged in some of the more hands-on activities such as digging holes, planting and watering the trees, because other group members were doing these activities and some of the more passive students became mainly bystanders and observers. Getting physically dirty may also have played a role in some students choosing not to become engaged in activities. Clearly, an important prerequisite for building future versions of the game is to minimise any aspects of the game that might worry children and put them off playing JTF, so this is one area that will need further investigation.

**Question 4. Were you scared by something while playing the game (for example, plants, animals, dirt etc.)?**

Although two students had previously indicated that being scratched by vegetation was something they disliked, neither of these indicated that it was a cause of fear or concern to them. In response to this question only one student (No.1, male) indicated any concern, and this was in regard to spiders.

**Question 5. Do you think that the game encouraged you to become more interested in the natural environment and ecological systems?**
Question 6. Did playing the game at school encourage you to spend more of your own time outside than you would normally?

All eleven students answered question 5 with yes, which indicates that playing the game encouraged the students to become more interested in the natural environment and ecological systems, however four students indicated that the game did not encourage them to increase the time they spent outdoors when not at school, suggesting that one of the game’s objectives had not been achieved for these students. However, given that eleven out of twelve students had earlier indicated a preference for bodily / kinaesthetic learning and ten had said they enjoyed exploring nature and making collections (naturalist learning) the fact that the majority of students (seven) answered yes to question 6 is encouraging. In addition, in the first survey eleven out of twelve students had indicated they liked to play outside on a regular basis, so what constituted an increase in time to these students is not clear. As previously, it would have been valuable to have asked the four students why they thought that the game activities did not encourage them to spend more time outside, exactly how much they already spent outdoors and whether it encouraged them to become involved with any other environmentally related activities instead.

Question 7. Did you enjoy working in a group? What did you enjoy about working with your group?

Question 8. Would you rather play the game on your own? If yes, why?

All eleven students answered yes to this question. Child No. 1 liked working in a group but noted that his fellow team members were sometimes annoying (a real world experience). According to the author’s videotaped observations, this student was typically his group’s leader when engaged in outdoor activities and was also quite insistent on things being done right, for example, requesting that his team be given only native plants for their study area. The student also indicated in question 2 that planning the game was his favourite aspect of JTF, so it may be that his personality played some role in informing this statement. Child No.4 indicated that sharing tasks was important to her: “Knowing that all the work wasn’t just for me.” Four students (three male, one female) identified meeting other or new people and making new friends as being an important outcome of the group work (*Child No. 11 noted this in response to question 2). Given that the majority of students taking place in the trial did not know each at the start of the study (since they were recruited from different classes), the fact that students actively noted this as an enjoyable aspect of the group work was an unexpected outcome. Observations made in Chapter 5 showed that playing the game had a distinctly positive impact on child number three (identified by the teacher as being mildly autistic and as having difficulties in approaching strangers and working with others) and this student was one of the respondents that identified meeting new people as an enjoyable outcome. No students indicated that they would have preferred playing alone, which strongly
reinforces the previous outcome. Both questions highlight the fact that the students liked to work in a group and enjoyed the social aspects of the game. This outcome supports one of the project aims—encouraging players to develop social skills and become better team players.

The next three questions were intended to find out how this group of students thought that computers and mobile devices would enhance or detract from the game. Since this trial had been basically designed to test the game play and game model, little or no use of computers had been made in the testing process and, as noted previously, several students had expressed dismay about this at the start of the trial. The first question was intended to see whether actually playing the game without the computer may have changed their perceptions.

**Question 9. Do you think you need the computer or a mobile devices to play the game?**

After playing the game for several weeks, only five students thought it would be a good idea to have access to either a desktop computer or a portable device to use outdoors, whilst six students thought they were unnecessary and that the magnetic tiles plus the game board and printouts were sufficient. Given the initial concerns expressed by some members of the group about having to work outside rather than entirely on the computer, the experience of working without computers did not seem to make any significant difference in the follow up. Indeed, the general consensus in the follow up discussion was that the game itself was fine but could be enhanced by the use of computers. No students specifically mentioned not using them as the primary means of playing *JTF*.

**Question 10. How could you benefit from having access to a computer that is connected to the Internet in finding out more about things you discovered in the game?**

Although the majority of students said that the computer was not necessary for playing *JTF* as it stood, ten students recognised the potential of using a computer connected to the Internet in conjunction with the game and one did not respond. Four students were uncertain as to how this might be done, answering “I think it would help a little bit,” “I think it would be good” and “I think so,” (two students). Three students simply answered “yes” and three suggested how they would find it useful—“Use it to do research about plants and animals,” “This would be exciting and I could play outside more” and “Going on the Internet and looking at different stuff to research.”

**Question 11. How do you imagine you could use a mobile device such as a mobile phone, a GPS device or a computer notebook in this game?**

One student simply answered “no”, one student did not respond and two students said that they “could not imagine” any application for portable devices. Three said yes and two students gave more in-depth answers. Both of these students identified GPS tracking as
important in helping them navigate and in setting out their game areas, whilst one identified using the computer instead of paper as important and the other mentioned using a phone to ring group members and to take photographs. Given that only one student indicated that they owned a mobile phone and that the first iPad was not released in Australia until May 2010, the results here are not entirely surprising. Blackberry and smart phone devices and some simple tablet style computers were widely available at the time of the study, but it appears clear that the study group were not really familiar with such devices or their potential, although most were familiar with conventional computers and wired modes of Internet access. Many students in advanced countries (at all levels of education) are now totally familiar with accessing the Internet for home work, research and playing and it’s use has become second nature to them. Although these students did not yet understand the potential of wireless connectivity and portable computing, it was clear to the author from his own research that future versions of JTF must include some form of Internet connectivity if the game is to have lasting value to future generations of students.

Questions 12–15 were intended to find out more about the game itself, how it might be improved, what the students would like to change and the overall playability of the game in general.

Question 12. Do you think something was missing (i.e., clearer advice, more structure) in the game? If Yes, what was it that you felt was missing?

Seven students thought nothing was missing in terms of the game structure. One student answered with “yes” but provided no further comments, and three students thought that the game was missing some elements that would make it more playable. One student suggested that the game was lacking in the amount of useful scientific information it provided in the handbooks (this was brought out in the subsequent class discussion in response to the researcher’s questioning), one student suggested that more than more outdoor activities were needed “need to get out there more” and one said that “the environment was not balanced” but could not be drawn on what he meant in the follow up discussion. It was pointed out by the author that the lack of more detailed information at this point was due to the fact the project was using a paper based prototype and that this issue would be addressed in the digital version subsequently produced. As with any database, new material can be continually added and it was intended that the ability to add to the main database should be a key element of future iterations of the game.

Question 13. Did the game make sense to you?

Question 14. Do you think you would play the game in the future if it was available from your school or at home?
All students answered “yes” to both questions and no students elaborated on the questions.

**Question 15. What would you change about the game if you were the game designer?**

Three students replied “nothing,” one student replied “I don’t know” and one student did not answer. Of those that answered more comprehensively, Child No.1 noted that all plants used should be natives “unless they are part of the game” as mentioned earlier. Four students indicated that more engagement in outdoor activities and more freedom to move around would improve the game: “make it more active,” “need to get out there more,” “I will make it that the kids have more freedom” and “I would make it more free to roam.” One student simply answered “yes”. In the follow up discussion the theme of being outside more and having less strict restrictions on where the students could explore or move around during the course of the game was raised several times. The students clearly enjoyed being outside and moving about, but as the teacher noted later, the need to balance supervision and safety, especially with primary school age students is always a matter of concern. This issue of the need for extensive supervision and strict observation of health and safety rules, along with the associated paperwork and legal issues is mentioned extensively in the literature in relation to the increasing reluctance of educators to engage in activities associated with outdoor education and school field trips.

**Question 16. Do you think that playing this game at home would encourage you and your friends to spend more time outside exploring the natural environment?**

Nine students answered “yes” and two with “no”. The question was formulated slightly differently to question 6 (four “nos”) to see how the experience of playing the game itself in their own time may change students behaviour and encourage them to spend more time outside. The increase in yes answers is almost certainly because the game structure requires engagement with the natural environment and requires players to work in teams with their friends. Since all students indicated that they would be interested in playing the game at school or at home in question 13 and the author intends to make the game freely available to schools and students on completion, this is also a positive outcome in terms of the aims of the JTF project.

**Question 17. Do you think that the game helps to bring you together with other children?**

Only one child (Child No.3) was uncertain about the answer to this question, although in answer to question 7 (did you enjoy working in a group) he indicated that “meeting new people” was one of things he enjoyed about playing JTF. All other students answered yes. Even with the limited number of participants, the answers to these two questions strongly suggest that the social nature of the game was an aspect of JTF that was highly valued by the players.
Question 18. On a scale of 1 to 10 (no fun = 1 lots of fun = 10) how much do you think that the game was fun?

Answers ranged between 5 and 10 with an average of 8, suggesting that most students found the game to be enjoyable but in need of improvement. Only one student gave the game a 5 and this was Child No. 3. Interestingly, Child No. 7 (identified earlier as suffering from ADHD) rated the game at 10.

On the basis of these findings, the field observations and the teacher and student feedback, the researcher returned to the studio to amend the game plan and building the first digital prototype. This stage took approximately 18 months and was ready for testing in May 2010.

6.2. Final Game Prototype Testing.
Results of the first day visit questionnaire (May 2010).

In May 2010 the final game prototype was ready for testing at the same primary school but with a different group of students, as the majority of students from the previous study had since moved on to high school. For this trial, the school assigned a larger group of students, based on the positive recommendations made by the teaching staff following the conclusion of the first study. As previously, an initial survey of the students was made in order to identify their preferences, background knowledge and familiarity with computers and computer gaming—although profiling of their learning style preferences was not undertaken as before. 25 valid copies of the two questionnaires were collected before and after the five week period of applied testing was undertaken and no students dropped out of the trial. Due to time constraints within the school, the game was played for only five weeks with one session per week in class time and, as before, the teacher took on the role of game master with the researcher remaining in the background as far as possible as observer.

Based on the outcomes of the first visit, the principal of the school had suggested that it might be a good idea to test the game with a group of students that needed special attention because they included a higher than usual number of students identified as having developed ADHD. Since research studies have confirmed that boys are three times more likely than girls to develop ADHD (Boyles 2004), this might explain why the sex difference in the study group is so unbalanced—17 male students and 8 female students. Table 6.3 outlines the feedback provided by the students in the initial survey and the following section provides a brief analysis of the author’s initial observations based on these responses.
Table 6.3. Initial Survey Results from the First Visit of the Second Trial, May 2010.

<table>
<thead>
<tr>
<th>Question 1.</th>
<th>Do you like computer games? If yes, please tell us why. If no please tell us why not?</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 2.</td>
<td>What is your favourite computer game and why?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 3.</td>
<td>How much time per week do you spend playing computer games?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 4.</td>
<td>Do you participate in any organised sport activities? If so what are they?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 5.</td>
<td>Do you like learning through playing games?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 6.</td>
<td>Do you engage in physical exercise (such as ball games, push-bike riding, BMX etc) just for fun?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 7.</td>
<td>Do you enjoy being outside or in natural places (such as parks, forests or the beach)?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 8.</td>
<td>What aspects do you like about being outside or in natural places?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 9.</td>
<td>What do you NOT like about being outside or in natural places?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 10.</td>
<td>Do you and your family spend time exploring nature for recreational reasons—for example camping or bush walking?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 11.</td>
<td>Do you believe we should care about the natural environment? If yes please tell us why, if no please tell us why not?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 12.</td>
<td>Are you learning about the environment and nature at school at this time? If you are, please tell us what you are studying or learning.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6.2.1. Profile of the Second Trial Students.

19 of the 25 students claimed they enjoyed playing computer games whilst six students indicated they did not like playing computer games at all—of these, three students indicated that the reasons were that they “make your eyes go funny” “I hate it, it hurts my eyes” and that “they make you fat” and three gave no specific reasons. Of the three students who gave a reason, only one indicated they had a favourite computer game in response to the next question (what is your favourite computer game and why?) and this was an on-line Flash game (*Husky Races*) which typically takes only a few minutes to play through. No suggestion as to where the idea that games “make you fat” originated was given, though eyestrain is clearly a personal and distinctly physical factor informing the other two negative responses. Of the three who gave reasons for not liking computer games, each indicated that they were actively involved in organised sports activities whilst the other three indicated they were not. Of the remaining 19 students who said they enjoyed computer games, 12 indicated they were involved in organised sports and seven indicated they were not involved.

On the question of their favourite computer games, five students identified mildly violent or violent computer games, including *Tony Hawk–American Wasteland*, *Jack and Dexter 3*, *Ratchet and Clank*, *Commando 2* and *Modern Warfare 2*. These games range from animated “cartoon” type violence (*Ratchet and Clank*) to highly realistic first person shooter simulated warfare (*Modern Warfare 2*). At the time of writing, in the U.S. *Tony Hawk–American Wasteland* is rated as being suitable for children aged eight and older, *Jack and Dexter 3* is rated ten years and older, *Ratchet and Clank* is rated ten years and older, *Commando 2* is rated 14 years and older and *Modern Warfare 2* rated 18 years and older. Two of the games identified as being regularly played by the students fell well outside the recommended age bracket for the children surveyed. As with the previous visit, post game briefings with the students revealed that many students were very keen to get hold of those games and asked those students who claimed to be playing these games if they could get copies. Ten of the games identified as being most popular were online Flash games of the type identified by students in the first visit, with some new inclusions including: *Husky Racer*, *Snowboarding Supercross*, *Star Doll*, *Primary Games*, *Poptropica*, *Targeting Maths* (an educational site), *Jetpack* and *Commando 2*. Given the rapid growth in popularity of free Adobe Flash games during the period of the study, as well as the increase in bandwidth commonly available to ordinary households, the inclusion of so many new on-line games in the student survey comes as no real surprise.

The average time spent playing computer games averaged six hours and forty-nine minutes, which ranged from six students not playing at all to one playing for 48 hours per week. 15 of the respondents participated in organised sports activities such as *Nippers*. 
(Australian Junior Surf Lifesaving), dancing, boxing, basket ball, Australian Football League (AFL), soccer, swimming gymnastics and tennis, whilst ten students did not participate in any organised sports activities at all. Unfortunately, no students elaborated on the reasons why they did not take part in any sports activities, although they were encouraged to do so in the survey. However, this does not seem to the author to be an unusual outcome, given that many Australians actively choose not to be involved in organised sporting activities and seek other recreational or intellectual pursuits instead.

21 students indicated that they enjoyed learning through games (including games not played on the computer). Two did not like learning through games and two did not answer the question. Six students that previously stated they do not like computer games were amongst the students who like learning through games. On the other hand, the two students who did not answer this question plus the two students who did not like learning through games enjoyed playing computer games, suggesting that games that are specifically identified as containing educational content are being associated with either not being “fun” or possibly too challenging. Of these four students, all but one (Child No. 18, female) engaged in physical exercise outdoors “just for fun” and this student took part in organised swimming. Being a competitive swimmer demands extensive commitment and can sometimes become quite tiring for those participating in regular training—and this may well explain her response.

All 25 students in the survey liked to be outside or in natural places and the counter question “What do you NOT like about being outside?” was not answered by any of the students. Also a high number of students (23) spent time with their families outside exploring nature for recreational reasons. The two students who did not spend time with their families engaged in outdoor recreational activities indicated in the follow up discussion that were involved in organised sports activities which took up a lot of time both for the parents and the children (one was training to be a dancer). Students provide a diverse range of reasons for their enjoyment of the outdoor environment, including six who enjoyed going to the beach and water based activities (the school is one kilometre from the beach on the Sunshine Coast, so this would not be unexpected), five who identified the fresh air and three who mentioned being in nature. Other reasons were the opportunity to be active and move around, space to ride bikes and skate or just being active and playing with friends.

All students thought that we should care about the natural environment. Seven students identified the need to care for the environment specifically in order to care for the animals and, according to Acredolo and Davis (2011) children are attracted by animals from an early age on. Other students provided more practical reasons for saving the environment, including the need for oxygen and fresh air needed to keep humans alive and purely aesthetic reasons “It
is beautiful and I think it would be sad to see it go” and “We have a lovely world.” One student believed that we have a duty of care because “God made it for us” and another student simply noted “Because you have it” which suggests an awareness of a personal sense of responsibility.

Since this was early in the semester, the questionnaire also asked whether the students were learning about the environment and nature at school (they were as part of the ELs) but only five students thought were learning about it and 19 thought they were not. The low number of students that had not made the connection or were unaware that they were studying environmental issues was surprising.

Overall the second round study group largely reflected the interests and profiles of the first test group, although as noted earlier this group of students were pre identified by the school as having a higher than usual number of students with some form of learning disability, predominantly ADHD. Although this survey did not profile students according to their preferred learning styles based on Gardner’s intelligences, the remaining questions were similar to those asked in the initial survey. This group had a noticeably higher number of students who identified themselves as not liking computer games (6/25 as opposed to 1/12) although the average time spent by those who did play was significantly higher (six hours 54 minutes as opposed to one hour 30 minutes)—though these times are significantly skewed by the two students who claimed to play for 48 and 28 hours per week respectively. Even taking these two students out of the calculation the seventeen remaining students who played games spent on average four hours and three minutes, with the maximum number being 16 hours per week and the minimum being one hour. In the second group, only one identified favourite game (Call of Duty: Modern Warfare 2) rates as MA15+ as opposed to three games identified in the first group as being rated MA15+ or higher. As with the first group, almost all students said they enjoyed being outside (only one student in the first group did not like being outdoors) and most of the identified supervised and non supervised activities the students participated in were largely similar, with respondents from both groups mentioning the ability to move around and having space around them as being major factors in their enjoyment of outdoor activities. It seems fairly evident from the study that providing adequate space and the opportunities for physical activity is important to younger students and this is certainly in keeping with the existing literature.

6.2.2. Questions and Findings, Final Game Trial.

At the end of the final game trial the students were asked to fill in a questionnaire consisting of 31 questions related to their experience with the digital game prototype. In association with the author’s observations of the game being played, the results of the questionnaire provided feedback on what aspects of the game had worked, what did not work
and what else needed to be added to the game from the student’s own perspective. However, unlike the first trial, only written observations, discussion notes and some photographs were available to document the game in actual use and this must be taken into account when the results are analysed. As before, during the informal discussion following collection of the questionnaires, the students were asked a number of questions based on the author’s preliminary analysis of the questionnaire. Appendix C summarises the student’s responses to the survey conducted during the last visit. As before, incomplete answers or uncertain answers (such as I don’t know) are classified as being in the negative range and are shown in pink on the table. The following pages provide an overview of the student’s responses and an analysis and interpretation of the findings.

Question 1. On the list below, which line best describes how you liked playing the Jumping the Fence game?

20/25 students gave the game a positive rating, with 11 students indicating they enjoyed the game a lot and would download it to play in their own time, three students thinking it was good and would also download it, whilst six rated it as “OK” and said they would play it again in class time but not their own. Of the remaining five students, four thought it needed improvement and if it were improved they might consider playing it again in class and one student said they did not enjoy it at all and would not try playing it again. Of the five children who did not like the game, three were female (Children Nos. 5, 7 and 15) and two male (Children No. 6 and 10). Child No. 12 (male) should probably have classified himself as not liking the game, since his responses to most of the other computer game related questions were generally in the highly negative range.

Of the five students who identified as not enjoying the game, all said they enjoyed the computer-based component more than the outdoor activities. Child No. 12 (the “sixth” student) liked going outside and finding animals but did not like the computer based component. This group of six students all indicated that they did not like the graphics, characters and colours used in the game, although none said they had technical problems in navigating and interacting with the game. They also claimed not to have learned about biodiversity or what a biotope is from the game although all but Child No. 12 said they now liked to care for the biotope and Children Nos. 5, 10 and 15 said they believed that they had interacted more with the natural environment since playing the game.

The same five students (not including Child No. 12) indicated they would not recommend the game to their friends, mainly because they thought it would be thought of as boring by their peers. Child No. 12, having been very critical and negative about the game and the game experience later stated that she understood the purpose of playing JTF and that
she believed it would help the environment and, for this reason, she indicated that her friends might also enjoy playing it. Even in the follow up discussions, it was not made clear why some of her answers contradicted each other. Of these particular students, four also did not like group work, a key part of the JTF game play.

