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IT as a Social and Learning Tool for International Students: A Case Study in ICT Education

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IT as a social and learning tool for International students: A case study in ICT (NZQA Level 5) education

ABSTRACT

Internationalisation of education industry has increased the international student intake amongst private and public funded education providers in western countries. However, international students face many challenges in different educational and societal settings of the host country. This study examines a case (PlayIT) which is a non-university education provider involved in the information and communication technology (ICT) education sector in Auckland, New Zealand. In the first stage, study has identified some of the learning and social issues faced by international students. Learning issues relate to understanding of the host country's education framework structure and to application of subject related concepts to real world practice. Social issues relate to linguistic difficulties and cultural diversity in foreign countries. The first stage proposes to enhance the student' socio-learning experience by using a game based learning (GBL) strategy aligned with the ICT course structure, to encourage student interactions by having more learning and social exchanges. In the second stage, GBL has been used alongside traditional teaching methods to engage students and to bring about active learning for a subject module in an introductory ICT course. A GBL approach has been applied to international students enrolled in an ICT course at PlayIT. The study has utilised a GBL approach to engage students in learning and enhance their programming skills sets. The study gives a detailed narrative of how an educational game were first mapped with the curriculum of a programming course, and then examines the socio-learning experience of two separate student cohorts pursuing an introductory ICT course who participated in this classroom game-based learning intervention. One student cohort had not yet started study of the programming module, while the second student cohort had recently completed the introductory module on programming. Effectiveness of GBL has been analysed through students' feedback and results of outcomes achieved in the final assessment of programming module. Findings reveal that educational games add to the fun element in learning, with students rating the game as an effective way to learn programming. The study contributes to ongoing development of innovative pedagogies in teaching and learning with use of gaming elements in ICT education.

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PUBLICATIONS AND PRESENTATIONS

Publications generated from this project so far:

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1. Christian, S., & Mathrani, A. (2014). *ICT Education: Socio-Learning Issues Faced by International Student*s. Poster session presented at the Thirty Fifth International Conference on Information Systems, Auckland, New Zealand.
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CHAPTER 1: Introduction

1.1 Background

International students are crucial to the economy of the global education market, since they provide an opportunity to fund the education sector of host countries. Western countries compete to increase their international student intake by using aggressive marketing strategies to promote their country's qualifications. New Zealand (NZ) and Australia are attractive destinations for pursuing higher education as alongside internationally recognised qualifications, they also offer a study-migration pathway (Dzvimbo, 2003;Martens & Starke, 2008; Morrish & Lee, 2011). New Zealand's government is actively engaged in internationalisation of education sector. Recent post shows that the New Zealand government changed visa regulations and made entry requirements relaxed and easily approachable(Student visa requirements, 2015). As a result international student intake has increased considerably during the last 10 years. A ministry of education government report shows that total number of international fee paying students enrolled till 30th April in 2014 were 60,734 (8% increase than the last year)(Education Counts, 2014). The campus environment of educational organisations (i.e. polytechnics, universities and private educational organisations) are painted nowadays with multi-cultural students from all the global zones. However, international migration brings challenges both for the host country and for the student. The current study focuses on the societal and educational issues faced by the international students during their stay in the host country. International students face many societal issues which stem from diversity in socio-cultural practice, or are related to lack of English language proficiency, financial stress, and social relationships (Ramachandran, 2011; Sawir, Marginson, Deumert, Nyland, &Ramia, 2008). Social challenges are often related to linguistic and cultural differences, which may lead to learning challenges. International students may find study material to be uninteresting due to loneliness or acculturative stress (Berry, 2005; Sawir et al., 2008).

The growing use of information technology (IT) in day-to-day life encourages students to choose computing courses as their major field of study in high school and at tertiary level. The application of technology-enabled solutions in everyday activities has had a pervasive effect on

Information and Communication Technology (ICT) education. Further, occupational projections indicate that employment growth between 2008 and 2018 will mostly be related to healthcare and information and communication technology (ICT) sectors (Lacey & Wright, 2009), and students may need to be prepared for jobs that do not exist yet (Sipila, 2014). Thus, ICT is often seen as a pathway to future employment, which attracts many local and international students to opt for ICT related courses at colleges, training institutes and universities. It is expected that technological applications will get more efficient and advanced over time; as a result, ICT industry will require a more skilled workforce over time. The increasing demand in the analytical, technical and programming abilities of emerging IT graduates by the computing industry has put great responsibility on ICT education providers. To build up the problem solving capabilities of students, ICT courses are designed with many practical elements. The upcoming ICT industry requires students to be proficient in social (client facing and conversational), technical (programming and designing) and conceptual (analytical and reasoning) skill sets (Bullen, Abraham, Gallagher, & Kaiser, 2007;Downey, McMurtrey, Mark, Zeltmann, & Steven, 2008; Lee & Mirchandani 2010).

1.1.1 Need for the effective pedagogy in ICT education

In traditional classroom settings teachers evaluate students with a set of formal assignments and exams. Directed teaching is an inescapable part of classroom environment, where lectures are designed to explain theoretical concepts, which are complemented with practical experiments. However, after entering into ICT related courses (e.g., programming, networks, databases), many students find it difficult to relate the taught concepts to the real world, so find the course to be dry and boring, which lowers their motivation and interest in learning (Prensky, 2003; Sarkar, 2006). If students are not interested or motivated, it would be difficult to keep them engaged in classroom activities. To enhance student learning in achieving required IT based skill sets, innovative pedagogical approaches are applied to teaching and learning (T&L) practices.

Behavioural scientists suggest utilising some fun based interventions in classrooms to engage active learning as an effective pedagogical approach. This would make students more engaged and motivated, and change the student's mind-set that the journey of learning is not dry or boring, but can be enjoyable. One suggested approach to adding fun elements to classrooms are

use of GBL or serious games, whereby people of all ages and genders can learn classroom concepts by taught playing games. These games can be played for many hours without the player realising that they are potentially in a T&L environment (Soflano, 2011). Gaming activities is T & L environments provide instant gratification to players when tasks are completed successfully through passing different gaming stages. This study attempts to utilise a GBL approach to international student classroom context using a case involved in ICT education in New Zealand.

1.1.2 New Zealand education system

New Zealand Education system of New Zealand is divided into three levels, early childhood education, secondary schooling and tertiary education. Early Childhood Education (ECE) comprises the years from birth to school entry age. Next, secondary schooling is provided by state (government owned and funded) schools to students aged between 5 and 19 years. The secondary education system for schools involves 13 years of study (year 1 to year 13). Further, schooling is compulsory from age 6 to 16 (which is until Year 11). The last level is the tertiary education which includes all post-secondary education such as higher and vocational education. This can be delivered by both state and privately owned institutions. Tertiary education courses prepare candidate to transition from school environments to work place settings or to higher research environments through postgraduate study.

New Zealand Qualification Authority (NZQA) is a government body responsible for quality assurance of New Zealand's qualification framework (NZQF). NZQA administer the secondary school assessment system, provide independent quality assurance of non-university education providers, and set unit standards for qualification recognition from training institutes (http://www.nzqa.govt.nz). NZQF is the definitive source for latest information on quality assured qualifications in New Zealand. NZQF covers senior secondary school qualifications and tertiary education qualifications (New Zealand Qualifications Framework, n.d.). Qualifications are also categorised from level 1 to 10. Figure 1 briefly describes levels and qualification types defined in the NZQF along with the education provider for each level of qualification.

The current case study involves tertiary education courses in ICT pursued by international students. In this study, ICT courses taught at a non-university education provider (PlayIT) sets the context for the conduct of a classroom-based game intervention design.

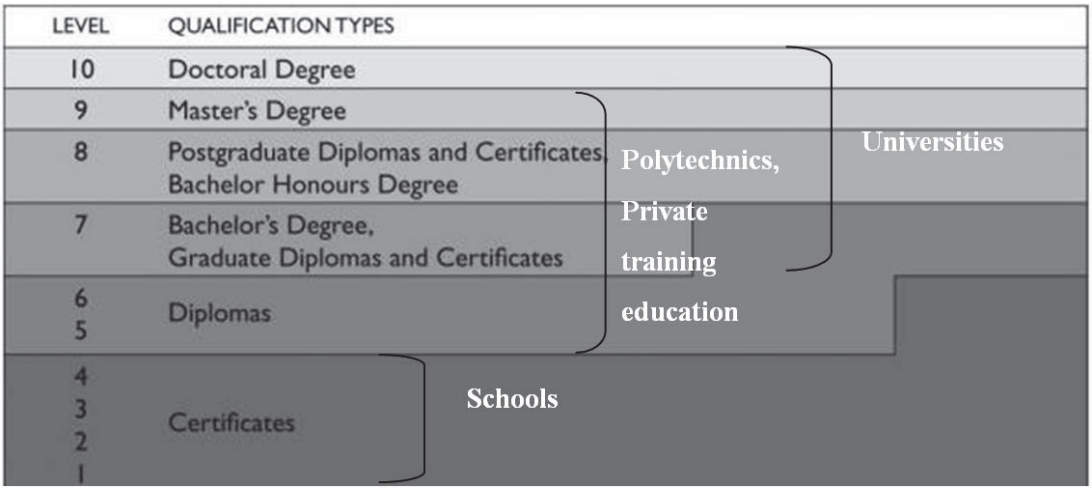


Figure 1- Level descriptors and qualification types along with the providers

(Source: http://www.nzqa.govt.nz)

1.2 Research questions and research process

The purpose of this study is to investigate issues faced by international students. Two research questions are posed based on the background of study.

RQ.1. What are the issues faced by international students pursuing NZQA based courses in information and communication technologies?

RQ. 2. How can IT tools be used to overcome these issues and enhance students' learning experience?

To answer these research questions, the case described herein as PlayIT has been employed. PlayIT is a non-university education provider offering ICT related subject courses at study levels 5 to 7 designed by NZQA. The study has been done in two stages to address the two research questions; RQ1 has been answered in the first stage which leads to the design of the second stage for answering RQ2. The research design in the first stage entailed conducting interviews at PlayIT with experienced tutors who are involved in teaching NZQA based ICT curriculum to international students. Interviews were conducted to identify learning challenges faced by

students pursuing ICT curriculum from the viewpoints of these tutors who are directly facing the students.

Interview findings served as a ground to set the design for stage 2, which looked at demonstration of how IT tools can be used for overcoming these challenges. To answer this, an intervention strategy was designed which involved aligning GBL activities with a course module set by the NZQA body. A programming module from a level 5 qualification (National Diploma in Computing) was selected for applying the game intervention strategy, because programming module is perceived to be a tough subject for students. Programming is broad topic and contains many more sub-topics; however the fundamental components such as sequential logic flow, if-then-else, loops, functions and recursions were selected for designing the game-play intervention.

PlayIT runs many courses in parallel, so two student cohorts who were at different stages of study at level 5were selected. Cohort 1 comprised of students who had not yet started studying the programming module, while cohort two students had recently completed the programming module. At the time of the game-play intervention, both cohorts had not been assessed through a final assessment, which was a requirement for completion of the level 5 diploma course. Both students' cohorts were invited in two separate classroom settings to play an educational game named Light Bot 2.0for investigating the effectiveness of GBL in T&L environments. Light Bot 2.0 utilises fictional problem scenarios aligned with ICT curriculum to engage students. Students' feedback was collected immediately after they engaged in GBL activity to examine the effectiveness of GBL to enhance their learning experience. Later students were again asked about effectiveness of GBL after the final course assessment for a level 5 completion.

1.3 Contribution of the study

International students are valuable assets as they add value to the host county's economical, educational and cultural growth. The study reveals several learning and social issues faced by international students and provide insight into how education providers can support the international student community and enhance their learning and social experiences in a foreign country. Study suggests use of some intervention strategy to bring more social and fun activities

within the traditional teaching and learning environment. Study has demonstrated how game interventions in classroom teaching aided students to learn technical and conceptual topics of a basic ICT course, while at the same time made students more open to socialising and conversing while studying in a multi-cultural environment.

This is also beneficial for tutors. Tutors can teach in more enjoyable settings by using gaming elements for difficult-to-grasp technology related topics. The findings can also help academics design better course delivery structure for international students. Further, study adds to ongoing teaching and learning pedagogies, and suggests a cost effective strategy to add the fun element to learning.