**Question 2. Which parts of the game did you like the MOST?**

Seven students specifically nominated the computer related activities such as the quizzes and online learning components whilst and nine listed the outdoor related activities. Three students said they enjoyed all of the parts of the game and five did not answer the question. This appears to be a fairly balanced outcome which supports the mix of indoor and outdoor activities as applied in the JTF game.

**Question 3. Which parts of the game did you NOT like?**

Eight students responded to this question, two did not like the Kangi the kangaroo character, one student thought the texts in the introduction movies were too long and Child No. 7 did not like “all of it”. Child No. 8 thought there were not enough plants and animals in the game tool box to choose from and Child No. 22 preferred to work on the computer and did not like going outside, which is in keeping with his overall profile. On child provided an ambiguous answer (“nothing”). 17 students did not give feedback and were mainly students who either enjoyed the game a lot or thought it was OK.

**Question 4. How did you like the look of the characters and the graphics that make up the different parts of the game?**

16 students rated the graphics and characters as being in need of improvement, rating them as either “Not liked at all” (2), “Some were OK but some were not” (8), and “OK but could have been better” (8). Only nine students gave them what in the author’s opinion is a nominally positive rating (“The graphics were good”). Clearly more effort needs to be put into user testing in regard to the graphics and characters, especially since two of the students who rated the game poorly earlier specifically noted that they did not like the kangaroo character. The outcome here points clearly to the need for game designers to work closely with graphic designers and illustrators and illustrates the author’s earlier contention that effective educational game design is beyond the capacity of any one highly motivated individual.

**Question 5. How did you like the introductory movies and tests?**

The response to this question was slightly better than that given in the previous question. Eight students thought the animations and quizzes were “good” and 12 students thought they were “OK but could be improved.” Two students liked them “only slightly” and three did not like them at all. Although the results suggest the introductory animations and test were
appreciated by a greater number of students, there is clearly need for improvement. Given the visual literacy of students in this age group and the sophistication of the game graphics they are used to at home when playing professionally designed and produced games, the results of these two questions come as no real surprise to the author. As noted in the last question, the outcomes point strongly to the need for games to be designed by teams of professionals, rather than individuals.

Question 6. How did you like the interface and colours of the game?

Nine students liked the colours and interface “A lot,” six students classified the colours and interface as “Good” and six thought they were “OK but could be better.” Three noted that the colours were “OK but some were not” and only one student (Child No. 12) did not like them at all. Overall, 15 students indicated they generally satisfied with the interface and colours whilst ten students suggested improvements could be made.

Question 7. Did you have difficulties in finding out how the game worked? If Yes, what made it hard to understand? What were the difficulties you had while playing the game? Your answer to this question will help us in making the game easier to play for other students in the future.

Only two students indicated they had difficulties with the game, one stating that “it was confusing” and one simply answering “Yes.” No further answers to this question were given during the final discussion with the students, so the problems encountered by these students remain unclear.

Question 8. Did you have to use the help section?

Question 9. If you answered Yes, how helpful was it to you? 1 = Not very helpful. 2 = Only a bit helpful. 3 = Helpful. 4 = Very helpful.

Only one student had to use the help section (Child No. 25) and he indicated it was that it was helpful (3). Nine students looked into the help section with two students rating it (2), five students rating it helpful (3) and two students rating it (4)—very helpful. Of the nine students rating the help section, seven students thought it would be useful.

Question 10. Did you experience any technical problems with playing JTF, such as buttons not clickable, animations not working, computer crashing etc.? If yes please tell us what the problem was.

Only one student experienced technical questions and had to use the help section, which he rated with a value of 3 (helpful). The student did not make any comment about what kind of problems he encountered.
The next set of questions looked into game play related themes rather than technical or graphic related topics.

**Question 11.** Did you enjoy having to take on a role in the game (i.e., the scientist, the environmentalist or the park manager)? Can you tell us what you liked about doing this?

21 students indicated they enjoyed the role-playing aspect of the game, two students did not enjoy the role-playing and two did not respond. Overall, the role-play was perceived positively and two students noted “It made me feel like a happy person” and “It made me feel happy” whilst one student observed: “It made me feel like I was really an environmentalist”. As noted in the literature, role play in the educational context allows the player to take on alternative roles that they may not encounter in daily life and experiment with them in a safe and non-threatening environment, as is often done in on-line games (for example, Barab et.al. 2005) so it was pleasing to note the clearly positive response to this question and even Child No. 12, who normally gave negative answers to most questions, indicated that he enjoyed having taking on different roles in the game. In retrospect, it would have been of interest to find out which roles the children preferred of the three roles available and whether these could have been better described.

**Question 12.** During the game play, did you interact more with the natural environment, than you normally would do? Can you tell us why or why you didn't?

21 students thought they had interacted more with the natural environment than they normally would have done and four answered in the negative. Of the latter, one was unsure of whether or not they interacted more and one noted that she already spent time outdoors anyway. However, two other students also indicated that they already spent time outdoors: “I already do these things” and one said she now did after playing the game because “I have never done it before.” In the vein, it appears that JTF played some role in encouraging players to spend more time outdoors: “I [now] look more at animals than usual,” “I look outside for animals and plants,” “Yes, I never really knew much about the environment,” “I see more insects than at home” and “I like animals.” As before, the pleasure of being outside and the resultant happiness experienced whilst playing the game is repeated with students noting: “Because it [JTF] was fun” and “Yes, I’m happy.”

**Question 13.** Do you think playing Jumping the Fence enhanced your understanding of the Australian Environment? Please tell us why or why not it helped your understanding.

11 of 25 students thought that their knowledge about the Australian environment was not enhanced by playing JTF, although two of these did not respond to the question and are therefore counted in the negative. Nevertheless, this result shows that the content or how the content was delivered needs further review and improvement since, even with the most
optimistic interpretation, only about two thirds (16/25) identify themselves as having actively benefitted. In respect to this outcome, it is the author’s contention that the time students were engaged in playing JTF in the trails may have been too short, however more trials are needed to prove or disapprove this assumption. Student feedback, when provided, seemed to emphasises direct engagement with the environment as being the main factor informing their response: “I learned a lot about compost”, “I learned that animals are very special”, “it (the environment) has lots of animals that I did not know”, “(I) learnt about ants in the sand hills and the grass” and “you can find things in the trees and what kinds of spiders there are.”

Question 14: What else would you like to learn about the Australian wildlife?

The responses to this question demonstrate the natural curiosity inherent in young learners and the considerable diversity of their interests. This question showed that the students who responded were primarily interested in Australian wildlife and wished to learn more about “food chains”, “how they [animals] strike their prey”, “dingoes”, “other types of animals”, “where the best place is for koalas”, “Australian birds”, “insects”, “more species and their habitats”, “what platypus eat”, and “animals” in general. Subsequent discussion revealed a high level of interest in more exotic native animals not commonly encountered in the student’s local environment, suggesting that those already familiar were often taken as being a normal part of the their daily lives. Dingoes, platypus, spiders and snakes (snakes are not uncommon in the area) seemed to predominate the discussion. Perhaps the most interesting answer comes from Child No. 20 (female) who wanted to know “how the sky works” which implies a deeper level of curiosity and suggests to the author that the learning content could be broadened in future versions to take into account subjects such as meteorology, geology, chemistry and physics. Of the 10 students who indicated there was nothing more about the environment they wanted to learn, six answered that JTF had not improved their understanding of the environment (Children Nos. 5, 10, 12, 14, 21 and 23) in response to the previous question and all but Child No.12 answered the next question in the negative.

Question 15. After having played JTF do you know what biodiversity is?

Only eight students replied that they understood what biodiversity is, with only two explanations being given: “More plants and animals means biodiversity” and “More nature.” Some confusion amongst students about the meaning of the terms biodiversity and biotope is evident though, with Children Nos. 7, 13, 19, 20, 21 and 25 providing answers opposite to their response to the following question, which is closely related.

Question 16. After having played JTF do you understand what a biotope is?

Only eight students claimed to know what a biotope is after having played the digital game and answering a test specifically addressing the subject. Again, this is result makes it clear
that using a short animation and follow up test early in the game in order to introduce certain concepts is not effective unless there is continued reinforcement and testing of the knowledge during the subsequent gameplay. It is also possible that the animation covering the topic was too complex and could have been broken up in smaller animations with more iterative testing. As well, by making the learning experience more situated, the topic could have been further explained and explored in required activities whilst the students were outdoors.

Question 17: Do you like caring for your biotope?

Oddly enough, 22 students said they enjoyed caring for their biotope, even though 17 did not know what one was in the previous question. Across the three questions (15–17) only five students gave consistent answers—these five students knew what biodiversity and biotope meant and, of these, three said they enjoyed caring for their biotope and two did not (Children Nos 1, 12, 18, 22 and 23). Even so, the majority of indicated they like caring for their biotope, suggesting that they understood there was some connection between the word and the area of the game they had been allocated. Reasons provided include “It is fun,” “I can plant more plants,” “I like plants and animals,” “To see more animals, that is fun,” “It would help the environment” and “It gave me self pride.” Of the three students who said they did not like caring for their biotope, two of them clearly fully understood the question (Children Nos. 12 and 23) so it is unfortunate they did not provide any reasons in response to the question.

Question 18. How would you rate the level of fun you had playing JTF?

1 = Not fun at all; 2 = A bit of fun (OK); 3 = Fun; 4 = A lot of fun. To help us improve the level of fun in JTF, can you make any suggestions as to what we should do?

18 students indicated they found the game to be either great fun (10) or fun (eight). Five students rated it as “a bit of fun”, one student indicated that it was not at all fun and one student did not answer the question (again Children Nos. 12 and 23 respectively). Given that the majority said they had fun or great fun playing JTF, the response suggests that the game strategy was generally enjoyed. As the literature demonstrates, fun is an important element in game design which keeps players motivated and, in the learning and teaching environment allows for better learning outcomes.

In response to the question “To help us improve the level of fun in JTF, can you make any suggestions as to what we should do?” the suggestions ranged from “Change readings into talking” which might help this particular student with the learning content more effectively, to “Growing more plants” “Put more animals in the game,” “Let us make our own environment and put animals in it” and “You should go on a bus to go to places and find more animals.” In a number of questions throughout the survey responses continually indicate that planting and maintaining the space and seeing, learning about and, most importantly interacting with
animals were key factors driving the interest of the students. One student identified Kangi the kangaroo guide as an issue: “Don’t use a talking kangaroo” which was also noted by two students in response to Question 3. Three children clearly did not like Kangi, and it would be worth following up this issue further—although a colleague suggested the children did not like Kangi because she looks like Tim Burton’s 1990 character Edward Scissorhands, with her long extended claws. One child suggested that the tool box tool needs improvement—instead of browsing to the text description of an animal, the text description should pop up when a player clicks on the animal, which makes good sense. “Changes the questions a bit” refers to the predictability of questions in the test, most correct answers had longer answers than the wrong ones and, as noted earlier, this was picked up by many children fairly early in the game play. The student that suggested going on a bus to places and finding animals there rather than staying at the school is also providing a valuable insight, in that visiting other areas would give the students the chance to investigate different biomes and use the results to compare biodiversity and wildlife. This would enhance the learning tremendously.

Question 19. Would you recommend JTF to your friends? If you would please tell us why. If not, please tell us why not?

18 students indicated they would recommend the game to their peers and seven said they would not. All of the students who rated the game at two or less in the previous question indicated they would not recommend the game to their friends, with two students not recommending the game because their friends might think it was boring (Children Nos. 5 and 10) and two students suggesting their friends would not find it interesting. Children Nos. 2, 13 and 17 gave rather unexpected answers which provide some insight into the student’s peer relationships. Child No. 2 said he would not recommend the game “Because my friends would hate me not to be cool” whilst Children Nos. 13 and 17 suggested “I would like to keep it a secret” and “Because they [my friends] would play it all the time” which also implies they enjoyed the game but would prefer to keep it to themselves.

Reasons for sharing the game include: “It is cool and they might like it,” “It is a fun game with lots of questions,” “Because it was awesome,” “Because all my friends love nature,” “It is fun and lets them learn about the environment,” “It is a good fun computer game and is teaching the kids a lot,” “It would be a good thing for them to play,” “It made me interested in the environment” and “Because I learnt stuff.” The focus of those statements clearly emphasised the fun and educational value students perceived themselves deriving from the game. Overall, the results and comments provided in this question suggest that the game left a positive impression with the students and that the majority would happily share the game with their friends, although a small number perceive the game as being a little too “uncool” to share with their peer group for some reason not provided.
Question 20. Do you think playing JTF would encourage you to spend more time outdoors being engaged with the natural environment in the future? If so please tell us why. If not, please tell us why not?

17 students answered yes and seven answered no. One student giving a yes answer put forward the obvious reply—“Because it is an outside door game.” Other responses included “So you can find more stuff,” “Because I learned stuff,” “Animals are interesting” and “It [the natural environment] inspires me,” “I can learn more about the environment,” and “It made me more interested in the environment” all point to an appreciation of the educational aspects of the game, whilst “Because you will get lots of fresh air,” “Because it was cool,” “It is more fun,” and “You feel forever good” suggest the sheer enjoyment and “fun” of being outdoors are a significant factor in why students enjoyed the game.

Eight students indicated that JTF would not be encourage them to spend more time outdoors, although this seemed to be more to do with their own preferences than the game itself: “I like to stay inside and play,” “Because outside is nil,” “It is no fun being outside,” “I is not fun going outside,” “Because I get headache outside,” and “Because people get bossy.” It was noted in the author’s field observations that Child No. 25 had been pushed around to a degree by his group members and it is clear from this last response that this had left some negative associations with the game. Why such a large number of students (8/24) identified themselves as not liking being outdoors in general and five specifically responded in such negative ways to the experience of being outside is a question that certainly needs further investigation.

Question 21. Did you like working in a group? If so please tell us why. If not, please tell us why not?

14 students enjoyed working in a group and 11 students did not. Students who enjoyed the experience gave the following responses: “You can get help from others,” “Because I can meet my friends,” “Because it is more fun. But there were too many people,” “Everyone worked together,” “Together you find more things” (four students gave variations of this answer). Three students specifically identified the fun aspect of working in groups whilst social interaction and teamwork account for seven responses. Of the 11 students who did not like working in groups, comments included: “Because we are all together,” “Because everything took longer,” “Because we can play it ourselves,” “It was annoying,” “It was really the people in the group”, and “It was too noisy”. These comments seem to suggest that students who prefer individual styles of learning or who found themselves in mismatched groupings found the gameplay model of JTF to be an unrewarding experience. Although it would be normal for such students to be found in any normal distribution of students, it may be the case that the game master (teacher) might have to be made initially responsible for the formation of the groups, using his or her knowledge of the students as the basis for
the initial selection. As the author knows from his personal experience as an educator, group composition and dynamics can sometimes have significant impact on individual student performance.

**Question 22. Do you discuss your game experience with friends, group members or teachers and family?**

This question was designed to see whether the game influenced the students enough that they might want to actively talk about it with other people close to them. 13 students indicated they spoke about the game with others, 10 students said they hadn’t and two students did not answer the question.

**Question 23: Do you think the game helped you to get to know other children better?**

14 students replied yes, nine answered no and two students did not answer the question. Only two children who answered in the negative provided comments: “I just did not like the game” (Child No. 7. female) and “Because you play it only with your own class”. The former student was consistent in her rating of the game (2—”a bit of fun,” “boring” “outdoors is nil” and did not like group work “because we are all together”) whilst the second student’s response reflected the fact that only one class played the game as opposed to the first trial where students were drawn from several classes. When the question was initially formulated, it was not known to the author that the students taking part in the second trial would all come from a single class and thus already know each other.

The children who thought they made a connection to other children provided varied responses: “Everyone would like to play the game,” “You need them to find things,” “Because they can help you,” “You learn with the children,” “It is cool to have a special place to share” (Child No. 19, female) and “You learn something off them.” These students clearly recognised the value of teamwork and sharing, whilst Child No. 19’s observation “It is cool to have a special place to share” stands out. In the author’s analysis, it suggests that the research area had become a special place to that student and, as such, one worth sharing with her peers.

**Question 24. Would it be correct to say that caring for your biotope brought you closer to your team members?**

This question was intended to support the previous question. 16 students thought the game brought them closer to their team members and nine thought it didn’t. Of the latter, eight had said no to Question 23 whilst Child No. 9 (male) had said yes, providing a contradictory result. In essence, approximately two thirds (14–16) of students thought that the game playing experience had a positive effect on their personal relationships with other class members.

**Question 25. Do you believe that caring for your biotope has helped you develop a sense of responsibility for the natural environment?**
23 students thought that they had developed a sense of responsibility for the natural environment and two students thought that they did not (Children Nos. 12 and 23, male). Even though the majority of students indicated previously they did not understand what biodiversity or biotope means, the students were aware of the intent of this question and answered in the affirmative. On the basis of this question and the response to Questions 15–17, it appears clear that the idea of using the game to help develop a sense of responsibility and respect for the natural environment did in fact work although the students had not learned the terminology. In the author’s view, such a sense of responsibility is essential for the development of a future society that will take care of the planet and will preserve natural landscapes and native species for future generations.

Question 26: What activities did you most enjoy in playing JTF?

Eight students did not answer that question and 17 students provided comments. Nine students specifically noted the outdoor activities whilst seven students liked the computer component of JTF and the quizzes and questions and one noted simply that she “liked learning.” Again, this supports the idea that an effective learning game should cater for the learning preferences of a diverse range of students by offering a mix of computer based game activities combined with outdoor physical activities.

Question 27: What activities did you least enjoy in playing JTF?

Six students responded to this question and 19 did not answer. Two students indicated that they did not like the introductory animations and one student replied “trying to get to the computer with the kids,” a problem caused by there not being enough computers in the classroom for all the students. The other three responses were “Filling in the questionnaire” which was not a game related task, “The arid biome we had to work in” and “I don’t have one.” The second student here is referring to the research area used in this test, which she indicated later did not have enough animals and plants to begin with. This is an interesting response since a key aim of JTF is to enhance the biodiversity of the game area and, in the longer term this would have improved if the game play was extended over some months.

Question 28. On a scale of 1 to 5, how well do you think the rewards system worked?

1 = did not work at all; 2 = worked only occasionally; 3 = worked OK; 4 = worked well; 5 = worked very well.

15 students did not answer the question, two students thought it worked very well, three students thought it worked well, three students rated it as being OK, one student thought it worked only occasionally and one student thought it did not work at all (Child No. 12). The reason why so many students did not answer the question might be that the rewards system was used only once during the trial where the prize was plants for their research project (all
teams received plants). To test the reward system of JTF in more depth the game needs to be played over a longer period of time.

**Question 29: Do you think the rewards system was a major incentive to help you play the game better?**

15 students did not answer, two students said no and eight said yes. Only one student provided feedback: “yes it helps you learn.” Again, this is due to the fact the system was used only once and students had little experience of the rewards system in use.

**Question 30: What should happen to your biotope once you leave this school and cannot play JTF any longer?**

Nine students did not answer and one indicated he “did not know.” Ten students indicated that they should nominate someone to look after the area and keep it alive, with such responses as “I would leave it in the hands of someone I trust,” “Get a younger student to take care of it” and variations of “They should get someone to look after it.” Three students took a more pessimistic view: “It would break,” “It would die” and “It will die.” All students that replied demonstrated their awareness of the consequences stemming from no longer caring of their research area. One student gave the cryptic response “We would learn no hands on.”

**Question 31. On a scale of 1 to 5, how well did you like the way outdoor activities and computer activities were blended together in the game?**

1 = did not work at all; 2 = worked only occasionally; 3 = worked OK; 4 = worked well; 5 = worked very well.

18 students rated the blended game approach between worked OK and worked very well: seven students thought it worked very well, seven students thought it worked well and four students rated the blended approach as OK. Three students thought the approach worked only occasionally and two students said it not work at all (Children Nos. 7 and 12). Overall seven students did not like the mixing of outdoor and computer activities. Of the six students who indicated they did not like being outdoors in Question 20, only two (Children Nos. 7 and 14, female) gave negative ratings to this question (1 and 2 respectively). Children Nos 3 and 17 rated the blended learning as a 5, Child No.9 rated it 4 and Child No. 15 rated it 3.

**Question 32. Would you prefer not to go back to the computer based game and access the game via a portable computer device such as a mobile phone or hand held computer?**

22 students answered yes and three answered no. Comments included “It is easier to get information,” “It takes too long to go back,” “I would be able to play JTF on site,” “To have the game in your hand,” “So you need no computer,” “Yes, I would like to bring memories” “It would be more like a Nintendo DSI” and “Because it would be more fun.” Three students answered no but only one student gave a reason: “I don’t use one.”
As noted in the first trial, very few students of this age group own their own mobile phone (although the results may be quite different in other countries and in more recent years). In this survey question, only one student referred directly to owning a phone (Student No. 8, female) and it is a fairly safe assumption that many of the students may have been unfamiliar or only slightly familiar with some of the features and possible uses of today’s generation of smart phones. In addition, the iPad and other tablet style computers were still relatively uncommon in 2010 (the iPad 1 was released in Australia after this trial took place) so many of the students may have had only a partial understanding of the potential of such devices. Nevertheless, being Digital Natives, the majority of students still recognised the potential of using mobile devices to access and record information in the field and were open to using such tools if they were available. The result support the researchers contention that incorporating portable computer devices in future versions of JTF would enable the students to play the game entirely outside. Other comments provided by the students suggest they are quite aware of the benefits of mobile computing.

6.3. Discussion.

The results of both questionnaires suggest that the idea behind the Jumping the Fence game is valid and that it is possible to design a computer based learning game that requires students to leave the classroom and spend more time outdoors engaging with the natural environment. It is also relatively easy to encourage students / players to take on the role of active researchers rather than passive observers, given that many are already familiar with role playing games based on their existing experiences of computer games. In taking on their roles, the students clearly developed an understanding of what a biotype is (even though very few of them were aware of most of the correct terminologies) and, in so doing, most developed a sense of responsibility for, and personal connection with, their research areas. Overall, students indicated there was a high level of pleasure associated with playing JTF, with 20 students saying they enjoyed the game and four saying they would play it again with some changes. Quotes such as “It made me feel like a happy person” and “It made me feel like I really was an environmentalist” suggest that the strategy of using role-play in the game is workable and that it provided students with a sense of both responsibility and pleasure.

To the author, perhaps the two things that came across most strongly from both groups were the enjoyment and pleasure of being outside away from the constraints of the classroom, and the sense of attachment the students clearly developed for the area used in the study. Student responses such as “It made me feel like a happy person,” “Because it is an outdoor game,” “Because you will get lots of fresh air,” “Animals are interesting,” “You can find things in the trees [such as] what kinds of spiders are there,” “It inspires me,” “I can learn more about the environment,” “You feel forever good,” “It made me more interested in the environment,”
and “Because I learned stuff” suggest that students are not adverse to learning when fun is involved and that they are already aware that being outdoors and “fresh air” are synonymous with better health and well-being. Students also showed a high level of interest in caring for their allocated area, with reasons ranging from the hands on: “It is fun,” “I can plant more plants,” “I like plants,” “I love animals and plants” to the more practical and personal: “It would help the environment,” “It gave me self pride” and “I learned that they are [all] special”. All but three of the students agreed that having played JTF would encourage them to interact more with the natural environment, although only 14/25 of the students in the second group thought that playing JTF had enhanced their knowledge about the Australian environment.

Practical, hands-on activities and tasks which made visible and long lasting changes were most popular with the students. Almost all enjoyed the planting and weeding activities and anything that required physical effort—and this was highly evident in the activities videotaped during the first visit, with the students appearing to be most focussed and at their quietest during at these times. Anything that involved seeing or interacting with animals, insects or birds also rated highly and student feedback supports this extensively. Several students commented on wanting to see more animals and one specifically requested field trips for this purpose. No students indicated there were phobias associated with this interest, with composting, worms, where ants live, the different kind of spiders in the area and dingoes all being mentioned as being of particular interest in the surveys. However, further research and testing is needed to find out why only half of the students believed that JTF improved their knowledge about the Australian environment. It is possible that the time students played JTF in the trails was too short, but it is also worth noting that most of the plant and animal species covered in the game were not of the venomous or dangerous type (perhaps I should say “interesting to 8–12 year old children”). More trials would quickly prove or disapprove this assumption.

Giving students custodianship and a duty of care for their study area is an important part of the JTF game strategy, as it requires the application of physical effort as well as the utilisation of appropriate knowledge. Many children by this age have already developed an appreciation for nature and it is therefore relatively easy to encourage most children to become involved in JTF’s activities. However, an unexpected outcome of the second study was the number of students (8/24) who specifically identified themselves as not liking being outdoors or who found the experience stressful—as indicated in response to Question 20. Responses such as “I like to stay inside” “Because outside is nil,” “It is no fun being outside” and “Because I get headaches outside,” were quite unexpected. Although it is perfectly normal for some children to prefer being indoors, it seems that having one third of the students so actively not liking being outdoors is either an aberration (which I suspect may have something to
do with the composition of this particular group) or is an indication that changing trends in society may be influencing this outcome. There is a lot of anecdotal evidence suggesting that contemporary children are leading much more protected lives than in the past and that current concerns over “stranger danger” and health and safety issues are bringing about a culture in which children are over protected both at home and at school. As noted in the literature review, educational researchers have already pointed to the fact that outdoor education is falling from favour in the UK and USA due to legal, health and safety and bureaucratic restrictions (for example, Learning and Teaching Scotland 2010 p.24, Morris 2003 p.3). It would certainly be unfortunate if this is indeed indicative of a long term trend, although it would be interesting to see whether playing JTF over a longer period might change the attitude of some of these students to being outdoors.

Although one third of the students in the second study group identified a dislike for being outdoors, the actual behaviour of the students and their responses to the outdoors were often somewhat different. For example, one student became quite scared by a Golden Orb spider that was living in the research area her group had been allocated. The other two students in her team showed off their bravery by carefully catching the spider and taking it away from the designated study area, demonstrating how well the team worked together and illustrating team spirit by not excluding the team member because she had shown signs of fear. As noted in the last Chapter, the girl did not comment on the incident in the follow up survey, suggesting that it had either been forgotten or overcome as an issue in her mind. In the same vein, it was noticed that the initial fear demonstrated by many students in relation to getting dirty or sitting down on rocks and the ground diminished quite quickly and soon disappeared almost entirely (other than natural caution). In just a few weeks, initially conservative students began exhibiting more adventurous behaviour such as balancing on fallen branches and running through the buffer zone—which was full of spider webs and jumping ants.

In both trials of JTF, many of the students clearly developed a sense of responsibility for, and connection with, both the research area and the natural environment in general. In both trials, the author noted that students often acquired personal spaces in their study area, such as a favourite log on which to sit or a favourite spot in the shade, to which they returned in every session when time permitted (some students reported that they sometimes went there at lunch time and breaks with their friends). The students were also very concerned that their biotope would not survive after they left the school (in follow up discussions it seemed to be understood that they would continue to care for the area in their own time after the project was finished) unless arrangements were made to have other students look after it in the future. Several students proposed that responsibility should be passed on to younger students and one student argued that it needed to be someone who could be trusted in the long term,
a statement which demonstrates not only how closely the students had become attached to their study area, but an awareness of the longer term needs of the environment they had nurtured.

In the 2008 study, students were asked if mobile computing devices might be of use in playing JTF. At that time, only half of the students thought that JTF might be playable on mobile devices. Since the first prototype was played using a paper based model, the connection to how it might work on a computer may not have been well understood, even though the students were quite familiar with computer based games and could understand how the game would work as a computer game. However, by the time of the 2010 trial, the majority of students thought that it would be advantageous to use mobile devices such as smart phones and tablet computers to play JTF and that a mobile device would enhance the game by providing instant access information in the field. Several students suggested that the entire game should be ported to a mobile format for this reason (and also because it meant spending more time outdoors). The students noted that it would be easier to get information directly from the Internet in the course of the game play; but many students argued that mobile devices would not only speed up the game play, they would enable them to stay outdoors all the time. It was quite clear from both written student feedback and follow up discussions that being outdoors and away from the classroom was a major attraction of playing JTF for both groups of students. Both groups also recognised the value of digital photographs and video recording and noted that by having the game continuously available and being able to instantaneously input and retrieve information from the computer would increase the level of fun.

It is the author’s opinion that the rapid development of mobile technology in the eighteen months between the game trials was a significant factor in the changing opinions of the students. Although mobile devices were commonplace in 2008, they were still expensive and used mainly by professionals, with the Blackberry line of Personal Digital Assistants (PDAs) being perhaps the most familiar of devices of the time. However, the introduction and widespread popularity of the Apple iPhone, which was released in early 2007, made significant inroads into the consumer market and, by 2010, it was both common and highly popular. Most primary school age students by this stage would have seen and possibly played with such a device and the ability of most smart phones by this time to act as a camera, video recorder, web browser and media player was quite familiar to most users. This trend towards mobile computing and the use of portable devices is clearly set to increase. However, in the interests of equity, it is essential that schools provide mobile computer devices and make them available to children through the school library.
During the outdoor game play it was quite clear that the students communicated with each other far more extensively than they did in the classroom—which is entirely natural. High level communication between team members, as well as other groups, was continually observed during the outdoor activities and it was common for students to move between groups to observe how they were progressing, share any unusual findings, follow up on their friends and, on occasion help out on projects that required extra assistance. However, it was also observed that some less outgoing students were sometimes overwhelmed by other, more dominant team members and ended up as bystanders or becoming obviously frustrated. On several occasions during both trials some evidence of minor friction developing between team members became evident, although never seriously. Often these incidents occurred when there was considerable activity and pressure on teams to complete tasks within a certain time frame, although in the second trial, it was evident that one team simply did not get along. It is clear that the teacher, as game master, needs to be fully aware of potential problems and whenever possible should restructure groups where conflict is identified. Realistically, however, it must also be acknowledged that the increased pressure on the teacher when working in a more unstructured environment can also mean that it is much more difficult to spot such issues as they develop.

Several students commented on the content of the introductory quizzes, noting that they found that the content was too heavy on text and that it should be more image and animation based. Several students said they specifically did not like Kangi the Kangaroo, which the author acknowledges as being a reflection of his drawing and animation skills. It is clear that in future versions it will be necessary to working with a professional illustrator as part of any character development process. Nevertheless, most students had little or no difficulty understanding the key concepts of what an ecosystem is and what a biotope is, although some misunderstanding about biodiversity was evident, with only 16 students being able to answer questions correctly about what biodiversity means at a later stage. The key issue appears to be that the students seemed to understand the concepts, but failed to learn the correct terms, something which needs to be followed up on in later work. Both student cohorts were able to judge if the research area was in a healthy balanced state and were able to draw conclusions as to what strategies needed to be developed and implemented to enhance the health of the system and thus make connections to the meaning of biodiversity. The teacher who observed the students engaging with the learning quizzes later told the researcher that the quizzes were too long for the age group and needed to be made shorter, but that there should be more of them. In addition he noted that some of the scenes moved too quickly in making the transition from one scene of the animation to the other, whereas slowing down the transition would provide more time for the student to absorb the content before moving forward.
Several students indicated that they had been able to predict the correct answers based on the length of the questions and answers, with correct answers typically being longer than incorrect answers. This was certainly a failing on the author's part and demonstrates the need for working much more closely with the teachers during the developmental stages. Although the draft questions had been discussed with the teachers involved, the final questions were written directly into the game script and thus were only seen in full when the game was tested. Correcting this issue is not difficult and will be undertaken in the next version along with the development of more in depth content. This is the kind of feedback that can only come about from live testing and is valuable because it impacts on the positive outcome of the learning goals set by the developer of JTF and also points to potential problems that may decrease the "fun" element and corresponding motivation in the early and important stages of the game. The delivery of teaching content needs therefore to be revised.

In the first study two students noticeably stood out from the group (Children Nos. 3 and 7, identified as having mild autism and ADHD respectively) and, according to feedback from the teachers both students benefitted positively from the game trial in terms of behaviour and improved ability to engage socially. It was observed and noted by the teacher that Child No. 7 had the opportunity to be physically active, which helped him to be calmer and more collected by having the opportunity to move around whilst also concentrating on the game play and research. Child No. 3 was helped by his peers and soon began to integrate with the other students as he found his role and place in the game—to the extent that his self-confidence grew sufficiently for him to be able to speak in front of other students about his work. This was a significant breakthrough for this student and was commented on by both teachers and his fellow students. Very similar observations were made during the second trial, in which a large part of the class consisted of students with special needs. In both field observations and follow up discussions with the teacher it was noted that after only a short time outdoors, the class was significantly calmer and quieter than it was observed to be when working in the classroom. The teacher later suggested that by the end of the trial it was as if he had different students in the class, since the group was generally much more collected and better disciplined, as well as showing an active interest in Australian wildlife and environmental topics. Whether JTF had been a significant influence on the student’s behaviour in general or whether the class dynamics would have changed over the course of time as the group became more familiar with each other is difficult to say without further testing using an equivalent control group, but, given the teacher’s long term experience with teaching special needs groups, I would certainly like to take his word on this.

6.3.1. Limitations of the Study.

The data and findings described in this chapter derive from only two small-scale studies, with samples consisting both times of the equivalent of just one class (although students
in the first trial were from different class groups and largely did not know each other, as opposed to the second trial where all students were classmates). In addition, the second group consisted of a larger than normal number of special needs students—although it must be noted that the behaviour of the two groups in the field was largely consistent and that as an observer, the author did not notice any particular differences in the behaviour and attitudes of the groups when playing the game. This certainly comes across in the author’s observations in the second study, when there were no real examples of unusual behaviour significant enough to actually be noted as such. It is possible that video recording of the gameplay may have brought some examples to the author’s or the teacher’s notice in follow up reviews, but at the time, nothing of specific note came to my attention. Both class groups seemed to the author to be generally normal, slightly boisterous upper primary school level students, as most children of this age are naturally. Nevertheless, the limited number of students will have influenced the validity of the study results to some degree.

For this reason, it is suggested that further studies be undertaken with larger sample groups and with students from different social backgrounds—the primary school in which this study took place could be readily described as largely middle class and as being located in a particularly affluent area of the State. In addition, the school is located in a fairly pristine area, with beaches, national parks and open spaces being readily accessible within just a few minutes for most of these children and it stands to reason that some of the benefits of the outdoor aspects of the study may have had less impact on the student group. The benefits associated with outdoor education are well documented in the literature, but observing how \textit{JTF} works in a more urbanised environment would certainly be of great value if the game is to be thoroughly tested for its potential as a vehicle for environmental education.

Another limitation was the brevity of the two trials. Time and resources are difficult to come by in any school and many teachers are already very busy people—and the author recognises the additional effort and time that participating in such a study requires of the teachers who were involved. However, nature moves at a very different pace to that of the school year and the activities of humans and the few weeks spent in setting up the game and improving the study area certainly requires a longer term follow up if students are to even begin to appreciate the benefits of their efforts. It is quite clear in retrospect that a game such as \textit{JTF} needs to run for a whole semester—if not a full year—if it is to have any meaningful long term impact on the students. Additionally, more time would return more meaningful data relating to the student’s motivation and connection to the study area over a longer period and would thus help measure to what extent learning content is stored in the short, medium and long term memory of the students.
The findings clearly demonstrate that the JTF game supports teaching and learning in both an indoor and outdoor learning environment. The game also shows that individual and group tasks can be designed that bring team members together to engage in co-operative learning but which also provide the freedom to carry out individual work and research if the team work aspect of the game begins to overwhelm the personal learning style of the individual player. The implementation of more individualised learning tasks into the game and a revision of the rewards system to better support individual effort would undoubtedly help support the motivation of more individualistic players.

Finally, in the last trial, students spent far more time than expected in familiarising themselves with the computer based game, especially when they were required to research their roles and the classification and characteristics of their allocated research area. More time than expected was also spent in group discussions during the phase of the game where the students had to come up with strategies on how they could make improvements to their allocated research area. The author had clearly underestimated both the interest the students naturally had in their environment and their commitment to doing the right thing to improve it. In retrospect, it now clear to the author that young people are indeed well aware of environmental issues and the impact that humans are having upon it and are very keen to play their part in its protection. It seems clear that the environmental message is well understood by most primary school students and, although many have a concern about actually being outside and engaging with it, most understand why it is so important to all life on earth. Future versions of JTF may need to spend less time informing students about why we need to protect the environment and more time helping them work out how.
Chapter 7

“Education is not preparation for life; education is life itself.”

John Dewey

While the pedagogical approach, game and game system models presented in this work are not novel representations by themselves, their combination together, along with the proposed improvements to the game strategies and game mechanics developed in this study suggest that the principle tenet behind *Jumping the Fence*—that educational computer games can be designed that require students to move away from the classroom and actively engage with their physical environment—is valid. Whether we like it or not, children today spend significant amounts of time playing and working with computers. To date, these have typically been expensive and bulky desktop devices that require desks and chairs and access to electrical power and appropriate cabling. However, in the past few years we have seen major changes to computer technologies that are reshaping the way we interact with and use them. Whilst mobile devices were not uncommon in 2008 when this study commenced, they were expensive and typically used more in business applications and so, given the prevalence of desktop computing, it made sense that the game be designed so that students returned to the classroom to enter data and do their research. However, the incredible rate at which smart phones and tablet computers have become popular in the past few years, along with their power and sophistication is nothing short of astonishing. Camera phones have become video recorders, web browsers, GPS tracking devices and portable music players as well as telephones. Many homes and schools are now wi-fi hotspots and students using laptop and tablet computers can be seen almost everywhere in schools and universities. In the past two years, students have largely broken free from the desktop environment and now use their computers wherever they choose or need to work. At the same time, computer prices have dropped significantly, making these powerful devices even more affordable.

What this means for *JTF* is that the technology seems to have come to the game, rather than the other way round. It is as if the technology has been specifically developed to do what *JTF* was trying to do all along—and that is to liberate students from being bound to a desk.
for long periods of time and get them outdoors and moving about. Tablet computers and
smart phones are the perfect tool for playing, mapping, researching in the field and recording
game related data. It is certain that the next stage in developing Jumping the Fence will be to
develop it into a web based tablet application rather than updating it in its present form. This
is also very much in keeping with current trends and developments in web programming.

There have been numerous technical challenges to software and web development in
recent years due large corporations trying to dominate the market with proprietary systems.
Both Apple and Adobe come readily to mind in this context, although neither are alone in
taking such a stance. For example, Adobe has long promoted its Flash platform as a vehicle
for Rich Internet Applications (RIAs) whilst Apple has largely sought to restrict its use on
its iPhones and iPads, insisting instead that developers work with open standards such as
HTML5, CSS and Java Script. The current XML module in JTF can be easily transformed
into an APP which can be used by many mobile devices running iOS, Android and Mobile
Windows. It is also intended to facilitate the Google maps application in a combination
with GPS functionality, so that players can set up their own outdoor research area on the fly
and synchronise it with elevation data and biome data from open source research databases
wherever they wish. All collected data can then be stored in the Cloud and shared with
other players in Australia or around the world. This way all students participating in the
JTF game will play an important part in the scientific research community and might also be
able to contribute to that community in the longer term by providing an historical database
of climate change. All features allowing for this to happen have all ready been proposed
and integrated into the GUI of the game. Data collected by the players and site biodiversity
documented and monitored could also be used to help to protect the natural environment. It
is the author’s belief that it is the move to open standards and the making of content available
under Creative Commons licensing that will define the Internet and how we communicate
in the next few years—although the issue of ownership and control over the web is nowhere
near being resolved at this time. It is for this reason that I have made JTF freely available
for educators to download, modify and improve to suit their own needs—sharing knowledge and
open sourced software is the way of the future and a reflection of the democratic ideal that
many web developers aspire to.

The research has been purposely focussed on children in the mid-developmental
stage, with the intent of developing positive behaviour and attitudes towards the natural
environment. The study results clearly show that the majority of players developed an
affection towards the biotope they cared for. It is hoped that these attitudes towards caring
for nature will result in a long term relationship with nature and help to protect our natural
environment further. A study conducted by Hinds and Sparks (2008) revealed that people
who grow up in rural areas tend to show more positive orientations towards engaging with
the natural environment than do urban citizens. Playing the JTF game in urban parks and
backyards has the potential to also engage urban children with the natural environment—
giving them a chance to develop a sense of appreciation for the natural environment.