1.4 Thesis outline

Existing literature suggests seven forms of organising the writing-up of a case study, the 'issue/methods/findings/conclusions' structure, suspense structure, narrative structure, comparative structure, chronological structure, theory generating structure and un-sequenced structure(Robson, 1993, p.416). Researcher has adopted the 'issue/methods/findings/conclusions' structure, which provides the broad framework consisting of:

Issue:

a) an explanation of the focus of the case study (e.g. problem, issue, policy option, topic of evaluation)

Methods:

b) a description of the context or setting in which the enquiry took place, and with which it was concerned

Findings:

c) a description and analysis of the data obtained

Conclusion:

d) a discussion of the outcomes of the enquiry

Thesis comprises of total seven chapters in total. Chapter 1 (Introduction) has introduced the background of the study including explanation of the context of the case study and has posed the research questions. Chapter 2 (Literature Review) conducts reviews on teaching and learning

pedagogical approaches related to ICT education. Review gives some highlights on current literature in pedagogical approaches to ICT education, and how educational games have been used in previous studies. Pedagogical thinking geared towards supporting social and learning environments for international students are also discussed. The research design is explained in chapter 3 (Research Design). This includes description of the context or setting in which the enquiry took place. The chapter 4 (Data Analysis and Results) analyses the data obtained along with the methods used for data analysis. Chapter 5 (Discussion) discusses the outcomes of the study derived from the results and maps those outcomes with the existing literature. Next chapter 6 (Conclusion)concludes with an overview on findings. Finally, the last chapter (Limitations and Future Scope) describes limitations of the study and proposes the next steps to facilitate better social and learning experiences for international students within the current teaching and learning environment.

CHAPTER 2: Literature Review

This chapter firstly discusses the importance of ICT industry in New Zealand and the expectation of ICT professionals from ICT graduates in terms of desired skills sets. The review focuses mainly on international students based in New Zealand and their importance to the country. Next, the review identifies many issues that have been faced by international students pursuing ICT courses, such issues are categorised as social issues and learning issues. Further the chapter discusses existing literature based on pedagogical approaches applied in ICT education. Game based learning approach has been explored in detail in order to mitigate the issues discussed in previous section. Finally the chapter discusses few challenges that may be faced while applying GBL in educational settings.

2.1 ICT industry in New Zealand

The use of ICT is growing rapidly in most aspects of our daily lives. People consider computers and other technological devices as essential home-ware rather than luxury items. Technology enabled web services include, online purchasing, online gaming, online streaming of music and movies, social networking, file sharing, eBooks and many others. A report by Statistics New Zealand shows that around 1.3 million (80%) houses had some form of internet in 2012(Statistics New Zealand, 2013a),a further growth of 5% from the data obtained in 2009. Further, 1.8 million New Zealanders made online purchases during the last 12 months before the survey was conducted. ICT plays an important role in commerce sector leading to further economic growth of the country. Computing is interwoven in almost all facets of managing and running a business with technology being the core of every departmental activity (for example; administration, production, HR, payroll, help desk, customer service and support etc.). With just one click of mouse we can buy and sell products from the comfort of our homes, regardless of our geographical position. For a country like New Zealand, which is geographically isolated, ICT plays an important role since it connects businesses with the rest of the world. The article specifically refers to the relationship between ICT usage and our online activities which contributes to overall business growth (Statistics New Zealand, 2013b). Businesses that use internet to collect sales orders have higher rates of growth activity such as exporting, investing in expansion of firm and introducing new or improved goods, services, and processes(Strong

connection between ICT and bussines-growth activities, 2013). The U.S. Department of Labour estimates fastest five top occupations expected to rise between 2004 and 2014 in US are computing or things related to IT (www.bls.gov). A report shows that IT industry is growing fast in New Zealand. The number of ICT firms has risen by more than 4000 since 2002, which is drastic growth of 37%. In addition, the Computer and Information Services have increased export services by 85% since 2006. The minister of economic development of New Zealand has presented IT services and high-technology manufacturing as equally important emerging export sectors of New Zealand as the traditional export sectors such as tourism, forestry and food. (Ministry of Business Innovation and Employment, 2013).

2.2 Industry expectations from IT graduates

Increase in the prominence of ICT brings challenges for emerging professionals. It is expected that technological applications get like more efficient and advanced over time especially in sectors of human lives such as health, education, commerce, and security. As a result IT industry require more skilled workforce. Occupational projections indicate that employment growth between 2008 and 2018 will mostly be related to healthcare and information and communication technology (ICT) sectors(Lacey & Wright, 2009). However, research shows that number of qualified graduates is not sufficient to meet demands of IT industries (Akbulut & Looney, 2007). This becomes evident in New Zealand's IT industry too. A comment by a CEO of one of the industry bodies

> *"The best guesstimate is that we will need twice as many people working in the technology industry – broadly defined – as we have today. The biggest bottleneck is the scarcity of people"*(Ministry of Business, Innovation and Employment, 2013, p. 16).

The shortage of IT staff leads to high pay rate in industry. A recent article referring to job search website has stated that ICT industry offers the second most lucrative jobs in New Zealand, having median pay between $92,000 and $95,000 pa. (Newson, 2014). Demand of technology encourages students to choose IT as their major field of study in high school and at tertiary level. Students are enrolling in IT courses to learn new technologies in classrooms, as they comprehend

how technological solutions are being applied by the current workforce. However, graduates from ICT courses are not up to the mark with IT industry requirements and expectations. A study investigating critical IS/IT skills from the perspectives of seventy managers. The study suggested, web applications, online services, networking protocols, wireless communications and their applications to be the most important five skills in future (Lee & Mirchandani, 2010). IT industry continually requires more skills from new graduates. Bullen et al. (2007)asked IT professionals which capabilities are critical for in-house employees, the respondents mentioned items that might be considered "new" programming environments operations skills and capabilities (e.g., Java, .Net, Linux, wireless, etc). Surprisingly knowledge of programming languages are considered as critical skills in departments having core business functions such in management information systems (MIS). Personal attributes include problem solving, critical and creative thinking, oral and written communications and team skills in demand (Downey et al., 2008).

> .....increased use of ICT across the economy generating employment growth across a range of skill-sets, including software engineering and development, project managers, marketers, sales, administrators and business analysts(Ministry of Business, Innovation and Employment, 2013, p. 16)

Small to medium size organisations (SMEs) seek specific skills for entry level positions (Simon, Kaiser, Beath, Goles, & Gallagher, 2007). Survey results show that the most of the IT positions are with SMEs and the help desk is the most common entry level position at SMEs. Helpdesk roles require not only the technical knowledge but soft skills as well. Academic institutions should adequately prepare students for this position. Since communication skills are in top three most desired entry level skills in small to large organisations. Further results show that programming is in top five most desired entry level skills in all three categories of organisations (i.e. very large, large and small to medium). The education sector can contribute a great deal in creating a skilled workforce by providing quality education.

2.3 ICT education in New Zealand

This section discusses the literature review based on New Zealand's education sector and the importance of IT field in it. In addition, the review focuses on international essence of education system as the current study is about international students. Academic disciplines can be categorised as pure hard, applied hard, pure soft, and applied soft (Neumann, Parry, & Becher, 2002). Hard disciplines like sciences, engineering and medicine utilise teacher-centred approaches to organising, structuring and presenting the course for understanding a specific problem domain. Soft disciplines like social sciences and humanities require the teacher to play the role of a facilitator to support knowledge construction process across diverse societal domains (Lindblom-Ylännea, Trigwellb, Nevgia, & Ashwin, 2006). The ICT discipline falls in the applied hard and applied soft domain, as students view conceptual elements which require reasoning and logical skills, alongside practical skills which use the physical environment to exemplify how growing use of technology is affecting people's day-to-day lives. Previous literature indicates that ICT has been seen as a pathway to future employment, which attracts many local and international students to opt for ICT courses at colleges, training institutes and universities. This has added to the onslaught of technology courses offered by education providers. New Zealand has quality education system; students studying in New Zealand can be assured of earning world-class qualifications. United Nations ranked New Zealand seventh best country in the world based on the mean years of schooling and the expected years of schooling index (Education index, 2013). New Zealand has large educational system, there are total 1935 educational organisations across the New Zealand, and highest numbers of educational organisations (32%) are in Auckland (Find Education Organisations, n.d.).

Educational organisations are categorised in New Zealand as schools, polytechnics/institutes of technology, private training establishment (PTE), government training establishments (GTE), universities etc. NZQA administers the secondary school assessment system; conduct reviews for quality assurance of non-university education providers, and manages standard settings for specified unit standards (Our role, n.d.). Courses which have ICT/IT as a major field of study are basically tertiary qualifications, which is defined by NZQA as any form of learning which commence after completing secondary education. Tertiary qualification includes studying or training at some tertiary institution/workplace. The New Zealand tertiary sector covers i)Private

Training Establishments (PTEs), ii) Institutes of Technology and Polytechnics (ITPs), iii) Universities, iv) Workplace Training and v) Wananga (A teaching and research institution regarding Māori tradition and custom). Students studying in ICT courses at non-university organisations (such as PTEs, ITPs, and Wananga) achieve course outcomes designed by NZQA. Outcomes describe knowledge, skills and attributes of graduates, and are indicators of minimum achievements expected by NZQA from graduate students (www.nzqa.govt.nz).

2.4 International Students

International students are valuable assets of the host country which makes a huge impact on the economy of the host country. There is much competition amongst western countries to increase their international student intake, and they use aggressive marketing strategies to promote international student enrolments (Joseph & Joseph, 2000). New Zealand and Australia are attractive destinations for pursuing higher education, since alongside internationally recognised qualifications; they also offer a study-migration pathway(Dzvimbo, 2003; Martens & Starke, 2008; Shanka, Quintal, & Taylor, 2006). Study shows that New Zealand has maintained its position as a high quality education provider because of comparatively low cost of study and having reputation of being a safe country (Morrish & Lee, 2011). This is supported by comparative analysis of New Zealand with other countries which shows that international students' principal drivers of decision-making that selected New Zealand as country for further study are safety, reputation of a qualification and low cost of study (Education New Zealand, 2011). Even though international student enrolments have fluctuated over the last decade, it is showing a slow but steady upward trend since 2009. New Zealand's global education industry plays an essential role in New Zealand's overall economic, social and cultural development. Recent news reveals that the international education sector valued $2.5 billion to the economy and contributed 28,000 jobs (Trevett, 2014). A government report by New Zealand's ministry of education shows total number of international fee paying students enrolled till 30th April in 2014 were 60,734 (8% increase than the last year), of which 24,213 pursued tertiary level education at private training establishments. In addition, from 1st January to 30th April 2014, it was found that the five major source countries of international students were China, India, Japan, South Korea and Thailand (Education Counts,2014). Moreover, Saudi Arabia and Germany are also providing significant number of international students to New Zealand. The report shows that

New Zealand is in the list of top ten preferred study destinations chosen by German students(Chow, 2011). New Zealand's government provides support to education industry by for international students by easing the student visa regulations simplifying entry requirements(Martens & Starke, 2008).

International students' preference to choose Information Technology or Computing as the major field of study has fluctuated within the last decade. New Zealand statistics shows that the number of students in IT field vacillated during last five years (refer Figure 2).

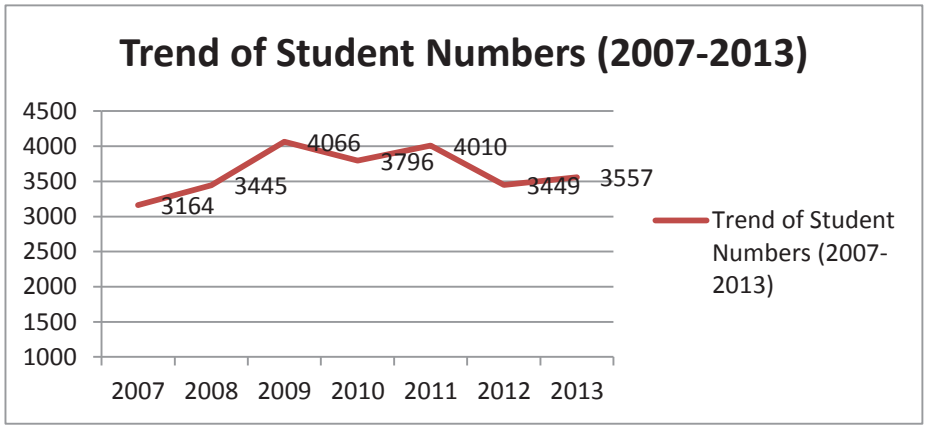


Figure 2- Number of international fee-paying students in tertiary IT course

(Source: Education Counts, 2013)

2.5 Social issues faced by international students

International migration can be defined as, "a social phenomenon that crosses national borders and affects two or more nation-states"(Castles, 2007, p. 351). Migration from home country to other brings many challenges to immigrants and to the host country as well. Challenges for the host country include regulation of immigrants, national security, managing multicultural environment, risk of terrorism, and unemployment(Martin & Widgren, 2002; Castles, Miller, & Ammendola, 2005). Immigrants faces challenges such as health issues, adjustment to new life style including food, language and culture, need for social support etc. (Berry, 2005; Kondakci, Herman Van den Broeck, & Yildirim, 2008; Ramachandran, 2011; Segal & Mayadas, 2005). When migration takes place due to educational purpose, the challenges faced by international students are specific to diversity in socio-cultural practice, which may relate to English language proficiency, financial stress, and social relationships (Ippolito, 2007; Ramachandran, 2011;

Sawir et al., 2008; Wei, Heppner, Mallen, Ku, Liao& Wu, (2007)). Extensive research is available confirming cultural diversity as a major issue faced by International students, often described as a culture shock (Rienties, Heliot, & Jindal-Snape, 2013; Sawir et al., 2008). Acculturation (cross-culture) issues are discussed by many researchers in perspective of international students (Kashima & Loh, 2006; Poyrazli, Kavanaugh, Baker, & Al-Timimi, 2004; Wei et al., 2007).Berry (2005, p. 708)defined acculturative stress as, "a stress reaction in response to life events that are rooted in the experiences of acculturation". In other words, these issues related to the mental difficulties arising due to unfamiliar culture surroundings or in adapting to a new culture. A survey of 141 international students conducted in US examined the association of acculturative stress with the variables such as age, gender, English language proficiency, ethnicity, and access to social support(Poyrazli et al., 2004). Results show that only two predictors impact directly on acculturative stress which are English language proficiency and social support (negatively moderate relationship). Language barriers and loneliness are encountered as acculturative stressors, moreover language barriers is the most common cause behind all socio-cultural problems (Sawir, 2005).