An unexpected success with JTF was the ease with which students adapted to role
playing as part of the game. Role playing games have long been highly popular—many
children's games such as Cops and Robbers are essentially role playing games and it is
almost certain children have played contemporary variations of it for centuries. As the
literature demonstrates, role playing is a powerful and widely used educational tool in that
it allows students to rehearse various scenarios and interactions in the safety of the learning
environment. Based on observations in the testing of JTF, it is clear to the author that role
playing, combined with computer based simulations has the potential to create increasingly
sophisticated and life like experiences as the technology moves forward. Most of the students
who participated in this project had little or no problem taking on the three roles allocated
them in the game, and switched happily from one role to another. This is, in part, because
students in this age group are naturally imaginative and relatively uninhibited, but the long
term popularity of more ‘traditional’ role playing games such as Dungeons and Dragons,
along with their console based and online adaptations such as the MMORPGs World of
Warcraft and Runescape amongst older players indicates that role playing is an effective means
of engaging students with learning content—once inhibitions are broken down. With the
students in this study, role playing worked particularly well as a vehicle for getting students
engaged quickly with the game, since it provided students with immediate role related tasks
and guaranteed that all students would get to play each of the roles and thereby share in
all the experiences and activities as their turn came up. Certainly, with primary school aged
students this came across as a highly effective way of sharing out roles and responsibilities in a
fair and equitable way.

The feedback from the students about the appearance and interface of the game was
refreshingly direct. Whilst the students were positive about the game overall, they made
it quite clear in both written feedback and follow up discussions that there was too much
text used in the initial stages of the game, they wanted more interactivity and they did not
like the talking Kangaroo. What this certainly makes clear in retrospect is that developing
a sophisticated computer based learning game requires extensive input from a range of
artists, designers and programmers. Although the idea behind JTF was to see whether
a computer based learning game could achieve the author's original objective, it became
quickly apparent that implementing game based learning strategies and applications into a
teaching environment is incredibly time consuming and demands a range of technical skills
and knowledge often well beyond the capacity of the dedicated individual. Even a game as
technically simple as JTF took the author many months to develop, code and animate—and
this was for a five week trial. As we have seen, planning, research, content development and
quizzes need to be set up and learning tasks must be customized for individual children’s particular learning styles as well as the requirements and learning objectives of any given course of study. This is more than any individual teacher can realistically achieve, no matter how open the deadline.

Today’s students are highly computer literate and have grown up with games and interactive tools that are capable of creating nearly seamless virtual realities and yet, even now, many teachers struggle to produce an effective Power point presentation. It is no wonder the children did not like the Kangaroo, since many of them indicated they played games such as *Tony Hawk’s American Wasteland* and *Modern Warfare 2* on a regular basis so, although they were familiar with the Flashimation style used in JTF, they certainly come into the classroom with incredibly high expectations—and rightly so. If we are to keep students interested, there is great need to invest more in the design and development of appropriate learning materials. There is clearly a need for teams of educational designers, artists, animators, videographers and content developers to be formed that can work in schools or with education departments and who can liaise with teachers and students to develop sophisticated and up to date learning materials. It is clearly beyond the capacity of any individual classroom teacher to produce anything like the content these digital natives interact with on a daily basis. Senior managers in education and politicians also need to be made much more aware of this problem, as far too many seem to think that simply providing online learning portals (such as Blackboard) is all that is required to implement “on-line” learning.

The one outcome of this study that I found most surprising and of greatest concern was the number of students who claimed they did not like going outdoors. Yet one third of the students in the second visit indicated they did not like being outdoors. This is certainly something that needs further investigation—there is certainly anecdotal evidence of this and I have heard many parents discuss how reluctant their children are to leave the television or computer and play outdoors, but it something I initially ascribed to the age group. The teachers who so kindly participated in the study also complained about how difficult it was to gain all the necessary permissions, parental authorities, fill in the H&S paperwork and generally arrange to take the children outdoors—even on to the school’s own grounds during regular teaching hours. Even in my own University I have noticed that field trips and study visits are becoming less common than they were a few years ago. The literature from overseas also supports this observation and it seems to me that the clearly documented advantages of outdoor education are being overwhelmed by a society in which risk aversion and threats of legal action are taking precedence. Nevertheless, even though so many students said they did not like being outdoor in general, the majority indicated they enjoyed the blended approach to learning and this, to a significant extent, overcame their initial dislike.
Using a computer based learning game and combining it with outdoor activities meant that an environment in which situated learning occurred was relatively easy to achieve. By balancing academic content with the opportunity to directly engage with the environment being studied, JTF allowed the students to both learn by doing and to learn from their own (moderated) failures. Not all plants survived, animals and insects did not always return immediately to feed on the plants or drink the clean water and students learned quickly that time was also a major factor in their endeavours—JTF was designed from the outset to make a connection between what the students learned from their computers and then realising this knowledge in a real-world scenario. In the real world not everything happens immediately and the students clearly came to understand that a commitment to improving and maintaining their environment was a long term endeavour. Since the success of any game based learning application depends on the intent of the teaching content and the audience’s needs and expectations, educators need to be open to new ideas and strategies if they decide to use GBL in the teaching and learning context. Every approach needs to custom made for the intended application—there is no one model fits all. For this reason, this study did not focus on the transference of the learning experience to other subjects and areas of the Queensland primary school curriculum and thus, if more information about this approach is to be gained, a longer term study investigating other areas of the curriculum would be well worthwhile.

If there is one thing that can be said about my own experience with this project, it is that the technology has moved with incredible speed in the past few years and will continue to do so well into the foreseeable future. Designing content for any given platform or media (i.e., Playstation, DVD or even an e-book reader) is a dead end in itself—anyone who has content created a few years ago and stored on a Zip disk or video tape will know how difficult it is to re-access the content once the technology moves on. Designers do not seem to have learned this lesson and large companies continue to develop proprietary formats and attempt to dominate the market with their own approach to new technology, which is clearly a wasteful, expensive and time consuming pursuit. At the present moment for example, there are more than 15 e-book formats and several kinds of reader competing for market dominance. In a few years this number will probably come down to perhaps two or three, but many hundreds of thousands of people will be left with useless devices and unreadable books. It is probably foolish of me to make a prediction in the face of this rapid rate of change—but I will. Only a freely available, open source and universally agreed upon standard can last into the future and allow for content to be preserved, accessed and updated as needed by anyone who wants to. Timothy John Berners-Lee has done precisely that. It’s called the World Wide Web and it stands right next to Johannes Gutenberg’s invention of more than 570 years ago. Any designer of educational content should avoid proprietary systems and try to make their content available using common, internationally agreed upon web based standards.


MICHAEL, D., and CHEN, S. 2006. Serious games: games that educate, train, and inform. Boston, Massachusetts, USA: Thompson Course Technology PTR.


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Appendix A: Introductionary Animations—Storyboard Examples.

Appendix A Figure 1. Two pages from the animation storyboard for JTF.
Appendix A Figure 2. Two pages from the animation storyboard for JTF.
Appendix A Figure 3. Two pages from the animation storyboard for JTF.
Appendix B. JTF Action Script Code.
The Full version of the game can be accessed at

addbutton.as
Function: Adds the navigation buttons to the JTF main level GUI.

//Add Buttons
package
{
    import flash.display.MovieClip;
    import flash.events.*;

    public class addbutton extends MovieClip
    {
        //Temporary cache which stores the ID
        var safeID:Number = 0;
        public function addbutton(x_: y_: id)
        {
            this.x = x_; 
            this.y = y_; 
            this.buttonMode = true;
            //the parameter id is assigned to the buttons
            safeID = id;
            addEventListener(MouseEvent.CLICK, onClick);
        }

        public function onClick(e:MouseEvent):void
        {
            //Initialising the loading of images and IDs into the Grid Arrays
            main.main.gridloader(safeID);
        }
    }
}

customuiloader.as
Function: Creates an empty container which holds the main level GUI and cache.
package
{
    import fl.containers.UIManager;
}
import flash.events.*;
import flash.display.MovieClip;
public class customuiloader extends UILoader
{
    //Cache for ID
    var safeAP:Number = 0;
    var id:int = 0;
    var activeGrid:MovieClip;
    static public var cuil;

    public function customuiloader(_arrayplace:int, _id:int, _activeMovieClip:MovieClip)
    {
        cuil = this;
        id = _id;

        activeGrid = _activeMovieClip;
        safeAP = _arrayplace;

        this.buttonMode = true;
        //Der Parameter id wird dem Button fest zugewiesen

        addEventListener(MouseEvent.MOUSE_OVER, Over);
        addEventListener(MouseEvent.CLICK, onClick);
        addEventListener(MouseEvent.MOUSE_OUT, Out);
    }

    public function Out(e:MouseEvent):void
    {
        main.main.OutUILoader(this);
    }

    public function Over(e:MouseEvent):void
    {
        main.main.OverUILoader(id, this);
    }

    public function onClick(e:MouseEvent):void
    {
        if(safeAP == 10)
        {
            main.main.killBG(activeGrid);
            main.main.activeMovieClip.BackgroundImage = 0;
            main.main.activeMovieClip.Background = undefined;
        }
        else
        {
            main.main.activeMovieClip.GridArray[safeAP] = null;
        }
        main.main.minikill();
        main.main.newgridloader();
        this.visible = false;
    }
}

datasave.as
Function: Saves the grid content.
package
{
    import flash.display.MovieClip;
    import flash.events.*;
}
public class datasave extends MovieClip
{
    public function datasave()
    {
        this.buttonMode = true;
        addEventListener(MouseEvent.CLICK, SaveonClick);
    }
    public function SaveonClick(e:MouseEvent):void
    {
        if (main.main.buttonGuard == true) {
            main.main.lspopup.visible = true;
            main.main.deactButtons();
        }
    }
}

grid.as
Function: Creates the main level grid map.
package
{
    import flash.display.MovieClip;
    import flash.events.*;
    import flash.display.*;
    import fl.containers:UILoader;
    public class grid extends MovieClip
    {
        //die verschiedenen Arrays
        var GridArray:Array = new Array(8);
        //var activeGrid:MovieClip;
        //zum ansprechen der Klasse
        static public var grid;
        var Background:UILoader;
        var BackgroundID:int = 0;
        var piclist:Array = [];
        var rect:Sprite;
        public function grid()
        {
            grid = this;
            this.buttonMode = true;
            addEventListener(MouseEvent.CLICK, onClick);
        }
        public function onClick(e:MouseEvent):void
        {
            main.main.popup.visible = true;
            main.main.LoadBackground(e);
            main.main.setGrid(this.name, this);
            main.main.deactButtons();
            //trace(this.name);
            //activeGrid = this;
        }
    }
}

last.as
Function: Loads the movie clip that holds the last button, which takes the user to the previous view of the tool box pop-up window.
package
import flash.display.MovieClip;
import flash.events.*;
public class last extends MovieClip {
    var Less:Boolean = true;
    var test:Boolean = false;
    public function last() {
        /*this.x = x_;
        this.y = y_;*/
        this.buttonMode = true;
        addEventListener(MouseEvent.CLICK, onClick);
    }
    public function onClick(e:MouseEvent):void {
        if(main.main.piccounter != 4)
        {
            do
            {
                if(main.main.step % 4 == 0)
                {
                    main.main.piccounter = main.main.piccounter - 8;
                    main.main.kill();
                    Less = main.main.BuildProcess();
                    test = true;
                    next.next.More = true;
                }
                else
                {
                    test = false;
                    main.main.step--;
                    main.main.piccounter++;
                }
            }while(test == false);
        }
    }
}

loading.as
Function: Loads the pop-up tool box window onto the grid in the main level GUI.
package {
    import flash.display.MovieClip;
    import flash.events.*;
    public class loading extends MovieClip {
        public function loading() {
            /*this.x = x_;
            this.y = y_;*/
            this.buttonMode = true;
            addEventListener(MouseEvent.CLICK, onClick);
        }
        public function onClick(e:MouseEvent):void {
            main.main.lspopup.visible = true;
        }
    }
}
main.as
Function: Creates dynamically the JTF main level GUI and controls all content loaded from different Action Script files plus XML files.

package {
    import fl.controls.*;
    import flash.display.MovieClip;
    import flash.events.*;
    import fl.containers.NDELLoader;
    import flash.display.MovieClip;
    import flash.net.URLLoader;
    import flash.text.TextField;
    import flash.display.MovieClip;
    import flash.net.URLLoader;
    import flash.net.FileReference;
    import flash.net.URLLoader;
    import flash.geom.ColorTransform;
    import customuiloader;
    public class main extends MovieClip {
        // This variable calls the main.main function
        static public var main;
        // the selected active grid
        public var activeGrid:String;
        public var activeMovieClip:MovieClip;
        public var A1Begin:int;
        /*var MasterObjectArray:Array;
         var MasterStringArray:Array;*/
        var MasterStringGridArray:Array;
        var animalsXmlLoader:URLLoader = new URLLoader(); // new URLLoader-Objekt
        var animalsURL = new URLRequest("xml/animals.xml") // URL of the species XML Data
        var animalsXMLData:XML = new XML(); // new XML-object
        var plantsXmlLoader:URLLoader = new URLLoader(); // new URLLoader-Objekt
        var plantsURL = new URLRequest("xml/plants.xml") // URL of the species XML Data
        var plantsXMLData:XML = new XML(); // new XML-object
        var bgXmlLoader:URLLoader = new URLLoader(); // new URLLoader-Objekt
        var bgURL = new URLRequest("xml/background.xml") // URL of the species XML Data
        var bgXMLData:XML = new XML(); // new XML-Object
        var spNameList:XMLList;
        var spPictureList:XMLList;
        var spIDList:XMLList;
        var spDescript:XMLList;
        var spTrackList:XMLList;
        var rolle:String;
        public var buttonGuard:Boolean = true; // deactivates buttons when popup is active
        var piccounter:int = 0;
        var step:int = 0;
        var choise:String;
        var _next:next;
        var _last:last;
        var plantBool:Boolean = false;
        var LAIFlag:Boolean = false;
        //var mySharedObject:SharedObject = SharedObject.getLocal("savedData1");
        //var mySharedObject:SharedObject = SharedObject.getLocal("Data");
        var mySharedObject:SharedObject = SharedObject.getLocal("Data");
static public var list:Array = [];
static public var Customlist:Array = [];
static public var bglist:Array = [];
static public var UIlist:Array = [];
/* var ArrayList:Array = new Array("grid1_mc", "grid2_mc", "grid3_mc", "grid4_mc", "grid5_mc",
"grid6_mc");
var fileReference = new FileReference();
var zielXml:XML = new XML();
var quelURL = new URLRequest("xml/TEST.xml")
var quelXmlLoad:URLLoader = new URLLoader();
var quelXml:XML = new XML();*/
public function main() {
    // ON Start:
lspopup.visible = true;
deactButtons();

    //Load Park Manager Text
    var pmtextload:URLLoader = new URLLoader();
    var pmtextReq:URLRequest = new URLRequest("texts/roleparkmanager.txt");
    pmtextload.load(pmtextReq);

    //Load Scientist
    var sctextload:URLLoader = new URLLoader();
    var sctextReq:URLRequest = new URLRequest("texts/rolescientist.txt");
    sctextload.load(sctextReq);

    //Load Environmentalist
    var entextload:URLLoader = new URLLoader();
    var entextReq:URLRequest = new URLRequest("texts/roleenviron.txt");
    entextload.load(entextReq);

    //Load Help
    var helptextload:URLLoader = new URLLoader();
    var helptextReq:URLRequest = new URLRequest("texts/help.txt");
    helptextload.load(helptextReq);
    main = this;
popup.popupClose.addEventListener(MouseEvent.CLICK, hidePopup);
    _next = new next();
    _next.x = -240;
    _next.y = 476;
popup.addChild(_next);
    _last = new last();
    _last.x = -350;
    _last.y = 476;
popup.addChild(_last);
popup.visible = false;
creatLSmenu();

    //Role Popup
    btn_pmanager.addEventListener(MouseEvent.CLICK, pmanagerUp);

    // Opens up Manager popup
    btn_scientist.addEventListener(MouseEvent.CLICK, scientistUp);

    // Opens up Scientist popup
    btn_environmentalist.addEventListener(MouseEvent.CLICK, environmUp);

    // Opens up Environmentalist popup
    btn_help.addEventListener(MouseEvent.CLICK, helptextUp);

    // Opens up Help popup
    btn_introgame.addEventListener(MouseEvent.CLICK, startintrogame);

    // Opens up Help popup
    function startintrogame(e:MouseEvent):void {
    }

    //invisible MC
    rolePopup.visible = false;
function pmanagerUp(e:MouseEvent):void {
    rolle = "pmanager";
    viewrolepopup();
}

function helptextUp(e:MouseEvent):void {
    rolle = "helptext";
    viewrolepopup();
}

function scientistUp(e:MouseEvent):void {
    rolle = "scientist";
    viewrolepopup();
}

function environmUp(e:MouseEvent):void {
    rolle = "environm";
    viewrolepopup();
}

function viewrolepopup():void {
    rolePopup.visible = true;
    deactButtons();
    if (rolle == "pmanager") {
        /*rolePopup.roledescipt.htmlText = "<b><font color='#00aeef'>You are the 
        PARK MANAGER</font></b><br><br>You are a park manager. You have studied business, management
        and human resources management. You will have a good knowledge about managing staff, operating
        a business and leading a team. You know how to identify problems and you are able to work within a
        given budget. You also have the knowledge to promote your park to the media and to the public. You
        have chosen this profession because you love to manage and work in a park that aims to preserve the
        natural environment.<br><br>Your role being a park manager<br> Being a park manager you
        need to research sources that teach you how to manage a natural reserve. You also need to gain skills in
        pointing out issues that would threaten the business aspect of running your park. You need to develop
        people managing skills, just like a good film director leads the film production team including actors and
        actresses.<br> You are in charge of developing a management plan that states:<br><li>how the
        park is to be managed</li><li>how natural features of the park are to be protected and conserved</li>
        specify any operations that may be carried out to protect the park; and<li>indicate general
        activities (access by other students and teachers, school facility manager, council staff etc) to be
        regulated and how this will be done</li>
        You can use your school library, the Internet or
        expert help, such as your teacher, to gain the knowledge for your role. You will give recommendations
        to the scientist and the environmentalist who will determine the success, sustainability or recovery
        of the nature reserve.<br> Specific tasks for you to tackle -- <font color='#00aeef'>the
        park manager</font><br> Task 1:<br> Research and find out what a nature park manager
        does.<br> Task 2:<br> Develop a plan on how you, as a manger, will protect and conserve the natural
        features of the park.<br> Task 3:<br> Indicate how you plan to manage the access to the park area by other
        students and teachers that are not involved in park managment activities.<br> Task 4:<br> Identify how
        will you get enough money to pay for the conversion of your park.<br> Task 5:<br> Together with
        the environmentalist group and the scientist group you will write a report on the situation of the eco-systems in the park. How can the eco-system of the park be improved? What needs to be
done to bring the eco system into a stable balanced condition?";
        
        rolePopup.roledescipt.htmlText = pmtextload.data;
    } /*
    else if (rolle == "scientist") {
        rolePopup.roledescipt.htmlText = "<font color='#d2232a'>You are the
        SCIENTIST</font><br><br>You are a scientist. You have studied environmental science.
        Parts of your studies were zoology, botany, geology, chemistry and microbiology. You have a very
        good knowledge about eco systems and biospheres. You know how to identify problems within those systems
        and what measures must be taken to keep them in balance. You have chosen this profession because you
        love science and you love nature and you like to conserve the unique natural habitats of Australia for the
        
        270
future. Through your research you found out that human beings have to work together and act quickly to save the environment. This means you need to work in a close relationship with environmentalists and people responsible for managing nature refuges such as park managers. Being a scientist you need to research information about the plants and animals names and their role in an ecosystem. You also need to gain skills in pointing out threats and dangers to the eco system, such as pests, weeds, chemical states of soil, air and water, pollutants and toxic waste. You can use your school library, the Internet or expert help, such as your teacher, to gain the knowledge for your role. You will give recommendations to the park manager and the environmentalist that will determine the success, sustainability or recovery of the nature reserve. Specific tasks for you to tackle –