English language proficiency is described in literature as major independent issue rather than the acculturative stressors. Non-English speaking international students struggle a lot in English-speaking educational environment (Andrade, 2006; Holmes, 2004; Ippolito, 2007; Ramachandran, 2011; Smith & Khawaja, 2011), and find it as a barrier in academic success and social integration even from the faculty's perspective (Trice, 2003). Research indicates that even though students enrolled in international courses after achieving score from standardised tests, such as the International English Language Testing System (IELTS) or the Test of English as a Foreign Language (TOEFL), find the English-speaking environment difficult to interact (Holmes, 2004; Johnson, 2008; Ramachandran, 2011; Skyrme, 2007). International students are unfamiliar with the pace, accent, choice of words and terminologies used in everyday activities. The students' confidence goes down when they find that their earlier training in English language and achievements in TOEFL/IELTS is not helpful enough to communicate in a classroom environment(Ramachandran, 2011).Similar results found in another study, a Chinese student studying at well-known university of New Zealand quoted,

> *"Before I come to New Zealand I take IELTS and 5 mark, and then I think, 'Oh, New Zealand, they speak English and study in that is very good' and then I think I will easy to improve my English but when I come to here many things is different, I should consider many things and so many problems the first time you come here … Different learning and no people help you in the English and sometimes they all speak English and then you don't know what it means."* (Skyrme, 2007, p. 360)

International students get daunted by issues they face in everyday life. Such issues include relationships with students and staff of opposite gender, acceptable body movements to communicate, networking with other students, religious beliefs, human rights and value systems (Ramachandran, 2011; Rienties et al., 2013; Smith & Khawaja, 2011). International students studying in New Zealand too face similar issues stemming from English language proficiency and cultural diversity. The article draws attention towards experience of two Chinese students beginning study in a New Zealand's renowned university. The study found that despite having good experience with teaching staff (who are informal and provide good study materials) and from support centres, the students felt language to be a great barrier in developing skills (Johnson, 2008; Skyrme, 2007).A study assessed classroom activities of universities with many international students in New Zealand. It is estimated that in the first year of study, students could understood only around 20 to 30 percent of lecture contents, while the senior students stated that they still did not understand language used in lectures completely(Johnson, 2008). Another issue identified in literature is loneliness or home-sickness faced by international students (Sawir et al., 2008; Smith & Khawaja, 2011). Lack of familiar cultural and/or linguistic environments can cause loneliness(Sherry, Thomas, & Chui, 2010). This is consistent with another study, which found three types of loneliness among international students, such as personal loneliness due to lack of contact with family and friends, cultural loneliness causes from absence of familiar culture, and social loneliness because of the loss of shared communicable networks. This type of loneliness normally occurs during the early months(Sawir et al., 2008).

These issues can cause learning difficulties which results in poor performance in study (Sawir, 2005; Swami, 2009). Learning issues stemming from social issues are lack of understanding, difficulty in using course material etc. (Andrade, 2006; Holmes, 2004; Kelly & Moogan, 2012; Li & Gasser, 2005). As the level of loneliness increases, academic achievements decreases

(Demir & Tarhan, 2001), In addition, student's achievement is further affected by English language proficiency and academic background(Andrade, 2006). International students experience intercultural learning which includes communication with local and other English speaking students and lecturers. Linguistic inequalities are an important barrier in learning (Ippolito, 2007). An eighteen month ethnographic study conducted with Chinese students in a business school of New Zealand university showed that students could not communicate in classroom because of difficulties in listening, understanding, and interacting in English. Assignments were also affected as writing styles and critical analysis was not up to the expectation of teaching staff (Holmes, 2004). Linguistic inequality affects writing styles, reading, and communication methods, and has implications in the thinking process. Further, analytical and logical skills of international students could be influenced by linguistic inequality (Ramachandran, 2011).Another study explored the relationship between cultural adjustment difficulties and career goals among international students from Africa, Asia, and Latin America. Empirical data showed that greater degrees of acculturative stress experienced by international students were predictive of lower career aspirations. The authors stated that the lack of confidence and security amongst some international students is because of entering into a new culture which further affects their future career goals and planning(Reynold & Constantine, 2007).

Previous research suggests using technological tools to augment classroom teaching can help overcome some of the earlier mentioned verbal issues(Johnson, 2008). Utilising qualified staff who are familiar with cultural issues in order to organise programmes that highlights the possible cultural variations is advisable(Ramachandran, 2011). Higher education providers may consider for providing some form of technological and social support to face learning challenges faced by international students.

2.6 Learning issues faced by international students

The current study focuses on international students studying in ICT courses in New Zealand. Currently limited literature focuses on showing how international students learning ICT courses are affected adversely. The ITiCSE 2004 working group examined the knowledge in programming by testing students from seven countries. The study identified issues such as lack

of problem solving-skill, difficulty in understanding logical flow and tracing/ debugging (Lister et al., 2004). However, it is not evident that these issues are specific to international students alone. Previous literature supports the argument that thinking process, analytical abilities and logical skills are affected by linguistic inequality (Holmes, 2004; Ramachandran, 2011).ICT courses contain conceptual learning, requiring reasoning and logical skills to apply on tasks such as programming, database design, or in simulating networking protocols. Students often lack of analytical and logical skills which is crucial for compulsory subjects such as programming or in grasping concepts such as joins, grouping and aggregation while learning SQL(Connolly & Stansfield, 2006; Dekeyser, Raadt, & Lee, 2007). This observations show that ICT students struggle with both logical and analytical skills. In addition, students face significant difficulties in analysing problems which have quite complicated solutions.

> They have difficulty handling the ambiguity and vagueness that can arise during database analysis. Students can also display an inability to translate classroom examples to other domains with analogous scenarios, betraying a lack of analytical problem-solving skills. For the students these problems can lead to confusion, a lack of self-confidence and a lack of motivation to continue (Connolly & Stansfield, 2006, p. 462).

This again reinforces the suggestion that students pursuing ICT courses often struggle with logical and analytical skills.

Lack of command over English language, unwillingness and inability to communicate in classroom topics and lack of interest are factors that influence Asian students studying in ICT courses based in New Zealand(Asgarkhani & Wan, 2008). The first two factors (i.e. English language proficiency and unwillingness to communicate) are closely related to international students which arise due to language barriers (Holmes, 2004; Skyrme, 2007); however, the causes behind 'lack of interest' in international student might be due to loneliness or acculturative stress (Berry, 2005; Sawir et al., 2008).Although lack of interest in ICT courses is a general issue and which can be applied to all students (Chin, 2008).Many students entering IT field of study soon find it dry and boring which lowers their motivation and interest in learning (Prensky, 2003;

Sarkar, 2006) or lack of interest could be a result of difficult explanations given by teaching staff or use of uninteresting teaching methods(Piteira & Haddad, 2011).

It may also be noted that students face many challenges pertaining to the ICT discipline which are specific to course contents. These challenges can be applied to non-international students who are studying in ICT courses. Challenges such as difficulty in grasping conceptual understanding (Butler & Morgan, 2007; Tan, Ting, & Ling, 2009)and lacking the understanding in concepts reduce interests to pursue further exploration and decrease self-confidence and motivation (Kriz, 2003; Tan et al., 2009). Further students often struggle to reason how topics such as hardware, programming, databases or computer networks are used in real world applications (Janitor, Jakab, & Kniewald, 2010; Sarkar, 2006).

> Students could not transfer knowledge gained from either lectures or theoretical exercises to practical exercises.....Without having direct hardware interaction, students learning becomes abstract, which leads to their displeasure and to the main question: Why we are learning this, and how and where shall I use it? (Stolikj, Ristov, & Ackovska, 2011, p. 340).

Only a few students could take the content of ICT course to real life even after having good tutoring(Xie, Li, & Geng, 2008). By computer simulation and modelling, the students cannot gain first-hand experience but they can learn much better by configuring actual computer networks(Ruiz-Martinez, Guez-Garcia, & Marin-lopez, 2013; Sarkar, 2006; Wannous & Nakano, 2009).Opposite to hardware courses, most programming contents (algorithms and data structures) are abstract concepts(Amer & Ibrahim, 2014), which are hard to visualise having no obvious graphical form. Grasping their essentials is a challenging task for beginners and to explain them is also challenging for teachers(Baldwin & Kuljis, 2001; Chin, 2008; PearsPears et al., 2007).

2.7 Pedagogical approaches applied in ICT education

Programming is often considered a difficult subject area in ICT courses to learn from students' perspective (Baldwin & Kuljis, 2001; Bennedsen & Caspersen, 2007; Kim & Lerch, 1997), and, to teach from an academic's perspective (Chang & Chou, 2008; Muratet, Torguet, Jessel,

&Viallet, 2009; Tan et al., 2009). An existing study validated this concern by employing a survey of universities and colleges around the world, however, the study could not confirm that high failure rates were mostly for programming units(Bennedsen & Caspersen, 2007). To achieve effective delivery of programming subjects and to reach out to students' needs, teachers need to apply effective pedagogical approaches in teaching(Akbulut & Looney, 2007; Lopez, Clarkson, Fourie, Lopez, & Marais, 2010; Pears et al., 2007). Many ICT tools are used as pedagogical approach to enhance teaching and learning experiences, such as, accessing online library, online tutorials or other learning environments(Daly & Horgan, 2004; Hulls, Neale, Komalo, Petrov, & Brush, 2005), use of ICT in curriculum development (Jaffer, and, & Czerniewicz, 2007; Tondeur, Braak, & Valcke, 2007; Vajargah & Jahani, 2009), web-based environment or use of multimedia (Guzdial & Ericson, 2009), game based learning (Ab Hamid & Fung, 2007; Barnes, Richter, Chaffin, Godwin, & Powell, 2007; Feldgen & Clua, 2004; Resnick et al., 2009), use of smart devices such as iPad (Amer & Ibrahim, 2014)etc. All these ICT flavoured approaches can be seen as subsets of e-learning (Hsiao, and, & Brusilovsky, 2010; Law, Lee, & Yu, 2010). This is a broader pedagogical approach. Literature further indicates that each approach has pros and cons based on different environmental settings (Law et al., 2010; Soylu, 2004; Vajargah & Jahani, 2009). For example, one study suggests that simplified e-learning arrangements can help to increase learning motivation and self-efficacy(Chong & Choy, 2004). However, e-learning settings include up-front cost to design and build the actual e-learning courses in addition to hardware and software costs (Welsh, Wanberg, Brown, & Simmering, 2003). Moving further, by combining e-learning to different modes of delivery, methods of teaching and styles of learning the blended-learning can be derived as whole pedagogical approach (Djenic, Krneta, & Mitic, 2011; Hadjerrouit, 2008; Heinze & Procter, 2014). Blended learning is widely researched in ICT education, for example; a study used blended learning in Java programming by combining face-to-face learning to traditional distance education, Internet, Web, CD ROM, video/audio, and other electronic mediums (Hadjerrouit, 2008). Blending of virtual and physical learning environments enhanced the experience of university students (including international students) through social and academic interaction between peers(McCarthy, 2010).During entire semester, 120 students studying design interacted with peers using an online forum within a host site (Facebook). Moreover, to conventional classroom learning, students were required to submit their work online via Facebook tools which

allowed students to give critical comments on submissions made by their peers. Many international students found this approach as a perfect opportunity to engage with their peers. Further, blended learning provided them a platform to create a means of social interactions with other culture students. Another study also employed blended learning to better relate the contents of the course to the real world by Xie et al. (2008).The blended approach consisted of i) Classroom: traditional teaching, face-to-face learning, making notes and completing set exercises, ii) Website: using web-based applications consisting of courseware with online feedback, to support self-paced learning, iii) Actual lab: performing real experiments to give students a first-hand perspective, and iv) Virtual lab: providing an online platform for making simulations through animations to help students visualise different components. Again use of blended learning has mixed response of both negative and positive feedback(Akkoyunlu & Soylu, 2004).

2.8 Game based learning

The use of games in teaching and learning pedagogy is not uncommon among academics. Game based learning has been used for more than three decades, nevertheless in different perspectives. Creative game techniques were evolving in 1980s. In 1977 several researchers analysed effectiveness of simulation games over conventional classroom learning and the positive results obtained over time (Randel, Morris, Wetzel, & Whitehill, 1992).Game based learning has been largely applied in ICT education, although GBL has many success stories in other education disciplines too, such as English language course (Egenfeldt-Nielsen, 2007; Liu & Chu, 2010), maths (Scanlon, Buckingham, & Burn, 2005), social science (Randel et al., 1992), physics, history, health (Egenfeldt-Nielsen, 2007), science and engineering (Ebner & Holzinger, 2007; Mayo, 2007)etc. For example, an educational game IFM (Internal Force Master) was used in a mechanical engineering study programme. Findings demonstrated high levels for user empowerment and fun elements for the students who played IFM. The student experience showed their readiness to play the game a second time in the event of a failure, as students were keen to go over the game problem again to find their mistakes (Ebner & Holzinger, 2007).

Self-efficacy, interest and outcome expectations are factors that motivate students to choose computing as a major in the study (Akbulut & Looney, 2007). Self-efficacy defined as a

student's judgment of his or her capability to perform successfully in computing study. To increase self-efficacy, study recommends creating classroom environments which stimulate positive psychological states such as enjoyment and amusement, and alleviate negative states such as anxiety or stress. In addition, promoting interest in the computing study, innovative pedagogical techniques such as GBL argument learning environments as follows:

> (a) They can support multi-sensory, active, experiential, problem-based learning, (b) They favour activation of prior knowledge given that players must use previously learned information in order to advance, (c) They provide immediate feedback enabling players to test hypotheses and learn from their actions, (d) They encompass opportunities for self-assessment through the mechanisms of scoring and reaching different levels, and (e) They increasingly become social environments involving communities of players (Oblinger 2004 as cited by (Papastergiou, 2009, p. 1).

Many subjects in computing courses contain abstract concepts which are hard to visualise as they have no obvious graphical form (e.g. programming constructs, database normalisation, protocols, etc). This intangible nature of learning components causes challenges in understanding them (Butler & Morgan, 2007; Tan et al., 2009). In addition, students often struggle to apply concepts which are hard to visualise in practice (Sarkar, 2006; Stolikj et al., 2011). Humans can easily process information which is in visual form. Thus, humans can visualise the cause and effects which helps them in making decisions (Pears et al., 2007). Visualisation can be described as an attempt to use technology to improve learning by creating a mental image of how things work (Alhosban & Burd, 2012). In addition, visualisation is a common technique preferred by students to comprehend the concepts which increase the interaction between the learner and the subject being studied.

Games facilitate the visualisation through graphics, images, moving objects and animation through visualisation and computer games can be used to develop pedagogical basis for problem-based learning environments especially for ICT curriculum(Connolly & Stansfield, 2006). The study suggests using computer games to help IT students overcome learning difficulties, as GBL can be stimulating and enjoyable, which can further build on current research theories of motivation, constructivism, situated learning and problem-based learning. Another study

suggested use of interactive computer games which simulate some problem based scenarios to scaffold classroom teaching. This will provide more opportunities for collaboration and reflection, which in turn will lead to increased motivation. The use of games can prompt students' engagement and as a result eliminate the lack of interest in course contents(Barnes et al., 2007; Papastergiou, 2009). As discussed earlier, lack of interest is a big challenge for ICT academics (Berry, 2005; Chin, 2008; Connolly & Stansfield, 2006;Prensky, 2003; Sarkar, 2006; Sawir et al., 2008). Game-playing has the potential to develop skills in decision making, design, strategy, cooperation, critical thinking and problem solving (McFarlane, Sparrowhawk, & Heald, 2002).

2.9 Social issues addressed by GBL

Much of previous literature has addressed social issues faced by international students; however, no literature addressed how GBL can be used to deal with social issues of international students. Social issues identified in the study are loneliness due to cultural difference and lack of communication skills due to linguistic inequality. Games can be used to increase interaction between the students which can help the student feel less lonely. Further, many games achieve interaction through multiplayer scenarios. The collaborative multiplayer aspects in games create an inviting, safe and socially motivating environment (Barnes et al., 2007). In multiplayer scenarios players learn many processes through the game such as, decision making, retrieving source from different sources, creating strategies and thus increasingly they learn to collaborate with their peers (Prensky, 2003). Papastergiou (2009) advised that educational games are effective learning tools which transform social environments by gradually extending communities of players. Computer games are thus transformed into social experiences, to offer a constructivist approach that are interactive in nature and generate meaning in learning(Hamalainen, 2011).

Another study examined the ways in which computer games support the learning styles and skills through providing the educational games to the trained evaluators to further explore them in classrooms (McFarlane et al., 2002). Selected educational games were found to have the potential to develop particular skills, such as 'Personal and Social Development' and 'Language and literacy'. The use of games in educational settings can provide students interest and

motivation to learn and work together in groups which further develops their social contacts. Games encourage students to talk, share, ask, explain and develop attentive listening, questioning and commenting skills collectively. These communication skills are relevant to issues identified in international students in this study. Hence GBL can be considered as an effective tool to deal with social issues.

2.10 Learning issues addressed by GBL

Large set of literature is available which demonstrate use of GBL to mitigate teaching and learning challenges of tutors and students respectevely. However, number of literature which adresses computing subjects are comparatively less. Papastergiou (2009) evaluated learning effectiveness and motivational appeal of a computer game in subjects of computing for high school students. The study showed that the gaming approach was very effective in gaining students' understanding of the subject. Not only games aid in learning effectiveness, but, they also provided solution to the 'feeling bored' issue. One of the participants responded; "It's more enjoyable and active. You never get bored as in traditional teaching because you concentrate on a goal."

Another study investigated variety of teaching techniques which included traditional teaching methods as a secondary element with more non-traditional methods such as interactive visualisation and computer games helped the student develop the skills database analysis and design (Connolly, Stansfield, & McLellan, 2006). Analysis of results shows that dropout rates of the students who learned through interactive visualisation and computer games had dropout rate 6% less than that of the students who learned through face-to-face interaction with tutors. In addition, both student and faculty perceptions for the online environment was found to be extremely positive.

The Cisco Learning Network is another social learning community with more than 800,000 students aiming for international certification. Cisco Learning Network provides learning tools, training resources, and industry guidance to anyone interested in building an IT career through Cisco certifications (www.cisco.com). Online learning tools include variety of games to learn networking topics such as memory concept, sub-netting, and network protocols. Some popular

games provided by CISCO are, CISCO Aspire, Cisco CCENT Mind Share Game, Subnetting Game, and Wireless Explorer etc. (Games Arcade, n.d.).

2.10.1 Game-based approaches to teach programming

Game-based approaches are used in T & L environments in different ways depending on the purpose of application. Game based systems/approaches to teach programming language has been categorised as I) 'authoring-based', ii) 'visualisation-based', and iii) 'play-based'(Li & Watson, 2011). Figure 3 lists category based approaches along with the existing gaming tools and the concepts covered by the tool.

		Authoring				Visualisation					Play								
		2006 :: RoboCode	2010 :: Alice2	2010 :: Greenfoot	2010 :: Scratch	2003 :: Jeroo	2006 :: objectKarel++	2007 :: C-Sheep	2008 :: Bomberman	2008 :: Turtlet	2007 :: Catacombs	2007 :: Saving Sera	2009 :: EleMental	2009 :: Resource Craft	2009 :: WU's Castle	2010 :: Prog & Play	2010 :: Robozzle	2011 :: Lightbot	2011 :: PlayLOGO 3D
Style of Programming	procedural							X	X	X				X			X	X	X
	functional													X					
	object-based		X		X											multiple			
	object-orientated	X		X		X	X				X		X	X	X				
Programming Language	mainstream language	X		X				X	X	X	X	X	X	X	X	X			
	bespoke language		X		X	X	X										X	X	X
Concepts Taught	conditional		X		X	X	X	X		X	X		X	X	X	X	X		
	for				X	X	X	X		X	X	X		X	X	X			
	while		X		X	X	X	X		X	X	X			X	X			
	variable		X		X	X		X		X			X	X	X	X			X
	paramater		X		X	X	X	X		X			X	X		X			X
	function / method		X		X	X	X	X		X			X	X		X	X	X	X
	user-defined data type	Java language		Java language					C language										
	recursion							X					X				X	X	
	collections / array		X			X		X						X	X				
Code Representation	text	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X
	pictures																X	X	
Program Construction	typing code	X		X		X	X	X	X	X	X	X	X	X	X	X			X
	assembling graphical objects		X		X												X	X	
	selecting / form filling						X			X									
Microworld Metaphor	general (changable)		X	X	X														
	specific	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X

Figure 3- Game based approaches and tools teach programming

(Source: Li & Watson, 2011)

The 'authoring-based' approach of using games is to enhance students' learning process through game development. It is constructivist technique full of creativity in which students learn programming by developing their own games or by modifying existing games using programming concepts. To achieve this students are provided with a highly graphical and

simplified learning tool within an integrated development environment (IDE). The IDE helps to decrease the students' external cognitive load (Li & Watson, 2011).

Some popular examples of graphical tools used are Alice, Scratch and GreenFoot. These tools serves as a ground to develop animated output and are used in many educational organisations(Bishop-Clark, Courte, & Howard, 2006; Bromwich, Masoodian, & Rogers, 2012; Piteira & Haddad, 2011).

By using graphical tools, students can create an animation for story-telling, or develop an interactive video game, or make a video by dragging and dropping graphical commands. Instructions aligned with programming language constructs such as loops and conditional statements are embedded in the graphical commands. For example, Alice is freely available teaching tool which allows students to create a program using the visual 3-D objects (e.g., people, animals, and vehicles). Users can program the object using graphical commands. Furthermore, Alice shows players immediately that how their animation programs run, which enables them to understand the relationship between the programming constructs and the behaviour of animated objects. Students can learn all the programming constructs taught in introductory programming classes by manipulating the objects in their virtual world (www.alice.org). Existing literature shows that Alice is an effective tool which helped students to understand programming concepts (Bishop-Clark et al., 2006; Johnsgard & McDonald, 2008; Piteira & Haddad, 2011).

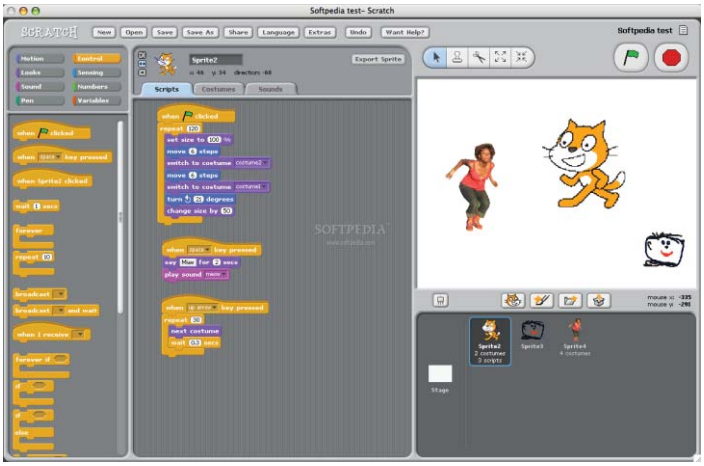


Figure 4- Scratch user interface

(Source: www.softpedia.com)

Another popular tool is Scratch; it is used in more than 150 different countries and available in more than 40 languages. Similar to Alice, a user can create their own interactive stories, games, and animations by using an event driven approach. The visual objects to be programmed are called "sprites" in Scratch (www.scratch.mit.edu). Figure 4 shows the user interface of Scratch including two sprites in the form of human and a cat. The left most column contains list of the commands or instructions which can be used to write a script/program in the middle column area.