**Task 1:** Research and find out what a scientist does. You will help to detect areas that are not balanced and find the reasons or sources for the imbalance of the eco system. You need to conduct research about the plants and animals names and their role in an ecosystem. You can use your school library, the Internet or expert help, such as your teacher, to gain the knowledge for your role. You will give recommendations to the park manager and the environmentalist in your group you will write a report on the situation of the eco-systems in the park. How can the eco-system of the park be improved? What needs to be done to bring the eco system into a stable balanced condition?**

**Task 2:** You are an ENVIRONMENTALIST. You have studied campaign development and posses a range of skills, such as writing for the news, radio and TV. You use the Internet for your awareness campaigns and for sending out e-mail newsletters and you are running a park website together with the park’s management. You are also an educator who teaches people about the environment and the importance of conservation. You can organise groups of volunteers to demonstrate for the protection of the park and you can encourage people to become active members to volunteer with campaigns. You also know a lot about the wildlife protection laws and have worked with politicians and political parties. You love nature and you want to fight for its protection. Your role is to give scientific advice and make recommendations on how to deal with problems and how to keep the eco-systems in balance. Together with the park manager and the environmentalist in your group you will write a report on the situation of the eco-systems in the park. How can the eco-system of the park be improved? What needs to be done to bring the eco system into a stable balanced condition?**

**Task 3:** Discuss with your group how you could tell other people about your park. Please document your findings in your group booklet. Identify the people you want to ask getting support and help in maintaining and running your park. Together with the park manager group and the scientist group you will write a report on the situation of the eco-systems in the park. How can the eco-system of the park be improved? What needs to be done to bring the eco system into a stable balanced condition?**
function closeTheRolePopup(e:MouseEvent):void {
    rolePopup.visible = false;
    trace("Close the Rollepopupwindow")
    actButtons();
}

MasterGridArray = new Array(grid1_mc, grid2_mc, grid3_mc, grid4_mc, grid5_mc, grid6_mc,
    grid7_mc, grid8_mc, grid9_mc,
    grid10_mc, grid11_mc, grid12_mc,
    grid13_mc, grid14_mc, grid15_,
    grid16_mc, grid17_mc, grid18_mc,
    grid19_mc, grid20_mc, grid21_,
    grid22_mc, grid23_mc, grid24_mc,
    grid25_mc, grid26_mc, grid27_,
    grid28_mc, grid29_mc, grid30_mc,
    grid31_mc, grid32_mc, grid33_,
    grid34_mc, grid35_mc, grid36_mc);
    MasterStringGridArray = new Array("grid1_mc", "grid2_mc", "grid3_mc", "grid4_mc", "grid5_mc",
    "grid6_mc", "grid7_mc", "grid8_mc", "grid9_",
    "grid10_mc", "grid11_mc", "grid12_mc",
    "grid13_mc", "grid14_mc",
    "grid15_mc", "grid16_mc", "grid17_mc", "grid18_mc",
    "grid19_mc", "grid20_mc",
    "grid21_mc", "grid22_mc", "grid23_mc", "grid24_mc",
    "grid25_mc", "grid26_mc",
    "grid27_mc", "grid28_mc", "grid29_mc", "grid30_mc",
    "grid31_mc", "grid32_mc",
    "grid33_mc", "grid34_mc", "grid35_mc", "grid36_mc");
    MasterStringArray = new Array("savedData1", "savedData2", "savedData3", "savedData4",
    "savedData5", "savedData6");
    MasterObjectArray = new Array(savedData1, savedData2, savedData3, savedData4, savedData5,
    savedData6);
*/
    animalsXmlLoad.addEventListener(Event.COMPLETE, LoadXML);
    // Eventlistener: wenn URL geladen --> onLoadComplete-Funktion ausfuehren
    animalsXmlLoad.load(animalsURL);
    // URL laden
    plantsXmlLoad.addEventListener(Event.COMPLETE, LoadPlantXML);
    plantsXmlLoad.load(plantsURL);
    bgXmlLoad.addEventListener(Event.COMPLETE, LoadbgXML);
    bgXmlLoad.load(bgURL);
    var PlantButton = new Button();
    PlantButton.label = "Plant";
    PlantButton.x = -240;
    PlantButton.y = -10;
    PlantButton.width = 80;
    popup.addChild(PlantButton);
    PlantButton.addEventListener(MouseEvent.CLICK, LoadPlant);
    var AnimalButton = new Button();
    AnimalButton.label = "Animal";
    AnimalButton.x = -325;
    AnimalButton.y = -10;
    AnimalButton.width = 80;
    popup.addChild(AnimalButton);
    AnimalButton.addEventListener(MouseEvent.CLICK, LoadAnimal);
    var Background = new Button();
    Background.label = "Background";
    Background.x = -410;
    Background.y = -10;
Background.width = 80;
popup.addChild(Background);
Background.addEventListener(MouseEvent.CLICK, LoadBackground);
var ArrayButton = new Button();
ArrayButton.label = "Field Content";
ArrayButton.x = -155;
ArrayButton.y = -10;
popup.addChild(ArrayButton);
ArrayButton.addEventListener(MouseEvent.CLICK, LoadArrayItem);
}
public function deactButtons():void
{
trace("deactivate buttons")
save.mc.buttonMode = false;
save.mc.alpha = 0.3;
btn_print.hitTestState = null;
btn_print.alpha = 0.3;
btn_archive.hitTestState = null;
btn_archive.alpha = 0.3;
buttonGuard = false;
}
public function actButtons():void
{
trace("Activate buttons")
save.mc.buttonMode = true;
save.mc.alpha = 1;
btn_print.hitTestState = btn_print.upState;
btn_print.alpha = 1;
btn_archive.hitTestState = btn_archive.upState;
btn_archive.alpha = 1;
buttonGuard = true;
}
public function hidePopup(e:MouseEvent):void
{
    actButtons()
    killCustom();
    popup.visible = false;
}
public function LoadBackground(e:MouseEvent):void
{
    _next.visible = true;
    _last.visible = true;
    if(LAIFlag)
    {
        killCustom();
    }
    else
    {
        kill();
    }
    LAIFlag = false;
    plantBool = false;
    next.next.More = true;
    Build("bg");
}
public function LoadArrayItem(e:MouseEvent):void
{
    _next.visible = false;
_last.visible = false;

if(activeMovieClip != null)
{
    LAIFlag = true;
    kill();
    killCustom();
    AIbegin = 0;
    //Length reads out the length of Arrays not only filled grid squares (arrays)
    /*if(activeMovieClip.GridArray.length > 4)
    {
        next.next.More = true;
    }*/
    piccounter = 0;
    //next.next.AIBool = true;
    AIBuildProcess();
}
}

public function AIbgBuildProcess():void
{
    var id:int = activeMovieClip.BackgroundID;
    var idcalc:int = 301;
    spNameList = bgXmlData.background.name;
    spPictureList = bgXmlData.background.image;
    spIDList = bgXmlData.background.id;
    spDescript = bgXmlData.background.description;
    var myUILoader = new customuiloader(10, id, activeMovieClip);
    myUILoader.width = 80;
    myUILoader.height = 80;
    myUILoader.scaleContent = true;
    myUILoader.source = spPictureList[id - idcalc];
    myUILoader.buttonMode = true;
    popup.addChild(myUILoader);
    myUILoader.move(-410, 273);
    //<--------------------------------------------here goes Back Ground of grid
    Customlist.push(myUILoader);
}

public function createLSmenu():void
{
    var Group1_lab:Label = new Label();
    Group1_lab.text = “Group 1”;
    Group1_lab.x = -360;
    Group1_lab.y = 50;
    lspopup.addChild(Group1_lab);
    var Group2_lab:Label = new Label();
    Group2_lab.text = “Group 2”;
    Group2_lab.x = -360;
    Group2_lab.y = 80;
    lspopup.addChild(Group2_lab);
    var Group3_lab:Label = new Label();
    Group3_lab.text = “Group 3”;
    Group3_lab.x = -360;
    Group3_lab.y = 110;
    lspopup.addChild(Group3_lab);
    var Group1SButton = new Button();
    Group1SButton.label = “Save”;
    Group1SButton.x = -120;
    Group1SButton.y = 50;
//Group1SButton.width = 80;
lspopup.addChild(Group1SButton);
Group1SButton.addEventListener(MouseEvent.CLICK, Group1Save);
var Group2SButton = new Button();
Group2SButton.label = "Save";
Group2SButton.x = -120;
Group2SButton.y = 80;
//Group2SButton.width = 80;
lspopup.addChild(Group2SButton);
Group2SButton.addEventListener(MouseEvent.CLICK, Group2Save);
var Group3SButton = new Button();
Group3SButton.label = "Save";
Group3SButton.x = -120;
Group3SButton.y = 110;
//Group3SButton.width = 80;
lspopup.addChild(Group3SButton);
Group3SButton.addEventListener(MouseEvent.CLICK, Group3Save);
var Group1LButton = new Button();
Group1LButton.label = "Load";
Group1LButton.x = -240;
Group1LButton.y = 50;
//Group1LButton.width = 80;
lspopup.addChild(Group1LButton);
Group1LButton.addEventListener(MouseEvent.CLICK, Group1Load);
var Group2LButton = new Button();
Group2LButton.label = "Load";
Group2LButton.x = -240;
Group2LButton.y = 80;
//Group2LButton.width = 80;
lspopup.addChild(Group2LButton);
Group2LButton.addEventListener(MouseEvent.CLICK, Group2Load);
var Group3LButton = new Button();
Group3LButton.label = "Load";
Group3LButton.x = -240;
Group3LButton.y = 110;
//Group3LButton.width = 80;
lspopup.addChild(Group3LButton);
Group3LButton.addEventListener(MouseEvent.CLICK, Group3Load);
var lsClose = new Button();
lsClose.label = "Close";
lsClose.x = -120;
lsClose.y = 150;
lspopup.addChild(lsClose);
lsClose.addEventListener(MouseEvent.CLICK, closeLS);
}

public function closeLS(e:MouseEvent):void {
    lspopup.visible = false;
    actButtons();
}

public function Group1Save(e:MouseEvent):void {
    saveArray("Group 1");
    actButtons()
    lspopup.visible = false;
}

public function Group2Save(e:MouseEvent):void {
    saveArray("Group 2");
    actButtons()
    lspopup.visible = false;
}
public function Group3Save(e:MouseEvent):void
{saveArray("Group 3");
actButtons()
lpopup.visible = false;}
public function Group1Load(e:MouseEvent):void
{loadArray("Group 1");
actButtons()
lpopup.visible = false;}
public function Group2Load(e:MouseEvent):void
{loadArray("Group 2");
actButtons()
lpopup.visible = false;}
public function Group3Load(e:MouseEvent):void
{loadArray("Group 3");
actButtons()
lpopup.visible = false;}
public function AIBuildProcess():void
{
    //Local Y coordinates for Content
    var y:Number = 0;
    //at the moment does not allow more than four different animals per grid square
    //var counter:Number = 0;
    var idcalc:int = 101;
    if(activeMovieClip.Background != null)
    {
        AlbgBuildProcess();
    }
    for(var i = 0; i <= 8; i++)
    {
        var id:int = activeMovieClip.GridArray[i]
        if(id != 0)
        {
            if(id > 200)
            {
                idcalc = 201
                spNameList = plantsXmlData.plants.name;
                spPictureList = plantsXmlData.plants.image;
                spIDList = plantsXmlData.plants.id;
                spDescript = plantsXmlData.plants.description;
            }
            else
            {
                idcalc = 101;
                spNameList = animalsXmlData.animals.name;
                spPictureList = animalsXmlData.animals.image;
                spIDList = animalsXmlData.animals.id;
                spDescript = animalsXmlData.animals.sdescription;
                spTrackList = animalsXmlData.animals.track;
                //spTrackList = animalsXmlData.animals.track;
            }
        }
        var myUILoader = new customuiloader(i, id, activeMovieClip);
        myUILoader.width = 80;
        myUILoader.height = 80;
        myUILoader.scaleContent = true;
        myUILoader.source = spPictureList[id - idcalc];
        myUILoader.buttonMode = true;
        popup.addChild(myUILoader);
        Customlist.push(myUILoader);
switch (i) {
    case 0:
        myUILoader.move(-410, 15);
        break;
    case 1:
        myUILoader.move(-325, 15);
        break;
    case 2:
        myUILoader.move(-240, 15);
        break;
    case 3:
        myUILoader.move(-410, 100);
        break;
    case 4:
        myUILoader.move(-325, 100);
        break;
    case 5:
        myUILoader.move(-240, 100);
        break;
    case 6:
        myUILoader.move(-410, 185);
        break;
    case 7:
        myUILoader.move(-325, 185);
        break;
    case 8:
        myUILoader.move(-240, 185);
        break;
}

    y += 110;
    piccounter ++;
    //counter ++;
    step = piccounter;
}
//return true;

public function UIClick(e:MouseEvent):void
{
    activeMovieClip.onClick(e);
}

public function LoadAnimal(e:MouseEvent):void
{
    _next.visible = true;
    _last.visible = true;
    if(LAIFlag)
    {
        killCustom();
    }
    else
    {
        kill();
    }
    LAIFlag = false;
    plantBool = false;
next.next.More = true;
Build("animal");

// sets the active Grid
public function setGrid(_grid:String, _mc:MovieClip):void{
    activeGrid = _grid;
    activeMovieClip = _mc;
}

public function LoadPlant(e:MouseEvent):void
{
    _next.visible = true;
    _last.visible = true;

    if(LAIFlag)
    {
        killCustom();
    }
    else
    {
        kill();
    }
    LAIFlag = false;
    //plantsXmlLoad.load(plantsURL);
    kill();
    plantBool = true;
    next.next.More = true;
    //plantsXmlLoad.addEventListener(Event.COMPLETE, LoadPlantXML);
    Build("plant");
}

public function LoadPlantXML(e:Event):void
{
    plantsXmlData = new XML(e.target.data);
    //plantBool = true;
    //Build(plantsXmlData);
    trace("Plant loaded");
}

public function LoadbgXML(e:Event):void
{
    bgXmlData = new XML(e.target.data);
    //plantBool = true;
    //Build(plantsXmlData);
    trace("Background loaded");
}

public function LoadXML(e:Event):void
{
    //later allows browsing
    animalsXmlData = new XML(e.target.data);
    trace("Animal loaded");
    //Build(animalsXmlData);
}

// creates the menu to select items
function Build(_choise:String):void
{
    choise = _choise;
    // global Listener for controlling the Content
    switch(_choise)
    {
}
case "animal":
spNameList = animalsXmlData.animals.name;
spPictureList = animalsXmlData.animals.image;
spIDList = animalsXmlData.animals.id;
spDescript = animalsXmlData.animals.sdescription;
spTrackList = animalsXmlData.animals.track;
b finally

case "plant":
spNameList = plantsXmlData.plants.name;
spPictureList = plantsXmlData.plants.image;
spIDList = plantsXmlData.plants.id;
spDescript = plantsXmlData.plants.description;
break;

case "bg":
spNameList = bgXmlData.background.name;
spPictureList = bgXmlData.background.image;
spIDList = bgXmlData.background.id;
spDescript = bgXmlData.background.description;
break;
}

Piccounter = 0;
BuildProcess();
}

public function kill():void
{
    for(var i:int = 0; i < list.length; i++)
    {
        popup.removeChild(list[i]);
    }
    list = [];
}

public function killCustom():void
{
    for(var i:int = 0; i < Customlist.length; i++)
    {
        popup.removeChild(Customlist[i]);
    }
    Customlist = [];
}

public function BuildProcess():Boolean
{
    //LocalY coordinates for the Content
    var y:Number = 30;
    //stops at the moment at 4 animals
    var counter:Number = 0;
    for each (var nameElement:XML in spNameList)
    {
        if((piccounter + 1) > spNameList.length())
        {
            return false;
            break;
        }
        var _object = new object(-410, y - 15);
        var ListitembColor:ColorTransform = new ColorTransform();
        if ((counter % 2) > 0) {
            ListitembColor.color = 0x97CA97;
        }
_object.popListitembg.transform.colorTransform = ListitembColor;
}
popup.addChildAt(_object, 2);
list.push(_object);
//creates Label
var myLabel:Label = new Label();
myLabel.text = spNameList[piccounter].children();
myLabel.width = 200;
myLabel.wordWrap = true;
myLabel.autoSize = TextFieldAutoSize.LEFT;
_object.addChild(myLabel);
myLabel.move(110, 0);

//creates Tracks
if(choise == "animal")
{
var UITracks:UILoader = new UILoader();
UITracks.scaleContent = true;
UITracks.width = 105;
UITracks.height = 105;
UITracks.source = spTrackList[piccounter];
_object.addChild(UITracks);
UITracks.move(325, 0);
}

//creates ObjectDiscription
var objectDesc:Label = new Label();
objectDesc.text = spDescript[piccounter].children();
objectDesc.width = 215;
objectDesc.height = 80;
//objectDesc.maxChars = 20;
objectDesc.wordWrap = true;
objectDesc.selectable = true;
//objectDesc.autoSize = TextFieldAutoSize.LEFT;
_object.addChild(objectDesc);
objectDesc.move(110, 18);

//creates Pictures
var myUILoader:UILoader = new UILoader();
myUILoader.scaleContent = false;
myUILoader.source = spPictureList[piccounter];
_object.addChild(myUILoader);
myUILoader.move(0, 0);

//creates the Add Button
var _addbutton = new addbutton(5, 80, spIDList[piccounter]);
_object.addChild(_addbutton);
y += 110;
piccounter ++;
counter ++;
step = piccounter;

//stops at 4, later will become important for browsing
if(counter == 4)
{break;}
}
return true;

// POPUP OF FIELD CONTENTS

public function OverUILoader(_id:int, _CUILoader:customuiloader):void
{
    if(_id > 300) // 300 ist die ID Kategorie der HINTERGRÜNDE
    {
        // Creates Green Background
        var _object = new objectsmall(-320, 273);
        popup.addChild(_object);
        UIlist.push(_object);
        _id -= 301;

        // Assigns values to the background in the arrays
        spNameList = bgXmlData.background.name;
        spPictureList = bgXmlData.background.image;
        spIDList = bgXmlData.background.id;
        spDescript = bgXmlData.background.description;

        // creates field names
        var bgFieldname:Label = new Label();
        bgFieldname.text = spNameList[_id].children();
        bgFieldname.width = 150;
        bgFieldname.wordWrap = true;
        bgFieldname.autoSize = TextFieldAutoSize.LEFT;
        _object.addChild(bgFieldname);
        bgFieldname.move(5, 0);

        // creates description of backgrounds
        var bgDescription:Label = new Label();
        bgDescription.text = spDescript[_id].children();
        bgDescription.width = 150;
        bgDescription.height = 80;
        bgDescription.wordWrap = true;
        bgDescription.selectable = true;
        _object.addChild(bgDescription);
        bgDescription.move(5, 18);
    }
    else if(_id > 200) // 200 ist die ID Kategorie der PFLANZEN
    {
        // creates green background
        var _object = new objectsmall(-150, 17);
        popup.addChild(_object);
        UIlist.push(_object);
        _object.popListitembg.width = 165;
        _object.popListitembg.height = 165;
        _id -= 201

        // assigns values to the plant list in the arrays
        spNameList = plantsXmlData.plants.name;
        spPictureList = plantsXmlData.plants.image;
        spIDList = plantsXmlData.plants.id;
        spDescript = plantsXmlData.plants.description;

        // creates field names
var plantFieldname:Label = new Label();
plantFieldname.text = spNameList[_id].children();
plantFieldname.width = 150;
plantFieldname.wordWrap = true;
plantFieldname.autoSize = TextFieldAutoSize.LEFT;
_object.addChild(plantFieldname);
plantFieldname.move(3, 0);

//creates description of the plants
var plantDescript:Label = new Label();
plantDescript.text = spDescript[_id].children();
plantDescript.width = 165;
plantDescript.height = 80;
plantDescript.wordWrap = true;
plantDescript.selectable = true;
_object.addChild(plantDescript);
plantDescript.move(3, 18);

else    // 100 ist the ID category of the ANIMALS  {

// creates green background
var _object = new objectsmall(-150, 17);
popup.addChild(_object);
UIlist.push(_object);
_object.popListitembg.width = 165;
_object.popListitembg.height = 165;
_id -= 101;

// Assigns animals to the arrays
spNameList = animalsXmlData.animals.name;
spPictureList = animalsXmlData.animals.image;
spIDList = animalsXmlData.animals.id;
spDescript = animalsXmlData.animals.sdescription;
spTrackList = animalsXmlData.animals.track;