However, some drawbacks of using such graphical tools encountered by students are IDE complexity or understanding compiler messages in the early stages of learning, inability to visualise the final effect/output of logic until the basic structure of the game is executed, and in developing the mental models for programmers at beginner level(Li & Watson, 2011).

Including game development as a part of curriculum may motivate a student to select computing as a major field of study and helps to decrease retention rate. A study shows that students were highly motivated to implement class material given by tutor due to the fact that they are having fun developing an entertaining and creative product (Sweedyk, deLaet, Slattery, & Kuffner, 2005). This has been evident in another study considering how gaming elements can fit into the computing curriculum of institutions in the US (Morrison & Preston, 2009). Authors re-designed the computer science course by making it more centred on a game development. Findings showed that students explored and experimented with the code beyond the scope of the assignment, since they were motivated to add more complexity, even though they were beginner students. Some of the comments made by students' show that they were emotionally involved with what they had made, “I’m so proud of myself. Look what I made it do.” A summer course was designed in another study which provided traditional outcomes from within the context of games as an application area(Bayliss & Strout, 2006). Despite being considered as the hardest course formats to succeed in, the study found the pass rate to be higher than they expected, and students did much more work than they were asked to do in assignment. Thus game centred approaches, either game development or game playing have been proved to be a source of engagement, motivation and fun. However, game development approach requires prior technical knowledge (such as computer graphics) and experience to play or to design games (Kazimoglu, Kiernan, Bacon, & MacKinnon, 2012). Leutenegger and Edgington (2007)proposed "Game

First" approach to teach fundamental programming concepts through two dimensional game development in three quarters. First quarter teaches how to create and move a graphical object around the screen using programming concepts such as 'if and else', 'looping', 'arrays' etc. Second quarter transit basic concepts to C++ and add further components such as pointers. Third quarter implements a multi-phase project based game approach using C++ and openG. Survey findings show that this approach improved students' understanding of fundamental topics and they learnt effectively, especially the second and third quarter classes helped students to sharpen previously taught concepts.

The second category of game based approaches is 'visualisation-based'(Li & Watson, 2011; Piteira & Haddad, 2011). The system used in this category does not teach programming concepts through developing a game or story but it demonstrates the effect of code execution in visual environment. Approaches from this category use micro-words to make player visualise the concepts and demonstrate visual code execution. This category is lacking game elements such as scoring, levels, competition or scenario. Further it does not allow users to create own game, thus can not be included in other two categories(Li & Watson, 2011). Jeroo, Turtlet, Jelito etc are other examples of the tools lies under ‘visualisation-based’ category (Li & Watson, 2011; Piteira & Haddad, 2011; Watson, Li, & Lau, 2011).

The third category given by is a 'play-based' approach(Piteira & Haddad, 2011). In this approach student acquires understanding of programming constructs by developing programming strategies to complete the given tasks or to solve a puzzle. In spite of development activity, this approach is different from the authoring approach by putting focus on programming. Player needs to program the visual objects such as robot, animal, human to make them complete a given goal. These goals can be anything reaching from a particular location. For instance, in Light Bot 2.0 a fictional scenario is given, where players to control a robot. The robot's task is to light up each blue tile in a given walking area. This could be done through a set of commands representing basic programming concepts such as sequential execution, functions, recursion and conditionals(Bromwich et al., 2012; Yaroslavski, 2014). In PlayLOGO 3D, a player executes logo-type commands to destroy the opponent, and by doing this players can achieve understanding of method calling and parameter passing. Further tasks given in the game require players to complete functions or debug existing code (Li & Watson, 2011). Another game Saving

Sera involves rescue of princess who has been kidnapped. The player has to construct code snippets to accomplish the rescue. Through this process student can learn about recursion and control structures while developing the code(Barnes et al., 2007). Other examples of play-based systems are Catacombs, Karel the Robot, Robozzle etc.(Barnes et al., 2007; Kazimoglu et al., 2012; Piteira & Haddad, 2011).

Game Name	Tool Type	Language	Computer Programming Concepts	Game Characteristics	Target
Jelito3	Program Visualisation Application	-Syntax Java	- object-oriented concepts - visualising objects and inheritance	Without any Characteristics of Games	Novice computer programming
Jeroo	Program Visualisation Application	- Syntax close to Java and C++	- Control Structures, methods, objects	Challenges: without score	Novice computer programming users
Alice	Visual Programming 3D Environment	Java, C++ and C#	- object-oriented concepts	Without any Characteristics of Games	Novice computer programming users
Raptor	A Visual Programming Environment	Based on symbols	Teaching Algorithmic Problem Solving	Without any Characteristics of Games	Novice computer programming users
Karel the Robot tool (versions: Karel++, Karel J.Robot, JKarelRobot and Waterloo)	Web Game	Visual Programming based on commands	Visual commands to execute instructions: moveon() turnleft() and others. Conditionals and Recursion implementation with the visual commands	Challenge: with level score and publication to others community members (optional)	Novice computer programming users and Expert computer programming users
Light Bot	A visual programming environment	Visual Programming based on commands	Object – oriented concepts	Challenge: without score	Novice computer programming users

Table 1- Tools to teach programming

(Source: Piteira& Haddad, 2011)

Table 1 shows a review made by Piteira and Haddad (2011) illustrating some game type tools with available games which correlate programming concepts with the game characteristics.

The 'authoring-based' tools are referred here as 'visual Programming 3D Environment', the 'Visualisation-based' tools are referred as 'A visual programming environment', and at last the 'Play-based' tools are referred as 'Web game'. Light Bot can be considered as a Play-based tool used within a visual programming environment. After reviewing all the game based tools discussed so far, the researcher selected Light Bot 2.0 for this study.

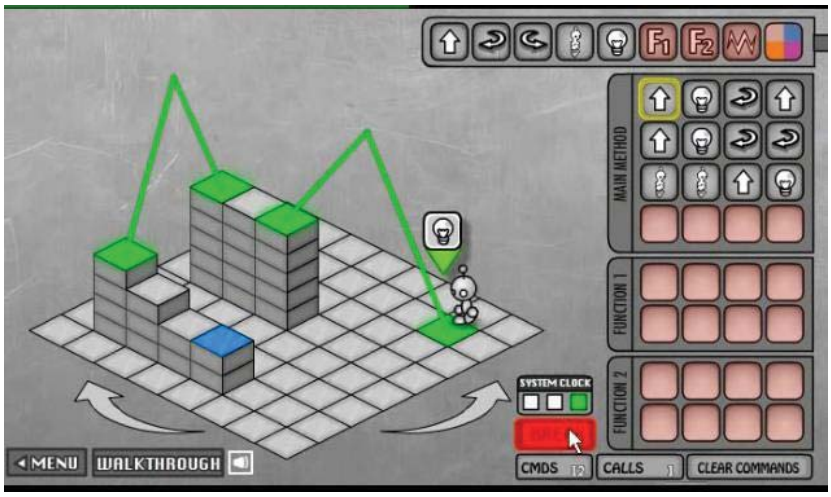


Figure 5- Light Bot 2.0 Basics stage – Level 4

The Light Bot 2.0 is developed by Danny Yaroslavski(Yaroslavski, 2014). Current study puts Light Bot in game category as it provides a gaming environment. Light Bot teaches programming lessons in the form of a game, where the player have to navigate a robot on a given block-area or a puzzle, and turn on lights placed on blue tiles of a walking area. Player can do this by arranging symbols or icons on the screen to command the robot to walk, turn, jump, or switch on a light. This could be done through a set of commands representing conditionals. The puzzle and the list of symbols become more complex and tricky as the levels move on.

As published in New York Times in August 2013, Light Bot game design targets children. It is great fun and does a surprisingly thorough job of introducing several complex principles of programming (Eaton, 2014). A commercial website (TechCrunch) which focuses on technological news and analysis of technological products edited the word of Light Bot developer as follows.

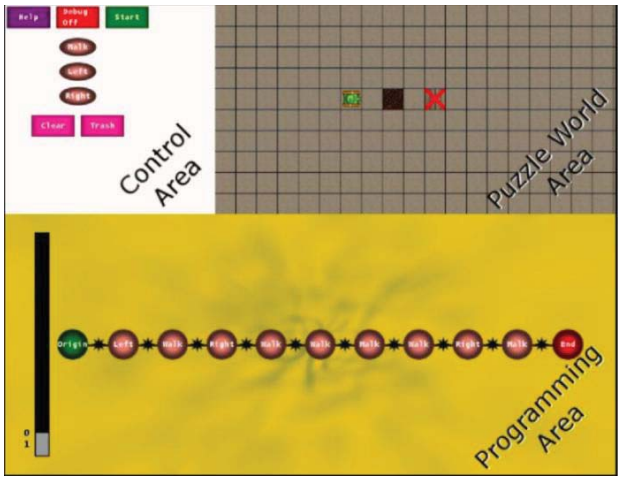
> Other players in the programming education space provide software which use code and words to teach programming. This instead is a video game and in its nature more

engaging and less obviously teaches computer science; masking concepts as game mechanics and focusing on programming logic rather than direct coding (Biggs, 2013).

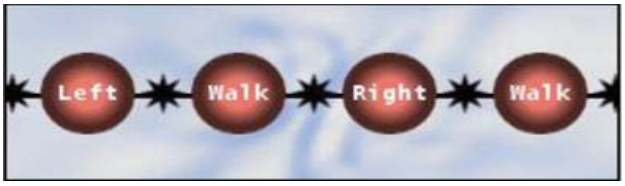
Literature also reveals several limitations of Light Bot, for instance, Light Bot doesnot clearly explain differences between different programming constructs such as recursion and loop, nor does it create competitive environments like multiplayer (Kazimoglu et al., 2012; Piteira & Haddad, 2011). The detailed description of the game is given into the next chapter.

2.10.2 Success stories of GBL ('Play-based' category)

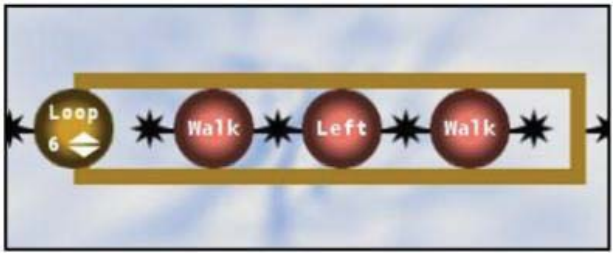
Previous studies have listed many success stories providing evidence of using game based learning to teach programming. Following is the review of some literature which illustrates the use of the 'Play-based' approach for educational purpose. A game framework was developed for the beginner students to practice and develop their skills in computational thinking with a game prototype named Program Your Robot(Kazimoglu et al., 2012). The game mechanics of the Program Your Robot was integrated to introductory programming constructs. It simulated a puzzle solving scenario where players controlled a robot by giving various commands. Players had to design an algorithm using symbolic icons (presenting commands) to assist the robot to reach at the destination block (also called "telepoter"). The programming commands incorporated into the game-play are symbolic representations of basic programming constructs such as sequential flow, decision making, loops and functions. There were five levels in the game, each with a higher level puzzle's complexity, so the player had to use new programming constructs. The score calculation depended on how well players have applied programming constructs efficiently. Students studying in computer science discipline gave positive feedback and felt the game to be suitable in understanding introductory programming constructs. However, literature does not show any measurement of the outcomes, for example, how it helped a novice to learn programming. Similar type of experiment was done by Bromwich et al. (2012). They developed a 2D cell-world game (VISPROCON), using a visual programming editor.



(a) Areas of interface



(b) Sequence Structure



(c) Looping structure

Figure 6-Interface of VISPROCON

(Source: Bromwich et al., 2012)

The player have to program the avatar (a visual object like robot) to navigate across a maze (puzzle world area). Player had to make the avatar reach to the destination indicated by the cell marked 'X' (refer Figure 6). The complexity of levels increased gradually with each higher level by introducing more programming concepts. The visual programming editor provides a structured flowchart, which can be zoomed-in and zoomed-out. This functionality maintains the visual continuity by reformatting when an instruction is added or removed by the player. The graphical icons presenting instructions/commands are available in control area which can be dragged and dropped into the appropriate places in the programming area. Instructions can be

removed from the program area by dragging and dropping it to the trash button. The manner instructions are put into the programming area helps player in learning programming concepts. For example the loop construct (refer Figure 6(c)) sets the number of iterations for a task. As indicated in Figure 6(c), the avatar will repeat the sequence of instructions: walk-left-walk six times. VISPROCON measures the score in the form of awards, gold, silver or bronze, for a working solution. Further, the score depends on the size of the solution, as lesser the number of instructions in solution, higher the score. This encourages the player to use the concepts cleverly to solve the puzzle. Findings from the user evaluation describe the game as exciting and novel. However, study the study does not explain further how the game has improved the programming ability of those who play it, or what is the effect of the game-play experience on the academic performance of the student.

Another study accomplishes the requirement to evaluate outcomes of applying GBL. The study illustrates the use of puzzle type game to teach software development (including programming concepts) to tertiary level students(Marques, Levitt, & Nixon, 2012). An educational computer game (Conveyor) developed in a client-server architecture was utilised. Figure 7 depicts the interface of Conveyor.

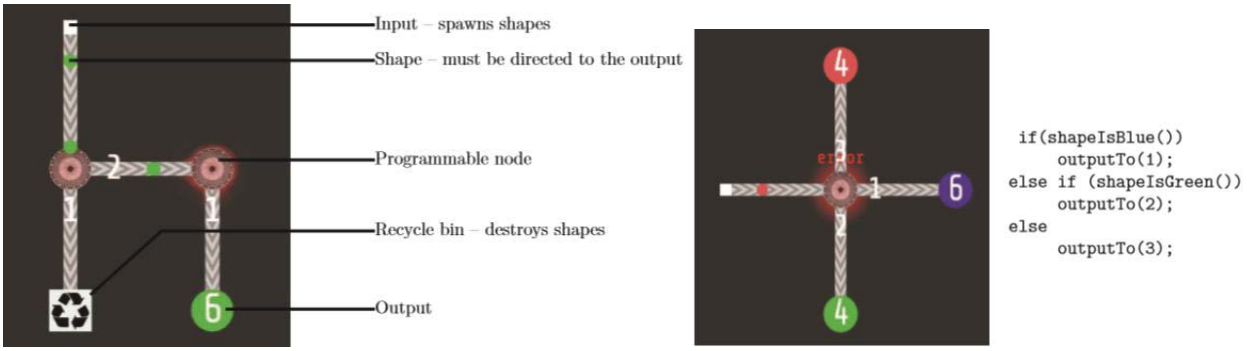


Figure 7-Interface of Conveyor an educational computer game

(Source: Marques et al., 2012)

A server side integrated analytics system collected data about player's interaction with the game which was used to observe and improve performance of the game. The game mechanics is the type of puzzle, the player has to solve puzzles within each game level. Solution includes the sorting of random input objects (which are in different shapes and colours) through a series of

conveyor belts into the desired output bins. The output bins need to be filled using number of shapes with a particular colour. A cohort of 39 students made of first year game design students and second, third, and fourth year electrical, information and biomedical engineering students participated in experiment. Results show that 80% of participants were able to complete the entire game, and analytics shows that the game was judged to be both fun and rewarding. However, participants in initial stages, participants found the game too instructive and because of the confusing user interface, a high number of attempts were noted. The effect of the GBL was investigated with students' marks in a traditional environment. Further, a software quiz was conducted before and after the game-play. Findings show that although computing students' performance had not improved significantly, but the marks of 63% electrical engineering students had increased by an average of 10%. The study concludes that the GBL has the potential of supporting traditional education and providing fun environment to stimulate student interest in computer programming(Marques et al., 2012).

Another study has described the design of an educational framework utilising an iterative development process with games to improve student engagement, satisfaction and skills transfer(Barnes et al., 2007). Researchers used students who had completed at least one computer science course and were moderately familiar with programming concepts. Each participant was given two games to play, that is, Saving Princess Sera and The Catacombs. Participants gave pre-test prior to the game-play and post-test after the game-play. Both the tests included problems where students had to determine the outcome of programming components such as ‘if-then-else’ and ‘while’ loop. Study found that despite poor test results students were able to understand most of the programming quests, and, the feedback of the students was extremely positive. Students were asked to give their opinion about using games to teach basic programming, one of the participants voiced:*"Yeah! I mean, it would be awesome if like, after a lecture, the professor just said ‘Alright, get to level 43 this weekend.’ I would have definitely wanted to be in that class."*

All games mentioned in this section used problem scenarios which can be solved by giving series of commands using graphical icons. The execution order of commands helps user to understand programming constructs. However, none of the above literatures explains how these games helped students to learn how to write actual code, or where students have to remember syntax of the language.

2.11 Challenges of GBL in education

Literature reviewed largely presents the positive aspects of the GBL. However, some literature points out some probable challenges while applying GBL. To analyse the characteristics of games-based learning, a study examined the evolution process of designing the videogames which can be used in education(Gros, 2007). Author concludes that it is challenging for the designers to make the sequences of play significant for both the students and school curriculum. Further challenges include appropriateness of content within the game as they should be closer enough to the actual learning content (Egenfeldt-Nielsen, 2007; Van Eck, 2006). Another challenge identified is associated to the teaching staff. Game based approaches require teachers as facilitators of learning. Teachers need to spend reasonable time to be expert in all the aspects of the game. But often due to lack of time, teachers may not get familiar with the game and its methods which can result in poor application of GBL (Gros, 2007). Further, teaching staff need to be trained to analyse, design, develop (in case of game development is part of learning process), implement and evaluate the game (Van Eck, 2006). Training is required when teachers are trying a particular game for the first time or GBL might be a new approach for the new staff.

> ….the teacher to revisit and rethink teaching and learning assumptions, because the games hook into other teaching practices and fit with recent research on how people actually learn(Egenfeldt-Nielsen, 2007, p. 276).

Previous literature has also noted some negative aspects of computer games used for teaching and learning. The staff who applied GBL was concerned about the development costs of the online environment as it was rather high(Connolly & Stansfield, 2006). The class size is another challenge when GBL is used for large classes of greater than fifty students. To participate actively, students need to be placed in smaller groups sizes which can then be easily monitored by a facilitator or tutor. Moreover if a large size of student group learns through online gaming environments, it would result in a significantly higher workload for teachers than if they were teaching same number of students in a face-to-face environment.

2.12Overview

Literature review has revealed the importance of ICT industry (including the education sector) in New Zealand. The chapter discussed the expected skills among ICT graduates from the ICT professionals' perspective, such as communication and presentation skills, programming skills, problem solving skills and project management skills. The review has also focused on the international student community (mainly in New Zealand) and their importance to the host country. Further, the issues faced by international students pursuing ICT courses have been discussed. The study summarised the issues such as linguistic inequality, cultural diversity (social issues), lack of interest in course contents, difficulty to transfer theory knowledge to practice, lack of analytical and logical skills (learning issues) etc. Further, existing literature based on pedagogical approaches which have been applied in ICT education with game based learning approach have explained how some of the learning issues can be mitigated. However, researcher could not find much literature which reveals the use of GBL to alleviate the social issues faced by international students. The chapter has also discussed some challenges faced while applying GBL in educational settings. As a whole, the review has built theoretical scenario for the problem area of research and used to construct the base for empirical appraisal. The next chapter disuses the research methods used in the current study.

CHAPTER 3: Research Design

3.1 Introduction

The previous chapter described innovative pedagogical approaches that are currently used in ICT education to enhance teaching and learning experience of international students. Literature was reviewed to gather more insight into how IT has been used as a tool to enhance the learning experience. It has widely been accepted by academics and researchers that students often struggle with computing subjects, as they try to relate theoretical concepts with practice. This is further amplified for international students who are placed in unfamiliar settings of the host country. Many experiments have been conducted in previous studies to address some of these issues. This study investigates these issues within a New Zealand context by employing a case study method. Two research questions are posed:

RQ.1. What are the issues faced by international students pursuing NZQA based courses in information and communication technologies?

RQ.2. How can IT tools be used to overcome these issues and enhance students' learning experience?

The current report follows the structure: 'issue/methods/findings/conclusions' (Robson, 1993). Chapter 3 outlines the second element - the research design and methodology, to answer the above questions. First, the chapter describes the motivation behind selecting the case study for this research. Next is detailed research design of the study including description of the case, and the ethical issues considered prior to the study. The study has been done in two stages as it addressed two research questions. RQ1 has been answered in the first stage, which lead to design of RQ2. RQ2 has been answered in the second stage. As the case study is divided into two stages, following section describes design of the first stage which entailed conducting interviews with IT tutors. Next, the chapter describes the second stage, which consists of how game intervention settings were designed with different student cohorts, selection of the educational game, and details of the game-play design. The chapter then proceeds to explains how the data was collected and analysed for findings.

3.2 Case study method

Yin (2014) suggests selection of methodology based on the type of research questions. The first and most important condition to differentiate the various research methods is to classify the type of research question. Normally 'what 'type questions may either be exploratory (where any of the methods could be used) or about prevalence (where surveys or the analysis of archival records would be preferable). 'How' and 'Why' questions are likely to be answered using case studies, histories, or experiments. Research questions posed in this study is grouping in 'What' and 'How' type of questions. The case study approach has been selected as research method because Moreover RQ1 explores challenges faced by international students and feeds into RQ2. When 'What' type questions serves as a pilot to another question, the case study method is appropriate and it is of type exploratory (Yin, 2003). The research question RQ1 (‘What’) in this study pilotsRQ2 (‘How’). Hence the case study is considered as a suitable method for the current research study, and answers both questions in context of one particular case.

Per Runeson and Höst (2009, p. 137) has given major process steps to be walked through while employing case study method,

i) Case study design: objectives are defined and the case study is planned.

ii) Preparation for data collection: procedures and protocols for data collection are defined.

iii) Collecting evidence: execution with data collection on the studied case.

iv) Analysis of collected data

v) Reporting

Current chapter describes methods applied to accomplish above five steps.

3.3 Research design

As discussed in the previous section, the research design has been divided into two stages using case study methods (refer Figure 8).The case described herein as PlayIT is a non-university

education provider offering ICT related subject courses at different study levels designed by New Zealand Qualification Authority (NZQA). Three computing courses and three business courses are running parallel at PlayIT. The computing courses running at PlayIT are National Diploma in computing (level 5), Diploma in Computer Networking and Security (level 6) and Diploma in Networks and Security (level 7). Levels 5 – 6 refer to diploma levels, within the New Zealand qualification system. The level 5 course National Diploma in Computing is based on NZQA framework, while other two courses are private courses of PlayIT. National Diploma in Computing contains modules such as database, hardware, networking, software engineering and programming. Curriculum components in these modules are introductory level. Each module contains one or more unit standards (US). Unit standard is a description of the skills and knowledge student can acquire by studying particular range of learning components. This study targets international students pursuing NZQA based ICT qualifications at levels 5 at PlayIT.

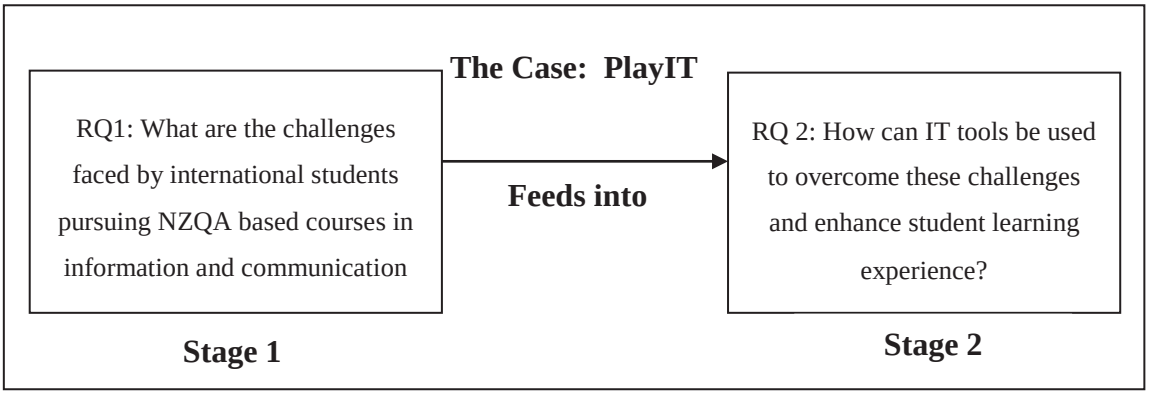


Figure 8-Research questions and stage design

Research design in the first stage entailed conducting interviews with experienced IT tutors who are involved in teaching NZQA based ICT curriculum to international students. In March 2014, interviews were conducted with experienced IT tutors at PlayIT to identify social and learning challenges faced by students pursuing ICT curriculum. Interviews served as data collection instrument in the first stage, which collected qualitative data. Interview findings provided further empirical grounding to design of stage 2. In stage 2 design, a game intervention strategy was applied to investigate how IT tools can be used in educational environment. The game intervention experiment was conducted in May 2014, in which GBL activities were aligned with course modules set by the NZQA body. Students were invited to play an educational game

utilising fictional problem scenarios aligned with ICT curriculum. The aim of using a game intervention was to engage students and bring fun in learning. At the end of the game-play, questionnaires were used to get students' feedback. Students' feedback data was collected immediately after students had engaged in GBL activity so that closeness to data with the GBL experience is maintained. After students completed the final course assessment they were again asked to give feedback to get more clarity on outcomes from GBL approach. The feedback after course assessment was collected through the structured questionnaire (quantitative method).