// creates field names
var animalFieldname:Label = new Label();
animalFieldname.text = spNameList[_id].children();
animalFieldname.width = 150;
animalFieldname.wordWrap = true;
animalFieldname.autoSize = TextFieldAutoSize.LEFT;
_object.addChild(animalFieldname);
animalFieldname.move(3, 0);

// creates descriptions of the animals
var animalDescript:Label = new Label();
animalDescript.text = spDescript[_id].children();
animalDescript.width = 165;
animalDescript.height = 80;
animalDescript.wordWrap = true;
animalDescript.selectable = true;
_object.addChild(animalDescript);
animalDescript.move(3, 18);

// creates the image of the animals
var animalTracks:UILoader = new UILoader();
animalTracks.scaleContent = true;
animalTracks.width = 80;
animalTracks.height = 80;
animalTracks.source = spTrackList[_id];
_object.addChild(animalTracks);
animalTracks.move(0, 170);
}
}

public function OutUILoader(_CUILoader:customuiLoader):void
{
    for(var i:int = 0; i < UIlist.length; i++)
    {
        popup.removeChild(UIlist[i]);
    }
    UIlist = [];
}

//sets if arrays are occupied
public function ArrayCheck(_i):String{
    //Rückgabewert ob Speicher belegt
    var fu:String;
    switch(activeGrid)
    {
    case "grid1_mc":
        fu = grid1_mc.GridArray[_i];
        break;
    case "grid2_mc":
        fu = grid2_mc.GridArray[_i];
        break;
    case "grid3_mc":
        fu = grid3_mc.GridArray[_i];
        break;
    case "grid4_mc":
        fu = grid4_mc.GridArray[_i];
        break;
    case "grid5_mc":
        fu = grid5_mc.GridArray[_i];
        break;
    case "grid6_mc":
        fu = grid6_mc.GridArray[_i];
        break;
    case "grid7_mc":
        fu = grid7_mc.GridArray[_i];
        break;
    case "grid8_mc":
        fu = grid8_mc.GridArray[_i];
        break;
    case "grid9_mc":
        fu = grid9_mc.GridArray[_i];
        break;
    case "grid10_mc":
        fu = grid10_mc.GridArray[_i];
        break;
    case "grid11_mc":
        fu = grid11_mc.GridArray[_i];
        break;
    case "grid12_mc":
        fu = grid12_mc.GridArray[_i];
        break;
    case "grid13_mc":
        fu = grid13_mc.GridArray[_i];
break;
case "grid14_mc":
    fu = grid14_mc.GridArray[_i];
    break;
case "grid15_mc":
    fu = grid15_mc.GridArray[_i];
    break;
case "grid16_mc":
    fu = grid16_mc.GridArray[_i];
    break;
case "grid17_mc":
    fu = grid17_mc.GridArray[_i];
    break;
case "grid18_mc":
    fu = grid18_mc.GridArray[_i];
    break;
case "grid19_mc":
    fu = grid19_mc.GridArray[_i];
    break;
case "grid20_mc":
    fu = grid20_mc.GridArray[_i];
    break;
case "grid21_mc":
    fu = grid21_mc.GridArray[_i];
    break;
case "grid22_mc":
    fu = grid22_mc.GridArray[_i];
    break;
case "grid23_mc":
    fu = grid23_mc.GridArray[_i];
    break;
case "grid24_mc":
    fu = grid24_mc.GridArray[_i];
    break;
case "grid25_mc":
    fu = grid25_mc.GridArray[_i];
    break;
case "grid26_mc":
    fu = grid26_mc.GridArray[_i];
    break;
case "grid27_mc":
    fu = grid27_mc.GridArray[_i];
    break;
case "grid28_mc":
    fu = grid28_mc.GridArray[_i];
    break;
case "grid29_mc":
    fu = grid29_mc.GridArray[_i];
    break;
case "grid30_mc":
    fu = grid30_mc.GridArray[_i];
    break;
case "grid31_mc":
    fu = grid31_mc.GridArray[_i];
    break;
case "grid32_mc":
    fu = grid32_mc.GridArray[_i];
    break;
case "grid33_mc":
    fu = grid33_mc.GridArray[_i];
    break;

case "grid34_mc":
    fu = grid34_mc/GridArray[_i];
    break;

case "grid35_mc":
    fu = grid35_mc/GridArray[_i];
    break;

case "grid36_mc":
    fu = grid36_mc/GridArray[_i];
    break;

}  

return(fu);

//fills the different arrays
public function ArrayFill(_i, _id):void
{

switch(activeGrid)
{
    case "grid1_mc":
        grid1_mc/GridArray[_i] = _id;
        break;

    case "grid2_mc":
        grid2_mc/GridArray[_i] = _id;
        break;

    case "grid3_mc":
        grid3_mc/GridArray[_i] = _id;
        break;

    case "grid4_mc":
        grid4_mc/GridArray[_i] = _id;
        break;

    case "grid5_mc":
        grid5_mc/GridArray[_i] = _id;
        break;

    case "grid6_mc":
        grid6_mc/GridArray[_i] = _id;
        break;

    case "grid7_mc":
        grid7_mc/GridArray[_i] = _id;
        break;

    case "grid8_mc":
        grid8_mc/GridArray[_i] = _id;
        break;

    case "grid9_mc":
        grid9_mc/GridArray[_i] = _id;
        break;

    case "grid10_mc":
        grid10_mc/GridArray[_i] = _id;
        break;

    case "grid11_mc":
        grid11_mc/GridArray[_i] = _id;
        break;

    case "grid12_mc":
        grid12_mc/GridArray[_i] = _id;
        break;

    case "grid13_mc":
        grid13_mc/GridArray[_i] = _id;
        break;
    
}
break;
case "grid14_mc":
grid14_mc.GridArray[_i] = _id;
break;
case "grid15_mc":
grid15_mc.GridArray[_i] = _id;
break;
case "grid16_mc":
grid16_mc.GridArray[_i] = _id;
break;
case "grid17_mc":
grid17_mc.GridArray[_i] = _id;
break;
case "grid18_mc":
grid18_mc.GridArray[_i] = _id;
break;
case "grid19_mc":
grid19_mc.GridArray[_i] = _id;
break;
case "grid20_mc":
grid20_mc.GridArray[_i] = _id;
break;
case "grid21_mc":
grid21_mc.GridArray[_i] = _id;
break;
case "grid22_mc":
grid22_mc.GridArray[_i] = _id;
break;
case "grid23_mc":
grid23_mc.GridArray[_i] = _id;
break;
case "grid24_mc":
grid24_mc.GridArray[_i] = _id;
break;
case "grid25_mc":
grid25_mc.GridArray[_i] = _id;
break;
case "grid26_mc":
grid26_mc.GridArray[_i] = _id;
break;
case "grid27_mc":
grid27_mc.GridArray[_i] = _id;
break;
case "grid28_mc":
grid28_mc.GridArray[_i] = _id;
break;
case "grid29_mc":
grid29_mc.GridArray[_i] = _id;
break;
case "grid30_mc":
grid30_mc.GridArray[_i] = _id;
break;
case "grid31_mc":
grid31_mc.GridArray[_i] = _id;
break;
case "grid32_mc":
grid32_mc.GridArray[_i] = _id;
break;
case "grid33_mc":
grid33_mc.GridArray[i] = _id;
break;
case "grid34_mc":
grid34_mc.GridArray[i] = _id;
break;
case "grid35_mc":
grid35_mc.GridArray[i] = _id;
break;
case "grid36_mc":
grid36_mc.GridArray[i] = _id;
break;
}

public function saveArray(_group:String):void
{
    switch(_group)
    {
    case "Group 1":
        trace("save1");
        mySharedObject.data.savedData1 = grid1_mc.GridArray;
        mySharedObject.data.savedData2 = grid2_mc.GridArray;
        mySharedObject.data.savedData3 = grid3_mc.GridArray;
        mySharedObject.data.savedData4 = grid4_mc.GridArray;
        mySharedObject.data.savedData5 = grid5_mc.GridArray;
        mySharedObject.data.savedData6 = grid6_mc.GridArray;
        mySharedObject.data.savedData7 = grid7_mc.GridArray;
        mySharedObject.data.savedData8 = grid8_mc.GridArray;
        mySharedObject.data.savedData9 = grid9_mc.GridArray;
        mySharedObject.data.savedData10 = grid10_mc.GridArray;
        mySharedObject.data.savedData11 = grid11_mc.GridArray;
        mySharedObject.data.savedData12 = grid12_mc.GridArray;
        mySharedObject.data.savedData13 = grid13_mc.GridArray;
        mySharedObject.data.savedData14 = grid14_mc.GridArray;
        mySharedObject.data.savedData15 = grid15_mc.GridArray;
        mySharedObject.data.savedData16 = grid16_mc.GridArray;
        mySharedObject.data.savedData17 = grid17_mc.GridArray;
        mySharedObject.data.savedData18 = grid18_mc.GridArray;
        mySharedObject.data.savedData19 = grid19_mc.GridArray;
        mySharedObject.data.savedData20 = grid20_mc.GridArray;
        mySharedObject.data.savedData21 = grid21_mc.GridArray;
        mySharedObject.data.savedData22 = grid22_mc.GridArray;
        mySharedObject.data.savedData23 = grid23_mc.GridArray;
        mySharedObject.data.savedData24 = grid24_mc.GridArray;
        mySharedObject.data.savedData25 = grid25_mc.GridArray;
        mySharedObject.data.savedData26 = grid26_mc.GridArray;
        mySharedObject.data.savedData27 = grid27_mc.GridArray;
        mySharedObject.data.savedData28 = grid28_mc.GridArray;
        mySharedObject.data.savedData29 = grid29_mc.GridArray;
        mySharedObject.data.savedData30 = grid30_mc.GridArray;
        mySharedObject.data.savedData31 = grid31_mc.GridArray;
        mySharedObject.data.savedData32 = grid32_mc.GridArray;
        mySharedObject.data.savedData33 = grid33_mc.GridArray;
        mySharedObject.data.savedData34 = grid34_mc.GridArray;
        mySharedObject.data.savedData35 = grid35_mc.GridArray;
        mySharedObject.data.savedData36 = grid36_mc.GridArray;
    }
mySharedObject.data.savedBG1 = grid1_mc.BackgroundID;
mySharedObject.data.savedBG2 = grid2_mc.BackgroundID;
mySharedObject.data.savedBG3 = grid3_mc.BackgroundID;
mySharedObject.data.savedBG4 = grid4_mc.BackgroundID;
mySharedObject.data.savedBG5 = grid5_mc.BackgroundID;
mySharedObject.data.savedBG6 = grid6_mc.BackgroundID;
mySharedObject.data.savedBG7 = grid7_mc.BackgroundID;
mySharedObject.data.savedBG8 = grid8_mc.BackgroundID;
mySharedObject.data.savedBG9 = grid9_mc.BackgroundID;
mySharedObject.data.savedBG10 = grid10_mc.BackgroundID;
mySharedObject.data.savedBG11 = grid11_mc.BackgroundID;
mySharedObject.data.savedBG12 = grid12_mc.BackgroundID;
mySharedObject.data.savedBG13 = grid13_mc.BackgroundID;
mySharedObject.data.savedBG14 = grid14_mc.BackgroundID;
mySharedObject.data.savedBG15 = grid15_mc.BackgroundID;
mySharedObject.data.savedBG16 = grid16_mc.BackgroundID;
mySharedObject.data.savedBG17 = grid17_mc.BackgroundID;
mySharedObject.data.savedBG18 = grid18_mc.BackgroundID;
mySharedObject.data.savedBG19 = grid19_mc.BackgroundID;
mySharedObject.data.savedBG20 = grid20_mc.BackgroundID;
mySharedObject.data.savedBG21 = grid21_mc.BackgroundID;
mySharedObject.data.savedBG22 = grid22_mc.BackgroundID;
mySharedObject.data.savedBG23 = grid23_mc.BackgroundID;
mySharedObject.data.savedBG24 = grid24_mc.BackgroundID;
mySharedObject.data.savedBG25 = grid25_mc.BackgroundID;
mySharedObject.data.savedBG26 = grid26_mc.BackgroundID;
mySharedObject.data.savedBG27 = grid27_mc.BackgroundID;
mySharedObject.data.savedBG28 = grid28_mc.BackgroundID;
mySharedObject.data.savedBG29 = grid29_mc.BackgroundID;
mySharedObject.data.savedBG30 = grid30_mc.BackgroundID;
mySharedObject.data.savedBG31 = grid31_mc.BackgroundID;
mySharedObject.data.savedBG32 = grid32_mc.BackgroundID;
mySharedObject.data.savedBG33 = grid33_mc.BackgroundID;
mySharedObject.data.savedBG34 = grid34_mc.BackgroundID;
mySharedObject.data.savedBG35 = grid35_mc.BackgroundID;
mySharedObject.data.savedBG36 = grid36_mc.BackgroundID;
break;

case “Group 2”:
trace(“save2”);
mySharedObject.data.savedData101 = grid1_mc.GridArray;
mySharedObject.data.savedData102 = grid2_mc.GridArray;
mySharedObject.data.savedData103 = grid3_mc.GridArray;
mySharedObject.data.savedData104 = grid4_mc.GridArray;
mySharedObject.data.savedData105 = grid5_mc.GridArray;
mySharedObject.data.savedData106 = grid6_mc.GridArray;
mySharedObject.data.savedData107 = grid7_mc.GridArray;
mySharedObject.data.savedData108 = grid8_mc.GridArray;
mySharedObject.data.savedData109 = grid9_mc.GridArray;
mySharedObject.data.savedData110 = grid10_mc.GridArray;
mySharedObject.data.savedData111 = grid11_mc.GridArray;
mySharedObject.data.savedData112 = grid12_mc.GridArray;
mySharedObject.data.savedData113 = grid13_mc.GridArray;
mySharedObject.data.savedData114 = grid14_mc.GridArray;
mySharedObject.data.savedData115 = grid15_mc.GridArray;
mySharedObject.data.savedData116 = grid16_mc.GridArray;
mySharedObject.data.savedData117 = grid17_mc.GridArray;
mySharedObject.data.savedData118 = grid18_mc.GridArray;
mySharedObject.data.savedData119 = grid19_mc.GridArray;
mySharedObject.data.savedData120 = grid20_mc.GridArray;
mySharedObject.data.savedData121 = grid21_mc.GridArray;
mySharedObject.data.savedData122 = grid22_mc.GridArray;
mySharedObject.data.savedData123 = grid23_mc.GridArray;
mySharedObject.data.savedData124 = grid24_mc.GridArray;
mySharedObject.data.savedData125 = grid25_mc.GridArray;
mySharedObject.data.savedData126 = grid26_mc.GridArray;
mySharedObject.data.savedData127 = grid27_mc.GridArray;
mySharedObject.data.savedData128 = grid28_mc.GridArray;
mySharedObject.data.savedData129 = grid29_mc.GridArray;
mySharedObject.data.savedData130 = grid30_mc.GridArray;
mySharedObject.data.savedData131 = grid31_mc.GridArray;
mySharedObject.data.savedData132 = grid32_mc.GridArray;
mySharedObject.data.savedData133 = grid33_mc.GridArray;
mySharedObject.data.savedData134 = grid34_mc.GridArray;
mySharedObject.data.savedData135 = grid35_mc.GridArray;
mySharedObject.data.savedData136 = grid36_mc.GridArray;

mySharedObject.data.savedBG101 = grid1_mc.BackgroundID;
mySharedObject.data.savedBG102 = grid2_mc.BackgroundID;
mySharedObject.data.savedBG103 = grid3_mc.BackgroundID;
mySharedObject.data.savedBG104 = grid4_mc.BackgroundID;
mySharedObject.data.savedBG105 = grid5_mc.BackgroundID;
mySharedObject.data.savedBG106 = grid6_mc.BackgroundID;
mySharedObject.data.savedBG107 = grid7_mc.BackgroundID;
mySharedObject.data.savedBG108 = grid8_mc.BackgroundID;
mySharedObject.data.savedBG109 = grid9_mc.BackgroundID;
mySharedObject.data.savedBG110 = grid10_mc.BackgroundID;
mySharedObject.data.savedBG111 = grid11_mc.BackgroundID;
mySharedObject.data.savedBG112 = grid12_mc.BackgroundID;
mySharedObject.data.savedBG113 = grid13_mc.BackgroundID;
mySharedObject.data.savedBG114 = grid14_mc.BackgroundID;
mySharedObject.data.savedBG115 = grid15_mc.BackgroundID;
mySharedObject.data.savedBG116 = grid16_mc.BackgroundID;
mySharedObject.data.savedBG117 = grid17_mc.BackgroundID;
mySharedObject.data.savedBG118 = grid18_mc.BackgroundID;
mySharedObject.data.savedBG119 = grid19_mc.BackgroundID;
mySharedObject.data.savedBG120 = grid20_mc.BackgroundID;
mySharedObject.data.savedBG121 = grid21_mc.BackgroundID;
mySharedObject.data.savedBG122 = grid22_mc.BackgroundID;
mySharedObject.data.savedBG123 = grid23_mc.BackgroundID;
mySharedObject.data.savedBG124 = grid24_mc.BackgroundID;
mySharedObject.data.savedBG125 = grid25_mc.BackgroundID;
mySharedObject.data.savedBG126 = grid26_mc.BackgroundID;
mySharedObject.data.savedBG127 = grid27_mc.BackgroundID;
mySharedObject.data.savedBG128 = grid28_mc.BackgroundID;
mySharedObject.data.savedBG129 = grid29_mc.BackgroundID;
mySharedObject.data.savedBG130 = grid30_mc.BackgroundID;
mySharedObject.data.savedBG131 = grid31_mc.BackgroundID;
mySharedObject.data.savedBG132 = grid32_mc.BackgroundID;
mySharedObject.data.savedBG133 = grid33_mc.BackgroundID;
mySharedObject.data.savedBG134 = grid34_mc.BackgroundID;
mySharedObject.data.savedBG135 = grid35_mc.BackgroundID;
mySharedObject.data.savedBG136 = grid36_mc.BackgroundID;

break;

case "Group 3":
trace("save3");
mySharedObject.data.savedData201 = grid1_mc.GridArray;
mySharedObject.data.savedData202 = grid2_mc.GridArray;
mySharedObject.data.savedData203 = grid3_mc.GridArray;
mySharedObject.data.savedData204 = grid4_mc.GridArray;
mySharedObject.data.savedData205 = grid5_mc.GridArray;
mySharedObject.data.savedData206 = grid6_mc.GridArray;
mySharedObject.data.savedData207 = grid7_mc.GridArray;
mySharedObject.data.savedData208 = grid8_mc.GridArray;
mySharedObject.data.savedData209 = grid9_mc.GridArray;
mySharedObject.data.savedData210 = grid10_mc.GridArray;
mySharedObject.data.savedData211 = grid11_mc.GridArray;
mySharedObject.data.savedData212 = grid12_mc.GridArray;
mySharedObject.data.savedData213 = grid13_mc.GridArray;
mySharedObject.data.savedData214 = grid14_mc.GridArray;
mySharedObject.data.savedData215 = grid15_mc.GridArray;
mySharedObject.data.savedData216 = grid16_mc.GridArray;
mySharedObject.data.savedData217 = grid17_mc.GridArray;
mySharedObject.data.savedData218 = grid18_mc.GridArray;
mySharedObject.data.savedData219 = grid19_mc.GridArray;
mySharedObject.data.savedData220 = grid20_mc.GridArray;
mySharedObject.data.savedData221 = grid21_mc.GridArray;
mySharedObject.data.savedData222 = grid22_mc.GridArray;
mySharedObject.data.savedData223 = grid23_mc.GridArray;
mySharedObject.data.savedData224 = grid24_mc.GridArray;
mySharedObject.data.savedData225 = grid25_mc.GridArray;
mySharedObject.data.savedData226 = grid26_mc.GridArray;
mySharedObject.data.savedData227 = grid27_mc.GridArray;
mySharedObject.data.savedData228 = grid28_mc.GridArray;
mySharedObject.data.savedData229 = grid29_mc.GridArray;
mySharedObject.data.savedData230 = grid30_mc.GridArray;
mySharedObject.data.savedData231 = grid31_mc.GridArray;
mySharedObject.data.savedData232 = grid32_mc.GridArray;
mySharedObject.data.savedData233 = grid33_mc.GridArray;
mySharedObject.data.savedData234 = grid34_mc.GridArray;
mySharedObject.data.savedData235 = grid35_mc.GridArray;
mySharedObject.data.savedData236 = grid36_mc.GridArray;