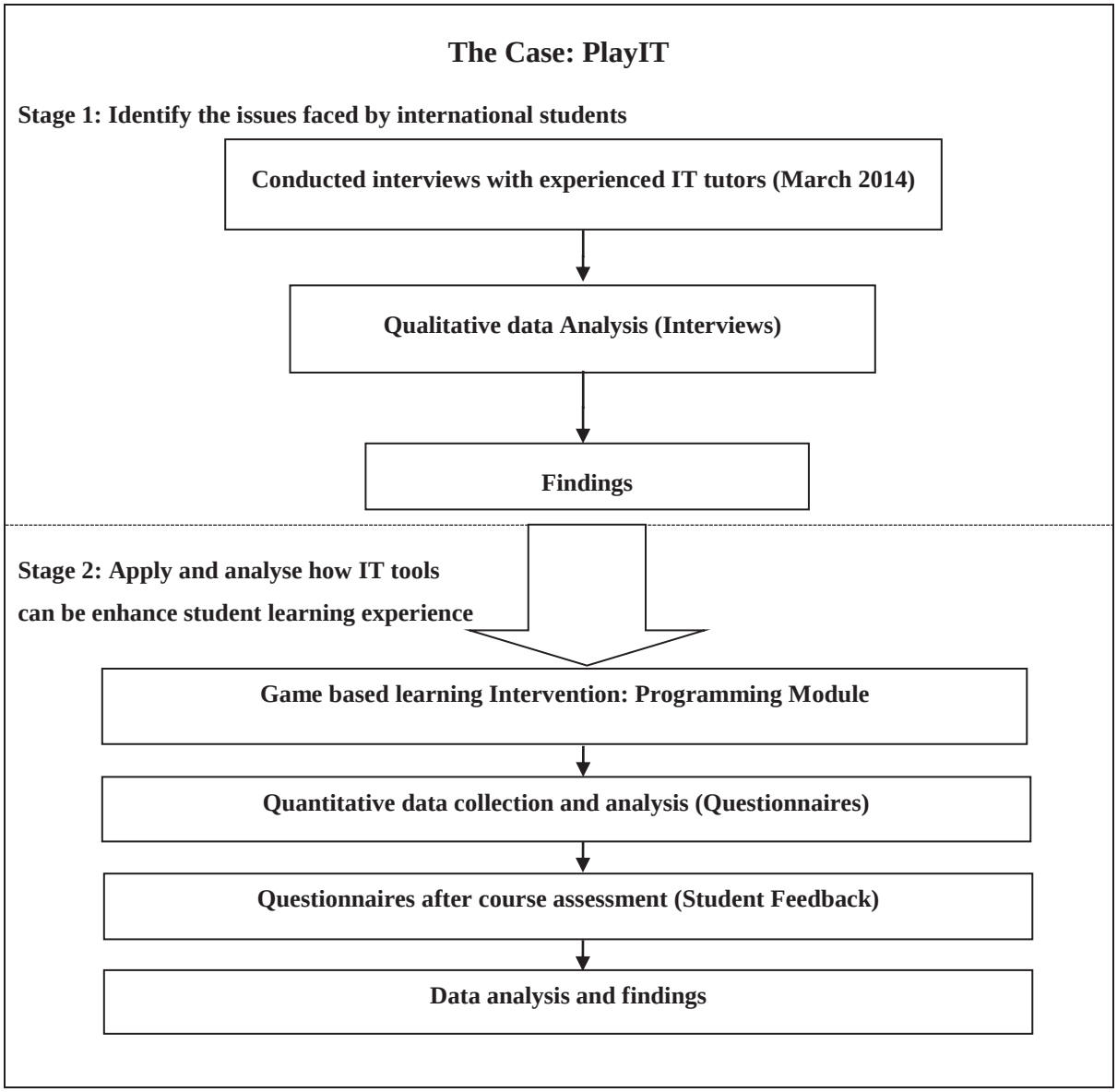


Figure 9- Mixed methods approach within the case

Thus, both the research questions were answered using two different stages implemented within a single case. Most importantly, the qualitative research in the first stage has been used to guide quantitative research design of the second stage (refer Figure 9), which is depicting one of the approaches used in mixed methods research (Bryman & Bell, 2011). Further, there are two ways explained in existing literature in which qualitative research can be used to guide quantitative research, 'Providing hypotheses' and 'Aiding measurement'. The current study includes 'Aiding measurement' which is explained as,

> The in-depth knowledge of social contexts required through qualitative research can be used to inform the design of survey questions for structured interviewing and self-completion questionnaire (Bryman & Bell, 2011, p. 634).

Ethical issues were considered prior to the interview, such as privacy, confidentiality, participant's rights, access to important and basic information about research projects, reciprocity etc. The brief overview, the purpose of the study and the intended research method were submitted to Human Ethics committee of Massey University in order to apply for notification for proceeding further in study. Committee approved the study as a low risk study. Participants have been kept anonymous to ensure the privacy of education provider and informants. Each participant was provided information sheet and consent form (refer Appendix A(1)). Information sheet contained brief overview of the study, the purpose of the study, basic details of researcher and university officials to whom the participants can contact in case of misconduct interview or violation of participant's rights. The participants' rights were listed in information sheet including the right to stop the interview at any time and their agreement for recording the interview. Researcher played roles of interviewer and facilitator in interviews (stage 1) and for the game intervention experiment (stage 2) respectively.

3.4 Stage 1: Interview of experienced IT tutors

Face-to-face interviews were taken by the researcher in first stage of the study. Face-to-face interviewing has advantages such as it employs controlled interview process and usually results in higher participation and completion rates (Salkind, 2010). This method reduces bias resulting from misunderstanding or misinterpretation of questions because participants can ask for

clarification. Further, face-to-face interviewing provides opportunity for interviewer to react on participants' nonverbal communication, for instance, the interviewer can explain the question again if facial expression of participant is suggesting confusion. Semi-structured and open-ended questions were used in interviews. Semi-structured questions bring forth foreseen information, while open-ended questions elicit unexpected types of information(Hove & Anda, 2005).In accordance with the current study researcher used specific questions to bring forth information on issues faced by international students, and also used open-ended questions to elicit views on the use of IT tools which were considered to assist teaching and learning experience in ICT education. Purposive sampling technique was employed as the participants were selected according to predetermined criteria relevant to the research objective. The objective of the first stage was to analyse issues faced by international students. Accordingly ICT tutors who have been teaching NZQA ICT curriculum (Level 5 to 7) to international students for a minimum of 3 years were selected to be interviewed rather than the students. Researcher considered several reasons here, firstly teachers play an integral and sensitive part of socio-cultural settings of learning environments, and their perspectives are essential in establishing pedagogical models and practices especially in the ICT education sector (Sipila, 2014). Researcher did not just want to list the issues but engage in discussion to collect insights on the cause of the issues, leading to how IT tools could be used to mitigate those issues. Secondly, it was recommended by PlayIT administration to interview tutors rather than the students. The researcher had to follow the integral policies of the organisation. At PlayIT, there were seven IT tutors. The researcher held interviews randomly with five of them. The concept of 'saturation' was adopted to decide the total number of interviews. Saturation is the point at which no new information or themes are observed in the gathered responses. Further, it is recommended in majority of articles and books that the size of purposive samples should be established inductively and sampling should continue until saturation point arrives (Guest, Bunce, & Johnson, 2006). In the fifth interview; there was no new information, thus, participant number ended at five.

Interview questions were designed carefully to help the participants dig deeper into their experiences and share knowledge of the subject with the researcher. Rich quality data was gained from interviews. Existing study points out guidelines to construct effective interview questions,

> (a) wording should be open-ended (respondents should be able to choose their own terms when answering questions); (b) questions should be as neutral as possible (avoid wording that might influence answers, e.g., evocative, judgmental wording); (c) questions should be asked one at a time; (d) questions should be worded clearly (this includes knowing any terms particular to the program or the respondents' culture); and (e) be careful asking "why" questions (Turner, 2010, p. 758).

Interview questions were designed following these guidelines. Questions were logically divided into three categories to facilitate the analysis process (such categories were defined only for researcher; participants were asked questions in sequence without putting emphasis on any category). The three categories are, i) questions to identify learning challenges/issues, ii) questions to identify social challenges/issues and iii) questions to obtain participants' views on mitigating these challenges/issues (refer Appendix A(2)).Learning issues are those which affect international students' performance during study (exam scores and achievements), cause poor understanding of subjects, and, as a result students cannot achieve their best outcome from the course. The issues that are not related to study but arise as challenges in daily activities are considered as social issues. For example, linguistic inequality is a social issue that can prompt lack of communication skills. Social issues may be the reason behind learning issues and directly affect students' performance in study. Appendix A(2) includes the list of questions asked from participants.

All the interviews were recorded with the permission of participants. Each interview lasted for approximately 30 minutes. Each interview was transcribed immediately after the interview, to help maintain closeness to empirical data. Moreover extensive notes were taken during interview to maintain uniformity and to get better understanding of the data derived from transcription. Transcriptions and notes were raw data that were analysed manually by the researcher. Interview findings revealed tutors 'perceptions of the issues faced by students and suggestions to help mitigate those issues. Figure 10summarises the interview process. Interview findings have been published in the 35th International Conference of Information Systems, held in December 2014.

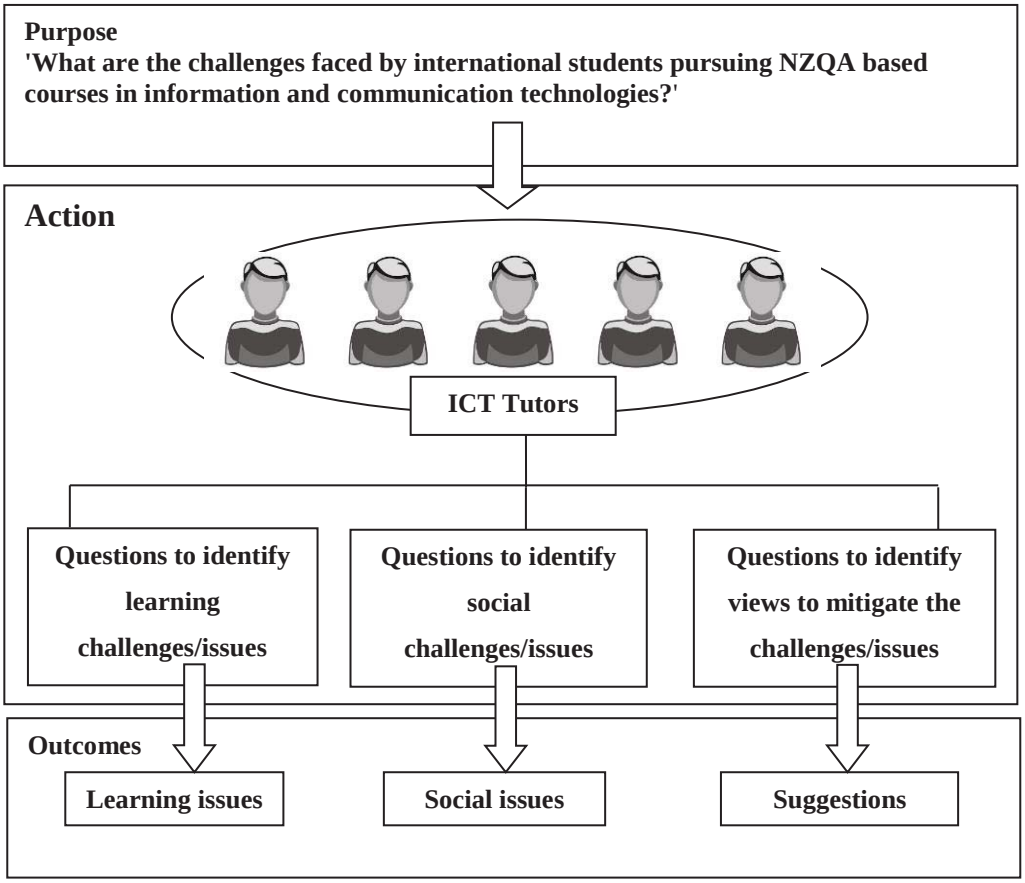


Figure 10- Interview design containing purpose, action and outcomes

3.5 Stage 2: Game intervention

The stage 2 of the study focuses on RQ2, 'how can IT tools be used to overcome these challenges and enhance student learning experience?'Three aspects of IT tools were considered for this study at this time: i) Which IT tool should be used? ii) Which topic in the course curriculum should be selected? and iii). Which pilot IT tool should be employed for applying game intervention strategy? These aspects are as follows:

i)GBL has been selected as an IT tool: Researcher selected GBL among all suggestions (given by the tutors) as an IT tool to engage students in the learning activity. Literature also suggests the use of GBL as one pedagogical approach to enrich student learning experience. Tutors' suggestions from stage 1 likewise affirmed the use of GBL strategy as an IT tool to encourage participation and bring about active learning through simulations of problem based scenarios in an animated environment.

ii) Programming subject module has been selected: Tutors voiced concerns about this module. They considered to this particular module to be rather challenging for students to understand. Topics related to programming constructs have also been identified in literature as one the difficult area of ICT education. Accordingly, the subject module of “programming” has been selected.

iii)The educational game Light Bot 2.0 has been selected: Mainly two points were considered while selecting the educational game, a) its relevance to curriculum topics, and) the coverage of minimum number of topics required for completing the introductory programming unit. Many games were investigated to see whether learning activities were aligned with the programming course module set by the NZQA body. The literature review (chapter 2)has already discussed some educational games which have been used in other research studies. After detailed investigation on ICT educational games, the researcher selected Light Bot 2.0.Light Bot 2.0 is a programming puzzle game available freely (http://armorgames.com/play/6061/LightBot-20).The next section describes the game-play and its relevance to curriculum components.