mySharedObject.data.savedBG201 = grid1_mc.BackgroundID;
mySharedObject.data.savedBG202 = grid2_mc.BackgroundID;
mySharedObject.data.savedBG203 = grid3_mc.BackgroundID;
mySharedObject.data.savedBG204 = grid4_mc.BackgroundID;
mySharedObject.data.savedBG205 = grid5_mc.BackgroundID;
mySharedObject.data.savedBG206 = grid6_mc.BackgroundID;
mySharedObject.data.savedBG207 = grid7_mc.BackgroundID;
mySharedObject.data.savedBG208 = grid8_mc.BackgroundID;
mySharedObject.data.savedBG209 = grid9_mc.BackgroundID;
mySharedObject.data.savedBG210 = grid10_mc.BackgroundID;
mySharedObject.data.savedBG211 = grid11_mc.BackgroundID;
mySharedObject.data.savedBG212 = grid12_mc.BackgroundID;
mySharedObject.data.savedBG213 = grid13_mc.BackgroundID;
mySharedObject.data.savedBG214 = grid14_mc.BackgroundID;
mySharedObject.data.savedBG215 = grid15_mc.BackgroundID;
mySharedObject.data.savedBG216 = grid16_mc.BackgroundID;
mySharedObject.data.savedBG217 = grid17_mc.BackgroundID;
mySharedObject.data.savedBG218 = grid18_mc.BackgroundID;
mySharedObject.data.savedBG219 = grid19_mc.BackgroundID;
mySharedObject.data.savedBG220 = grid20_mc.BackgroundID;
mySharedObject.data.savedBG221 = grid21_mc.BackgroundID;
mySharedObject.data.savedBG222 = grid22_mc.BackgroundID;
mySharedObject.data.savedBG223 = grid23_mc.BackgroundID;
mySharedObject.data.savedBG224 = grid24_mc.BackgroundID;
mySharedObject.data.savedBG225 = grid25_mc.BackgroundID;
mySharedObject.data.savedBG226 = grid26_mc.BackgroundID;
mySharedObject.data.savedBG227 = grid27_mc.BackgroundID;
mySharedObject.data.savedBG228 = grid28_mc.BackgroundID;
mySharedObject.data.savedBG229 = grid29_mc.BackgroundID;
mySharedObject.data.savedBG230 = grid30_mc.BackgroundID;
mySharedObject.data.savedBG231 = grid31_mc.BackgroundID;
mySharedObject.data.savedBG232 = grid32_mc.BackgroundID;
mySharedObject.data.savedBG233 = grid33_mc.BackgroundID;
mySharedObject.data.savedBG234 = grid34_mc.BackgroundID;
mySharedObject.data.savedBG235 = grid35_mc.BackgroundID;
mySharedObject.data.savedBG236 = grid36_mc.BackgroundID;
break;
}
mySharedObject.flush();
}
public function loadArray(_choise):void
{
clearGrid();
killAllBG();
switch(_choise)
{
  case “Group 1”:
    trace(“load 1”);
    grid1_mc.GridArray = mySharedObject.data.savedData1;
    grid2_mc.GridArray = mySharedObject.data.savedData2;
    grid3_mc.GridArray = mySharedObject.data.savedData3;
    grid4_mc.GridArray = mySharedObject.data.savedData4;
    grid5_mc.GridArray = mySharedObject.data.savedData5;
    grid6_mc.GridArray = mySharedObject.data.savedData6;
    grid7_mc.GridArray = mySharedObject.data.savedData7;
    grid8_mc.GridArray = mySharedObject.data.savedData8;
    grid9_mc.GridArray = mySharedObject.data.savedData9;
    grid10_mc.GridArray = mySharedObject.data.savedData10;
    grid11_mc.GridArray = mySharedObject.data.savedData11;
    grid12_mc.GridArray = mySharedObject.data.savedData12;
    grid13_mc.GridArray = mySharedObject.data.savedData13;
    grid14_mc.GridArray = mySharedObject.data.savedData14;
    grid15_mc.GridArray = mySharedObject.data.savedData15;
    grid16_mc.GridArray = mySharedObject.data.savedData16;
    grid17_mc.GridArray = mySharedObject.data.savedData17;
    grid18_mc.GridArray = mySharedObject.data.savedData18;
    grid19_mc.GridArray = mySharedObject.data.savedData19;
    grid20_mc.GridArray = mySharedObject.data.savedData20;
    grid21_mc.GridArray = mySharedObject.data.savedData21;
    grid22_mc.GridArray = mySharedObject.data.savedData22;
    grid23_mc.GridArray = mySharedObject.data.savedData23;
    grid24_mc.GridArray = mySharedObject.data.savedData24;
    grid25_mc.GridArray = mySharedObject.data.savedData25;
    grid26_mc.GridArray = mySharedObject.data.savedData26;
    grid27_mc.GridArray = mySharedObject.data.savedData27;
    grid28_mc.GridArray = mySharedObject.data.savedData28;
    grid29_mc.GridArray = mySharedObject.data.savedData29;
grid30_mc.GridArray = mySharedObject.data.savedData30;
grid31_mc.GridArray = mySharedObject.data.savedData31;
grid32_mc.GridArray = mySharedObject.data.savedData32;
grid33_mc.GridArray = mySharedObject.data.savedData33;
grid34_mc.GridArray = mySharedObject.data.savedData34;
grid35_mc.GridArray = mySharedObject.data.savedData35;
grid36_mc.GridArray = mySharedObject.data.savedData36;
grid30_mc.BackgroundID = mySharedObject.data.savedBG30;
grid31_mc.BackgroundID = mySharedObject.data.savedBG31;
grid32_mc.BackgroundID = mySharedObject.data.savedBG32;
grid33_mc.BackgroundID = mySharedObject.data.savedBG33;
grid34_mc.BackgroundID = mySharedObject.data.savedBG34;
grid35_mc.BackgroundID = mySharedObject.data.savedBG35;
grid36_mc.BackgroundID = mySharedObject.data.savedBG36;
break;
case "Group 2":
  trace("load2");
grid1_mc.GridArray = mySharedObject.data.savedData101;
grid2_mc.GridArray = mySharedObject.data.savedData102;
grid3_mc.GridArray = mySharedObject.data.savedData103;
grid4_mc.GridArray = mySharedObject.data.savedData104;
grid5_mc.GridArray = mySharedObject.data.savedData105;
grid6_mc.GridArray = mySharedObject.data.savedData106;
grid7_mc.GridArray = mySharedObject.data.savedData107;
grid8_mc.GridArray = mySharedObject.data.savedData108;
grid9_mc.GridArray = mySharedObject.data.savedData109;
grid10_mc.GridArray = mySharedObject.data.savedData110;
grid11_mc.GridArray = mySharedObject.data.savedData111;
grid12_mc.GridArray = mySharedObject.data.savedData112;
grid13_mc.GridArray = mySharedObject.data.savedData113;
grid14_mc.GridArray = mySharedObject.data.savedData114;
grid15_mc.GridArray = mySharedObject.data.savedData115;
grid16_mc.GridArray = mySharedObject.data.savedData116;
grid17_mc.GridArray = mySharedObject.data.savedData117;
grid18_mc.GridArray = mySharedObject.data.savedData118;
grid19_mc.GridArray = mySharedObject.data.savedData119;
grid20_mc.GridArray = mySharedObject.data.savedData120;
grid21_mc.GridArray = mySharedObject.data.savedData121;
grid22_mc.GridArray = mySharedObject.data.savedData122;
grid23_mc.GridArray = mySharedObject.data.savedData123;
grid24_mc.GridArray = mySharedObject.data.savedData124;
grid25_mc.GridArray = mySharedObject.data.savedData125;
grid26_mc.GridArray = mySharedObject.data.savedData126;
grid27_mc.GridArray = mySharedObject.data.savedData127;
grid28_mc.GridArray = mySharedObject.data.savedData128;
grid29_mc.GridArray = mySharedObject.data.savedData129;
grid30_mc.GridArray = mySharedObject.data.savedData130;
grid31_mc.GridArray = mySharedObject.data.savedData131;
grid32_mc.GridArray = mySharedObject.data.savedData132;
grid33_mc.GridArray = mySharedObject.data.savedData133;
grid34_mc.GridArray = mySharedObject.data.savedData134;
grid35_mc.GridArray = mySharedObject.data.savedData135;
grid36_mc.GridArray = mySharedObject.data.savedData136;

grid1_mc.BackgroundID = mySharedObject.data.savedBG101;
grid2_mc.BackgroundID = mySharedObject.data.savedBG102;
grid3_mc.BackgroundID = mySharedObject.data.savedBG103;
grid4_mc.BackgroundID = mySharedObject.data.savedBG104;
grid5_mc.BackgroundID = mySharedObject.data.savedBG105;
grid6_mc.BackgroundID = mySharedObject.data.savedBG106;
grid7_mc.BackgroundID = mySharedObject.data.savedBG107;
grid8_mc.BackgroundID = mySharedObject.data.savedBG108;
grid9_mc.BackgroundID = mySharedObject.data.savedBG109;
grid10_mc.BackgroundID = mySharedObject.data.savedBG110;
grid11_mc.BackgroundID = mySharedObject.data.savedBG111;
grid12_mc.BackgroundID = mySharedObject.data.savedBG112;
grid13_mc.BackgroundID = mySharedObject.data.savedBG113;
grid14_mc.BackgroundID = mySharedObject.data.savedBG114;
grid15_mc.BackgroundID = mySharedObject.data.savedBG115;
grid16_mc.BackgroundID = mySharedObject.data.savedBG116;
grid17_mc.BackgroundID = mySharedObject.data.savedBG117;
grid18_mc.BackgroundID = mySharedObject.data.savedBG118;
grid19_mc.BackgroundID = mySharedObject.data.savedBG119;
grid20_mc.BackgroundID = mySharedObject.data.savedBG120;
grid21_mc.BackgroundID = mySharedObject.data.savedBG121;
grid22_mc.BackgroundID = mySharedObject.data.savedBG122;
grid23_mc.BackgroundID = mySharedObject.data.savedBG123;
grid24_mc.BackgroundID = mySharedObject.data.savedBG124;
grid25_mc.BackgroundID = mySharedObject.data.savedBG125;
grid26_mc.BackgroundID = mySharedObject.data.savedBG126;
grid27_mc.BackgroundID = mySharedObject.data.savedBG127;
grid28_mc.BackgroundID = mySharedObject.data.savedBG128;
grid29_mc.BackgroundID = mySharedObject.data.savedBG129;
grid30_mc.BackgroundID = mySharedObject.data.savedBG130;
grid31_mc.BackgroundID = mySharedObject.data.savedBG131;
grid32_mc.BackgroundID = mySharedObject.data.savedBG132;
grid33_mc.BackgroundID = mySharedObject.data.savedBG133;
grid34_mc.BackgroundID = mySharedObject.data.savedBG134;
grid35_mc.BackgroundID = mySharedObject.data.savedBG135;
grid36_mc.BackgroundID = mySharedObject.data.savedBG136;
break;

case "Group 3":
    trace("load3");
    grid1_mc.GridArray = mySharedObject.data.savedData201;
    grid2_mc.GridArray = mySharedObject.data.savedData202;
    grid3_mc.GridArray = mySharedObject.data.savedData203;
    grid4_mc.GridArray = mySharedObject.data.savedData204;
    grid5_mc.GridArray = mySharedObject.data.savedData205;
    grid6_mc/GridArray = mySharedObject.data.savedData206;
    grid7_mc.GridArray = mySharedObject.data.savedData207;
    grid8_mc.GridArray = mySharedObject.data.savedData208;
    grid9_mc.GridArray = mySharedObject.data.savedData209;
    grid10_mc.GridArray = mySharedObject.data.savedData210;
    grid11_mc.GridArray = mySharedObject.data.savedData211;
    grid12_mc.GridArray = mySharedObject.data.savedData212;
    grid13_mc.GridArray = mySharedObject.data.savedData213;
    grid14_mc.GridArray = mySharedObject.data.savedData214;
    grid15_mc.GridArray = mySharedObject.data.savedData215;
    grid16_mc.GridArray = mySharedObject.data.savedData216;
    grid17_mc.GridArray = mySharedObject.data.savedData217;
    grid18_mc.GridArray = mySharedObject.data.savedData218;
    grid19_mc/GridArray = mySharedObject.data.savedData219;
    grid20_mc/GridArray = mySharedObject.data.savedData220;
    grid21_mc/GridArray = mySharedObject.data.savedData221;
    grid22_mc/GridArray = mySharedObject.data.savedData222;
    grid23_mc/GridArray = mySharedObject.data.savedData223;
    grid24_mc/GridArray = mySharedObject.data.savedData224;
    grid25_mc/GridArray = mySharedObject.data.savedData225;
    grid26_mc/GridArray = mySharedObject.data.savedData226;
    grid27_mc/GridArray = mySharedObject.data.savedData227;
    grid28_mc/GridArray = mySharedObject.data.savedData228;
    grid29_mc/GridArray = mySharedObject.data.savedData229;
    grid30_mc/GridArray = mySharedObject.data.savedData230;
    grid31_mc/GridArray = mySharedObject.data.savedData231;
    grid32_mc/GridArray = mySharedObject.data.savedData232;
    grid33_mc/GridArray = mySharedObject.data.savedData233;
    grid34_mc/GridArray = mySharedObject.data.savedData234;
    grid35_mc/GridArray = mySharedObject.data.savedData235;
    grid36_mc/GridArray = mySharedObject.data.savedData236;

    grid1_mc.BackgroundID = mySharedObject.data.savedBG201;
    grid2_mc.BackgroundID = mySharedObject.data.savedBG202;
    grid3_mc.BackgroundID = mySharedObject.data.savedBG203;
    grid4_mc.BackgroundID = mySharedObject.data.savedBG204;
    grid5_mc.BackgroundID = mySharedObject.data.savedBG205;
    grid6_mc.BackgroundID = mySharedObject.data.savedBG206;
    grid7_mc.BackgroundID = mySharedObject.data.savedBG207;
    grid8_mc.BackgroundID = mySharedObject.data.savedBG208;
    grid9_mc.BackgroundID = mySharedObject.data.savedBG209;
    grid10_mc.BackgroundID = mySharedObject.data.savedBG210;
    grid11_mc.BackgroundID = mySharedObject.data.savedBG211;
    grid12_mc.BackgroundID = mySharedObject.data.savedBG212;
grid13_mc.BackgroundImage = mySharedObject.data.savedBG213;
grid14_mc.BackgroundImage = mySharedObject.data.savedBG214;
grid15_mc.BackgroundImage = mySharedObject.data.savedBG215;
grid16_mc.BackgroundImage = mySharedObject.data.savedBG216;
grid17_mc.BackgroundImage = mySharedObject.data.savedBG217;
grid18_mc.BackgroundImage = mySharedObject.data.savedBG218;
grid19_mc.BackgroundImage = mySharedObject.data.savedBG219;
grid20_mc.BackgroundImage = mySharedObject.data.savedBG220;
grid21_mc.BackgroundImage = mySharedObject.data.savedBG221;
grid22_mc.BackgroundImage = mySharedObject.data.savedBG222;
grid23_mc.BackgroundImage = mySharedObject.data.savedBG223;
grid24_mc.BackgroundImage = mySharedObject.data.savedBG224;
grid25_mc.BackgroundImage = mySharedObject.data.savedBG225;
grid26_mc.BackgroundImage = mySharedObject.data.savedBG226;
grid27_mc.BackgroundImage = mySharedObject.data.savedBG227;
grid28_mc.BackgroundImage = mySharedObject.data.savedBG228;
grid29_mc.BackgroundImage = mySharedObject.data.savedBG229;
grid30_mc.BackgroundImage = mySharedObject.data.savedBG230;
grid31_mc.BackgroundImage = mySharedObject.data.savedBG231;
grid32_mc.BackgroundImage = mySharedObject.data.savedBG232;
grid33_mc.BackgroundImage = mySharedObject.data.savedBG233;
grid34_mc.BackgroundImage = mySharedObject.data.savedBG234;
grid35_mc.BackgroundImage = mySharedObject.data.savedBG235;
grid36_mc.BackgroundImage = mySharedObject.data.savedBG236;
break;
}

for(var i:int = 0; i <= 35; i++)
{
    if(MasterGridArray[i].BackgroundID != 0)
    {
        activeGrid = MasterStringGridArray[i];
        activeMovieClip = MasterGridArray[i];
        placepicture(301, MasterGridArray[i].BackgroundID);
    }
    for(var j:int = 0; j <= 8; j++)
    {
        if(MasterGridArray[i].GridArray[j] != null)
        {
            activeGrid = MasterStringGridArray[i];
            activeMovieClip = MasterGridArray[i];
            //trace(activeMovieClip.BackgroundImage);
            //if(activeMovieClip.BackgroundImage != 0)
            //    trace("bla");
            //placepicture(301, activeMovieClip.BackgroundImage);
            placepicture(j, MasterGridArray[i].GridArray[j]);
        }
    }
}

public function clearGrid():void
{
    for(var i:int = 0; i < MasterGridArray.length; i++)
activeMovieClip = MasterGridArray[i];
activeGrid = MasterStringGridArray[i];
activeMovieClip.GridArray = [];
//removeChild(activeMovieClip.Background);
minikill();
/*for(var j:int = 0; j <= 8; j++)
{
}*/
}

public function minikill():void
{
    /*if(activeMovieClip.Background != undefined)
    {
        removeChild(MasterGridArray[i].Background);
        activeMovieClip.BackgroundID = 0;
        activeMovieClip.Background = undefined;
    }*/
    /*if(bglist[0] != undefined)
    {
    }*/
    for(var i:int = 0; i < activeMovieClip.piclist.length; i++)
    {
        removeChild(activeMovieClip.piclist[i]);
    }
    //bglist = [];
    activeMovieClip.piclist = [];
}

//Loading Pics into the Grids
public function gridloader(id):void
{
    if(activeGrid != null)
    {
        var picplace:int = 0; //Pic Position
        if(id > 300)
        {
            if(activeMovieClip.Background == undefined)
            {
                //activeMovieClip.Background = id;
                placepicture(picplace, id);
            }
        }
        else
        {
            for(var i:uint = 0; i <= 8; i++)
            {
                if(ArrayCheck(i) == null)
                {
                    ArrayFill(i, id);
                    picplace = i;
                    placepicture(picplace, id);
                    break;
                }
            }
        }
    }
}
public function killBG(_activeGrid)
{
    removeChild(_activeGrid.Background);
}

public function killAllBG()
{
    for(var i:int = 0; i < MasterGridArray.length; i++)
    {
        if(MasterGridArray[i].Background != undefined)
        {
            removeChild(MasterGridArray[i].Background);
            MasterGridArray[i].BackgroundID = 0;
        }
    }
}

public function newgridloader():void
{
    var picplace:int = 0;

    //killBG();
    if(activeMovieClip.BackgroundID != 0)
    {
        placepicture(301, activeMovieClip.BackgroundID);
    }
    for(var i:uint = 0; i <= 8; i++)
    {
        if(activeMovieClip.GridArray[i] != 0 && activeMovieClip.GridArray[i] != undefined)
        {
            picplace = i;
            placepicture(picplace, activeMovieClip.GridArray[i]);
        }
    }
}

public function placepicture(_position, _id)
{
    var idcalc:int = 101;
    if(_id > 300)
    {
        idcalc = 301;
        spNameList = bgXmlData.background.name;
        spPictureList = bgXmlData.background.image;
        spIDList = bgXmlData.background.id;
        spDescript = bgXmlData.background.description;
        placebgpicture(_id, idcalc);
    }
    else if(_id > 200)
    {
        idcalc = 201
        spNameList = plantsXmlData.plants.name;
        spPictureList = plantsXmlData.plants.image;
        spIDList = plantsXmlData.plants.id;
        spDescript = plantsXmlData.plants.description;
        placesmallpicture(_position, _id, idcalc);
    }
    else
    {

idcalc = 101;
spNameList = animalsXmlData.animals.name;
spPictureList = animalsXmlData.animals.image;
spIDList = animalsXmlData.animals.id;
spDescript = animalsXmlData.animals.sdescription;
spTrackList = animalsXmlData.animals.track;
placesmallpicture(_position, _id, idcalc);
}
}

public function placebgpicture(_id, _idcalc)
{
    var myUILoader = new smallcustomuiloader(activeMovieClip);
    myUILoader.width = 100;
    myUILoader.height = 100;
    myUILoader.scaleContent = true;
    myUILoader.source = spPictureList[_id - _idcalc];
    addChildAt(myUILoader, 50);
    activeMovieClip.Background = myUILoader;
    activeMovieClip.BackgroundID = _id;
    bglist = [];
    bglist.push(myUILoader);
    myUILoader.move(getChildByName(activeGrid).x , getChildByName(activeGrid).y);
}

public function placesmallpicture(_position, _id, _idcalc)
{
    //accesses the global array to display the “small” icon images
    var myUILoader = new smallcustomuiloader(activeMovieClip);
    myUILoader.width = 33;
    myUILoader.height = 33;
    myUILoader.scaleContent = true;
    //myUILoader.alpha = .8;
    myUILoader.source = spPictureList[_id - _idcalc];
    addChildAt(myUILoader, 38);
    activeMovieClip.piclist.push(myUILoader);
    myUILoader.buttonMode = true;
    //At different coordinates an image will be added to the active grid
    switch (_position)
    {
    case 0:
        myUILoader.move(getChildByName(activeGrid).x + 1, getChildByName(activeGrid).y + 1);
        break;
    case 1:
        myUILoader.move(getChildByName(activeGrid).x + 34, getChildByName(activeGrid).y + 1);
        break;
    case 2:
        myUILoader.move(getChildByName(activeGrid).x + 67, getChildByName(activeGrid).y + 1);
        break;
    case 3:
        myUILoader.move(getChildByName(activeGrid).x + 1, getChildByName(activeGrid).y + 34);
        break;
    case 4:
        myUILoader.move(getChildByName(activeGrid).x + 34, getChildByName(activeGrid).y + 34);
        break;
    case 5:
        myUILoader.move(getChildByName(activeGrid).x + 67, getChildByName(activeGrid).y + 34);
        break;
    case 6:
    }
myUILoader.move(getChildByName(activeGrid).x + 1, getChildByName(activeGrid).y + 67);
break;
case 7:
myUILoader.move(getChildByName(activeGrid).x + 34, getChildByName(activeGrid).y + 67);
break;
case 8:
myUILoader.move(getChildByName(activeGrid).x + 67, getChildByName(activeGrid).y + 67);
break;
}
}
}

next.as
Function: Loads the movie clip that holds the nextbutton, which takes the user to the next view of the tool box pop-up window.
package
{
import flash.display.MovieClip;
import flash.events.*;
public class next extends MovieClip
{
var More:Boolean = true;
static public var next;
//var AIBool:Boolean = false;
public function next()
{
    /*this.x = x_;    
     this.y = y_;*/
     this.buttonMode = true;
    next = this;
    addEventListener(MouseEvent.CLICK, onClick);
}
public function onClick(e:MouseEvent):void
{
    if(More)
    {
        main.main.kill();
        /*if(AIBool)
        {
            main.main.AIBuildProcess();
        }
        else
        {*/
        More = main.main.BuildProcess();
        //}
    }
}
}

object.as
Function: Loads all objects into the empty GUI movie clip holder.
package
{
import flash.display.MovieClip;
import flash.events.*;
public class object extends MovieClip
public function object(x_, y_)
{
    this.x = x_;    
    this.y = y_;  
}

objectsmall.as
Function: Public class objectsmall extends MovieClip to allow to load GRID.
package
{
    import flash.display.MovieClip;
    import flash.events.*;
    public class objectsmall extends MovieClip
    {
        public function objectsmall(x_, y_)
        {
            this.x = x_;    
            this.y = y_;  
        }
    }
}

smallcustomuiloader.as
Function: Public class object small extends MovieClip to allow to load content into GRID.
package
{
    import fl.containers.UIManager;
    import flash.events.*;
    import flash.display.MovieClip;
    public class smallcustomuiloader extends UIManager
    {
        //Temporary cache for ID
        var Grid:MovieClip;

        public function smallcustomuiloader(_activeMovieClip:MovieClip)
        {
            Grid = _activeMovieClip;
            this.buttonMode = true;
            addButtonListener(MouseEvent.CLICK, onClick);
        }

        public function onClick(e:MouseEvent):void
        {
            trace(Grid.name);
            Grid.onClick(e);
        }
    }
}

smallcustomuiloader.as
Function: Loads function for the Up Button into the JTF tool box pop-up window.
package
{
    import flash.display.MovieClip;
import flash.events.*;
public class up extends MovieClip
{
   public function up()
   {
      /*this.x = x_; 
      this.y = y_;*/
      this.buttonMode = true;
      addEventListener(MouseEvent.CLICK, onClick);
   }
   public function onClick(e:MouseEvent):void
   {
      main.main.lspopup.visible = true;
   }
}
There are about 1300 species of Ants in Australia. Ants are insects and usually live in large colonies. Ants vary in length from about 1 to 30 mm and are typically black, brown, red, yellow or a combination of these colours. Habits, behaviour and nest sites vary widely between species. Many are scavengers and have varied diets, while others are specialist seed-eaters or predators. In a colony, there are three social levels: the wingless and usually sterile female workers, fertile females (or queens) and males. Winged males and queens are produced at certain times of the year and, when conditions are right, leave the nest on mating flights. After mating, the queen bites off her wings and establishes a new colony. She will not come to the surface again but will stay underground and lay eggs. The male dies after mating. Ants are found in all Australian States and Territories. Native ants play an important role in ecosystem health. Some species of ant can cause a painful sting.

The Australian Brush-turkey has a mainly black body plumage, bare red head, yellow throat wattle (pale blue in northern birds) and laterally flattened tail. It is the largest of Australia’s three megapodes (Family Megapodiidae). It inhabits rainforests and wet sclerophyll forests, but can also be found in drier scrubs and feeds on insects, seeds and fallen fruits. The Australian Brush-turkey incubates its eggs in a large mound. The male maintains a constant temperature of 33–38°C by digging holes in the mound and inserting his bill to check the heat, then adding and removing vegetable matter as required. Before the eggs hatch, many fall prey to burrowing predators such as goannas. After hatching, the chicks burrow out of the mound, at which point they are left to fend for themselves. These hatchlings are fully feathered and are able to walk and fend for themselves immediately. Remarkably, they are able to fly just a few hours after hatching.

Here is a sample from the background.xml:
<description></description>

<background>
    <id>302</id>
    <name>shrubs and bushes</name>
    <image title="shrubs">img/background/deepgrass.png</image>
    <description></description>
</background>

<background>
    <id>303</id>
    <name>rocks</name>
    <image title="rocks">img/background/rock.png</image>
    <description></description>
</background>

<background>
    <id>304</id>
    <name>sand and soil</name>
    <image title="sand">img/background/sand.png</image>
    <description></description>
</background>

<background>
    <id>305</id>
    <name>trees</name>
    <image title="trees">img/background/tree.png</image>
    <description></description>
</background>

<background>
    <id>306</id>
    <name>water</name>
    <image title="water">img/background/water.png</image>
    <description></description>
</background>

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Appendix 1 Figure 2. Some of the icons used in the Graphical User Interface of JTF.
Appendix 1 Figure 3. Some of the photo icons used in the Graphical User Interface of JTF.
Appendix C. Survey Results from the Second Visit of the Second Trial, May 2010.

<table>
<thead>
<tr>
<th>Question 1. On the list below which line best describes how you liked playing the Jumping the Fence game?</th>
</tr>
</thead>
<tbody>
<tr>
<td>I did not enjoy it at all and I would not play it again Yes = 1</td>
</tr>
<tr>
<td>I think the game could be improved. If it were improved I would try playing it again in class. Yes = 4</td>
</tr>
<tr>
<td>It was OK and I would play it again in class. Yes = 6</td>
</tr>
<tr>
<td>I enjoyed it a lot. If it were free on the Internet I would download it and would play it in my own time. Yes = 11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Question 2. Which parts of the game did you like MOST?</th>
</tr>
</thead>
<tbody>
<tr>
<td>The quizzes.</td>
</tr>
<tr>
<td>The questions</td>
</tr>
<tr>
<td>Everything</td>
</tr>
<tr>
<td>The questions</td>
</tr>
<tr>
<td>Everything</td>
</tr>
<tr>
<td>The questions</td>
</tr>
<tr>
<td>When we went outside.</td>
</tr>
<tr>
<td>All of it.</td>
</tr>
<tr>
<td>Going outside and finding the animals.</td>
</tr>
<tr>
<td>Looking for plants and animals outside.</td>
</tr>
<tr>
<td>The quizzes</td>
</tr>
<tr>
<td>Looking for plants and animals outside.</td>
</tr>
<tr>
<td>Going outside and looking for animals.</td>
</tr>
<tr>
<td>The learning part.</td>
</tr>
<tr>
<td>Going out and finding animals.</td>
</tr>
<tr>
<td>To go outside and explore nature.</td>
</tr>
<tr>
<td>N.</td>
</tr>
<tr>
<td>Hated the computer work.</td>
</tr>
<tr>
<td>Going outside.</td>
</tr>
<tr>
<td>All of it.</td>
</tr>
<tr>
<td>When we noticed the flowers outside.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Question 3. Which parts of the game did you NOT like?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nothing.</td>
</tr>
<tr>
<td>The reading was too long.</td>
</tr>
<tr>
<td>The learning part.</td>
</tr>
<tr>
<td>All of it.</td>
</tr>
<tr>
<td>Not enough plants &amp; animals.</td>
</tr>
<tr>
<td>The learning part.</td>
</tr>
<tr>
<td>I did not like the computer work.</td>
</tr>
<tr>
<td>Not sure.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Question 4. How did you like the look of the characters and the graphics that make up the different parts of the game?</th>
</tr>
</thead>
<tbody>
<tr>
<td>I did not like them at all. N = 2</td>
</tr>
<tr>
<td>Some were OK but some were not. N = 8</td>
</tr>
<tr>
<td>The graphics were OK but could be better. N = 6</td>
</tr>
<tr>
<td>The graphics were good. N = 9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Question 5. How did you like the introduction movie and test?</th>
</tr>
</thead>
<tbody>
<tr>
<td>I did not like them at all. N = 3</td>
</tr>
<tr>
<td>I only liked them slightly. N = 2</td>
</tr>
<tr>
<td>They were OK but could be improved. N = 12</td>
</tr>
<tr>
<td>They were good. N = 8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Question 6. How did you like the interface and colours of the game?</th>
</tr>
</thead>
<tbody>
<tr>
<td>I did not like them at all. N = 1</td>
</tr>
<tr>
<td>Some were OK but some were not. N = 3</td>
</tr>
<tr>
<td>The interface and colours were OK but could be better. N = 6</td>
</tr>
<tr>
<td>Question</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>1. The interface and colours were good.</td>
</tr>
<tr>
<td>2. I liked the interface and colours were a lot.</td>
</tr>
<tr>
<td>3. Did you have difficulties in finding out how the game worked?</td>
</tr>
<tr>
<td>5. If you answered yes, How helpful was it to you?</td>
</tr>
<tr>
<td>6. Did you experience any technical problems with playing JTF such as buttons not clickable, animations not working, computer crashing etc.?</td>
</tr>
<tr>
<td>7. Did you enjoy having to take on a role in the game (i.e., the scientist, the environmentalist or the park manager)?</td>
</tr>
<tr>
<td>8. During the game play, did you interact more with the natural environment, than you normally would do?</td>
</tr>
<tr>
<td>9. Do you think playing Jumping the Fence enhanced your understanding of the Australian Environment?</td>
</tr>
<tr>
<td>10. After having played JTF do you know what biodiversity is?</td>
</tr>
<tr>
<td>11. After having played JTF do you understand what a biotope is?</td>
</tr>
<tr>
<td>12. What else would you like to learn about the Australian wildlife?</td>
</tr>
<tr>
<td>13. After having played JTF do you understand what a biome is?</td>
</tr>
</tbody>
</table>
308

No.

5

Na.

6

Yes.

7
No.

8
No.

9
No.

10

Yes. It is
fun.

Yes.

Yes. I
can plant
more
plants.

Yes.
Because
I like
plants.

3

3

2

2

4

2

4

3

Change
reading
into talking.

Growing
more
plants.

Don’t use
a talking
kangaroo.

Put more
animals
in the
game.

2
Let us
make
our own
environment
and put
animals
in it.

3

2 = A bit of fun (OK).

Yes.

No = 3.

No.

11

No. It
is a bit
boring.

Yes.
Because
it is awesome.

No.
Because
some
of my
friends
would
not like
it.

Yes.
Because
all my
friends
love
nature.

Yes.
Because
it is fun.

No. It
will be
too boring.

Yes = 18

Yes. It is No.
fun and
lets them
learn
about the
environment.

No.
Because
I would
like to
keep it a
secret.

No = 7.
No. I
think
they
would be
not interested
in it.

Yes.
They got
a very
fun game
to play.

4

Yes. It
would
help the
environment

No.

15

17

Yes.

No.

No.
Because
they
would
play that
all the
time.

18

Yes.

Yes.

19

Yes. It is
basically
awesome
I love it.

It was
great.

4

No. I like Yes.
to stay
inside
and play.

Yes.
Because
you will
get lots
of fresh
air.

Yes. Animals are
interesting.

No.
Because
outdoors
is nil.

Yes.
No.
Because
I enjoyed
the game.

No.

Yes. You
can get
help
from
others.

Yes.
Because
I can
meet my
friends.

No.

Yes.
Because
it is more
fun. But
there was
too many
people.

No.
Because
we are all
together.

Yes.
Everyone
worked
together.

Yes. It
was fun.

Na.

Yes.

Yes.

No.

Yes.

Yes.

Yes.

No.

Yes.

No. I just
did not
like the
game.

Yes.
Everyone
would
like to
play the
game.

No.

No.

No.

No.

Yes.

Yes.

No. They Yes.
pushed
me a lot.

No.

Yes.

Yes.

No.

No.

Yes.

No.

No.
Because
everything
took
longer.

Yes.
Because
it is more
fun.

308

No.

No.

No.

Na = 2.

No = 9

Yes.

Yes.

No = 10

Yes = 16

Yes.

Na = 2.

No.

Yes = 13

No.

Yes.

No = 9

No.

Yes.
Together
you find
more
things.

No = 11.

Yes. It
inspires
me

Yes.

Na.

Yes = 14

No.

No.

Yes = 14

Yes.
Because
it was
cool

Question 24. Would it be correct to say that caring for your biotope brought you closer to your team members?

Na.

Question 23. Do you think the game helped you get to know other children better?

Na.

Question 22. Do you discuss your game experience with friends, group members or teachers and family?

Yes.

Question 21. Did you like working in a group? If so please tell us why. If not, please tell us why not?

Yes.
Because
it is an
outside
type of
game.

No. It is
not fun
going
outside

No.

No.

Yes.

No. BeNo.
cause you
play it
only with
your own
class.

No.

Yes.
Yes. It
Together was fun.
we would
find
more
animals.

No. It is
no fun
being
outside.

Yes.

Yes. You
need
them
to find
things

Yes.

Yes. The
people
can find
more
things
together.

Yes. I
can learn
more
about the
natural
environment.

Yes.

Yes.
Because
they can
help you.

No.

Yes.

Yes. You
learn
with the
children.

No.

No.
No. It
Because was anwe can
noying.
play it
ourselves.

No.
Yes. You
Because I feel for
get head- ever good
aches
outside.

No.
It was
really the
people
in the
group.

Yes.

Yes. It
is cool
having a
special
place to
share.

Yes.

Yes.

No.

20

Yes.

Yes. You
learn
something off
them.

Yes.

No. It
was too
noisy.

Yes.
Because
I learned
stuff

No = 8.

Yes. It is
fun and
great.

It was
fun.

4

Na = 1

Yes. It
gave me
self pride

No.

4 = 10

Yes. It
would be
a good
thing for
them to
play.

4

3=8

You
should
go on a
bus to go
to places
and find
animals.

4

2=5

Yes. It
is a good
fun
computer
game and
is teaching the
kids a lot.

Change
the questions a
bit.

3

1=1

Yes.

No.

16

Yes. It
made me
more interested
in the
environment.

Yes.

When
you click
on an
animal
you
would
read
about it.

2

4 = A lot of fun.

Yes. To
see more
animals,
that is
fun.

No.

14

Yes = 17

Yes. It
is a fun
game
with lots
of questions.

3

Yes.

Yes.

13

Yes. So
you can
find
more
stuff.

No. Because my
friends
could
hate me
not to be
cool.

1

3 = Fun.

No.

Yes.

12

Question 20. Do you think playing JTF would encourage you to spend more time outdoors being engaged with the natural environment in the future? If so please tell us why. If not, please tell us why not?

Yes. It
is cool
and they
might
like it.

Question 19. Would you recommend JTF to your friends? If you would please tell us why. If not, please tell us why not?

Nothing.

To help us improve the level of fun in JTF, can you make any suggestions as to what we should do?

4

Yes.

1 = Not fun at all.

Yes. I like Yes. I
them
love animals and
plants

Question 18. How would you rate the level of fun you had playing JTF?

Yes.

Yes = 22

No.

4

Yes.

No.

3

Yes.

No.

2

Question 17. Do enjoy caring for your biotope? If so please tell us why. If not, please tell us why not?

Yes. A
biotope
is alive.

1

Yes.

Yes.

Yes.

Yes.

Yes.

Yes.

4

Yes.

No.

21

Yes.

Yes.

Yes.

Yes.
Because
we could
find
more
stuff.

Yes.

Yes.

3

Yes.

Yes.

22

No.

No.

Yes.

Yes.

Yes.

No.

Na.

No.

Yes.

23

Yes.

Yes.

No.

Yes.

No.

Yes.

4

Yes.

No.

24

Yes.

Yes.

Yes.

No.

No.
Because
people
get bossy.

Yes. Because it is
cool.

3

No.

Yes.

25


<table>
<thead>
<tr>
<th>Question 25: Do you believe that caring for your biotope has helped you develop a sense of responsibility for the natural environment?</th>
<th>Yes = 23</th>
<th>No = 2</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Question 26: What activities did you most enjoy in playing JTF?</th>
<th>Na = 8</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Question 27: What activities did you least enjoy in playing JTF?</th>
<th>Responses = 6</th>
</tr>
</thead>
</table>

| Question 28: On a scale of 1 to 5, how well do you think the rewards system worked? | 1 = did not work at all 2 = worked only occasionally 3 = worked OK 4 = worked well 5 = worked very well. |
|---|---|---|---|---|---|
| 1. Yes. 2. Yes. 3. Yes. 4. Yes. 5. No. |

<table>
<thead>
<tr>
<th>Question 29: Do you think the rewards system was a major incentive to help you play the game better?</th>
<th>Yes = 8</th>
<th>No = 2</th>
<th>Na = 15</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Question 30: What should happen to your biotope once you leave this school and cannot play JTF any longer?</th>
<th>Na = 10</th>
</tr>
</thead>
</table>

| Question 31: On a scale of 1 to 5, how well did you like the way outdoor activities and computer activities were blended together in the game? | 1 = did not work at all 2 = worked only occasionally 3 = worked OK 4 = worked well 5 = worked very well. |
|---|---|---|---|---|---|
| 1. Yes. 2. Yes. 3. Yes. 4. Yes. 5. No. |

<table>
<thead>
<tr>
<th>Question 32: Would you prefer not to go back to the computer based game and access the game via a portable computer device such as a mobile phone or hand held computer?</th>
<th>Yes = 22</th>
<th>No = 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes. Yes. Yes. Yes. So you do not get tired. Yes. Yes. It would be easier to play the game. Yes. Yes. Because I have my own mobile phone. Yes. Na. Because I don't use one. Yes. It is easier to get information. No. Yes. Yes. It takes ages to go back to the computer. Yes. Yes. I would be able to play on. Yes. Yes. To have the game in your hand. Yes. Yes. You need a computer. Yes. Yes. I would like to bring memories. Yes. Yes. It would be more like a Nintendo DS. Yes. Yes. Because it would be more fun. Yes. Yes. Yes.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>