3.5.1 The educational Game - Light Bot 2.0

Li and Watson (2011)have categorised game based approaches to teach programming language as ‘Authoring-based’, ‘Visualisation-based’ and ‘Play-based’ (refer section 2.10.1). The Light Bot 2.0 uses both, 'Visualisation-based' and 'Play-based' approach. Player programs the visual objects such as robot, animal or human to make them complete some given goal. The reason behind elimination of 'Authoring-based' approach was that the researcher wanted to examine the contribution of the game in explaining programming constructs to students who had never learnt programming before or might be unfamiliar to the word 'programming' in computing reference. Thus, it might be difficult for them to develop game type activity or animation which demonstrates the programming constructs. The 'Visualisation-based' approach was eliminated because, it does not contain gaming elements such as given problem to solve. Light Bot game utilised fictional problem scenarios to engage students and bring fun in learning of the curriculum.

Light Bot 2.0 is developed by Danny Yaroslavski, who has worked at different companies such as Electronic Arts, Armor Games Inc, and Side FX Software(Yaroslavski, 2014). The game

design targets children is considered to be great fun and does a surprisingly thorough job of introducing several complex principles of programming (Eaton, 2014). Light Bot teaches programming lessons in the form of a game, where player has to navigate a robot on a given block-area (or a puzzle) and turns on lights placed on walking area. Player can do this by arranging symbols on the screen to command the robot to walk, turn, jump, or switch on a light. In puzzle mode, players had to control a robot whose task is to light up each blue tile in a given walking area. This requires application of concepts - sequential execution, functions, recursion and conditionals by using a set of commands representing these basic programming concepts. The puzzle and the list of symbols become more complex and tricky at higher levels of the game. The Light Bo interface is easy to understand and use. Figure 11displays the interface of Light Bot 2.0 game.

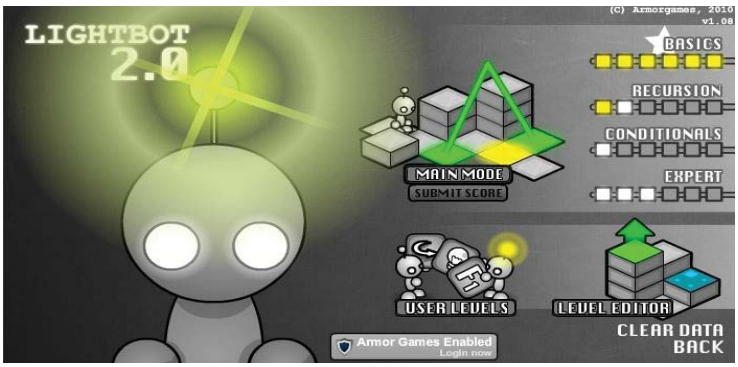


Figure 11- Light Bot 2.0 starting interface

There is specific website of Light Bot (www.Light Bot.com), though the game is freely available online through many gaming websites. There are free Android and iOS versions available with selection options for number of levels which users can try before purchasing the game, since the mobile compatible versions are not free. The developer Danny Yaroslavski said,

> Teachers in the U.S., Russia and more use the original Light Bot games in their classrooms to introduce programming concepts as well.....Other players in the programming education space provide software which use code and words to teach programming. This instead is a video game and in its nature more engaging and less obviously teaches computer science; masking concepts as game mechanics and focusing on programming logic rather than direct coding.....It's the perfect way to let

kids experience programming without sitting them in front of a wall of text(Biggs, 2013).

Light Bot game is available in many versions (e.g. 1.0, 1.3, 2.0, 1.3.51, Light Bot lite, Light Bot Jr 4+). Each version is different in terms of the covered programming topics. Several versions are aimed players of particular age group. For example, Light Bot Jr 4+ is made for children above the age of 4. Researcher selected Light Bot 2.0 since it covers most of the topics from a programming module of a NZQA level 5 course curriculum. It is also considered suitable for the novice programmers or students above age of 12.

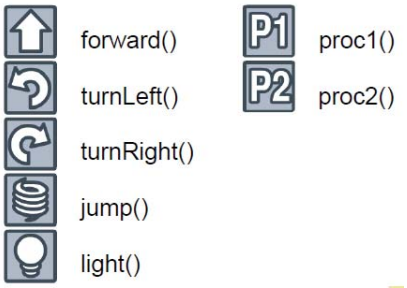
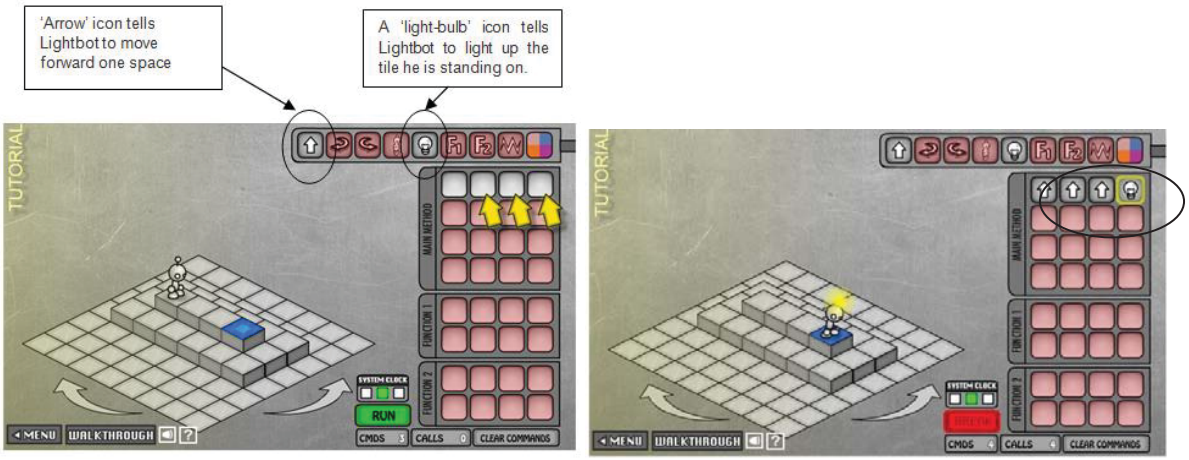


Figure 12- Light Bot icons

Each stage in the game has six levels. A level is a puzzle or maze, which represents fictional scenario, where players control a robot whose task is to light up each blue tile in a given walking area. To do so, the user must 'program' the robot using icons shown in Figure 12. Icons represent commands such as turn left, jump, move forward, etc.



(a) **(b)**

Figure 13- Basic stages of Light Bot 2.0

To solve the puzzle shown in Figure 13(a), the user has to program the robot to first reach the blue tile and then light it up. For that, the robot has to step forward three times and then it can be lighted up. Thus, the solution is to place four icons in a sequence, that is, three 'forward()' icons and the last 'light()' icon. The program executes by clicking 'Run' button. Figure 13(b) shows the robot on the lighted blue tile. This is called sequential execution in procedural programming terms.

The game mechanics of Light Bot have a one-to-one relationship with programming concepts. The developer of Light Bot explained relevance of the game to programming by splitting the concepts into two groups: i) programming practices and ii) control-flow (refer Table 2). Programming practices group is subdivided into planning, programming, testing and debugging stages to explain the order in which programmers solve the problem using instruction icons without actual coding being involved. Control-flow group is made of sequencing instruction (conditional statements), procedures (functions), and loops (including recursion) (Yaroslavski, 2014).

Concepts		**Relevance explained by Yaroslavski**
i) Programming Practices	Planning	*"Players must evaluate a level and the instructions they have available to them. Players must imagine some way to put themselves in the robot's position and figure out how to guide the robot to solve the level. This is the same as how programmers must understand and visualise a problem they are tasked with, evaluate the instructions they have available to them in their language of choice, and create a plan of action"*
	Programming	*"Players must sequence instructions according to their plan....This is the same as how programmers must write out their program (using code)"*
	Testing	*"Players run the program they've created and test to see if the solution holds. This is the same as executing a piece of code and seeing if the result holds with what's expected"*
	Debugging	*"When a level is not solved correctly, players must look for what may have caused the problem. This may include re-running Light Bot through the commands, or shifting commands around..... This is the same as what programmers must do when there is a bug in their code....."*
ii) Control-Flow Concepts	Sequencing Instructions	*"Players must place instructions in an order that gets read from first to last. This is much like how with code, programs execute one line at a time"*
	Procedures/ functions	*"Players in Light Bot must use procedures when they don't have enough space in the MAIN block to solve a problem. Procedures are helpful for extracting patterns and re-using a set of commands multiple times ..... This is much like procedures or functions in a typed programming language...."*
	Loops	*".....Loops are useful for repetitive tasks, and are an extension of*

		extracting a pattern which occurs over and over. In Light Bot, recursion is the type of looping that is used. This is much like a recursive loop in a typed programming language. Loops are, again, useful for executing code that happens over and over. In a typed language, recursion is also performed in the same way as in Light Bot, by calling a procedure from within the procedure itself....."

Table 2- Light Bot relevance to programming concepts

(Source: Yaroslavski, 2014)

As shown into Table 2, the player can learn 'program planning' through evaluating the instruction and visualising the position of bot. The player learns programming through icons rather than typed code of the programming language. This helps students to sequence the instructions in real code. The player can test the code by changing the order of commands anytime and can go back to the same stage, a concept applied to code testing and debugging in programming. Further, the control-flow concepts are also well covered by Light Bot. The most important aspect of the game is the division of the game into staged levels, which leads players through gradual development in programming abilities (Bromwich et al., 2012). The game contains four stages: Basic, Recursion, Conditionals and Experts. The 'Basic' stage includes program design based on sequential flow of execution, debugging and testing of the program and use of functions/procedure. Next stage is 'Recursion', which adds different types of loops to 'Basic' level. 'Conditional' or the third stage, adds more complexity by including conditions and, the last stage 'Expert' is combination of all previous contents. Each stage has six levels with gradually increases in complexity. Although the user can switch to any level of the four stages at any time during play, the students were told to play in a specific order to achieve gradual understanding of programming constructs. Following is the examples from the different stages depicting sequential programming, procedures/functions, conditionals and loops.

i) Sequential programming:

The Figure 14 is taken from the level 2 of the first stage 'Basics'. The solution of the given puzzle is highlighted with circle. All the commands in main menu will be executed in sequence in order to control the bot and help it to reach the blue tile.

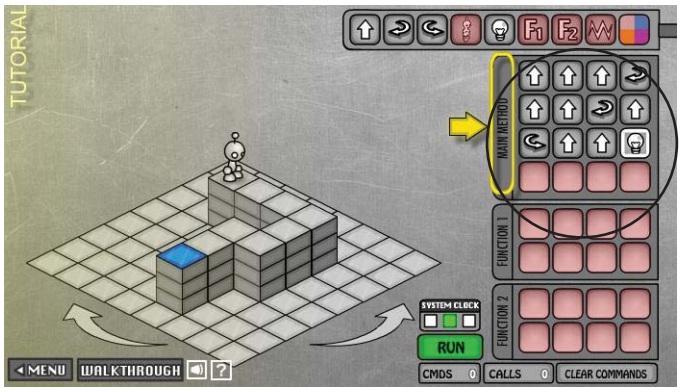


Figure 14- Sequential programming in Light Bot

ii) Functions/Procedures:

Light Bot teaches use of functions/procedures as shown in figure 15.This is the level 5 of 'Basics' stage. Functions are highlighted in yellow box and they can be called from 'main' menu.

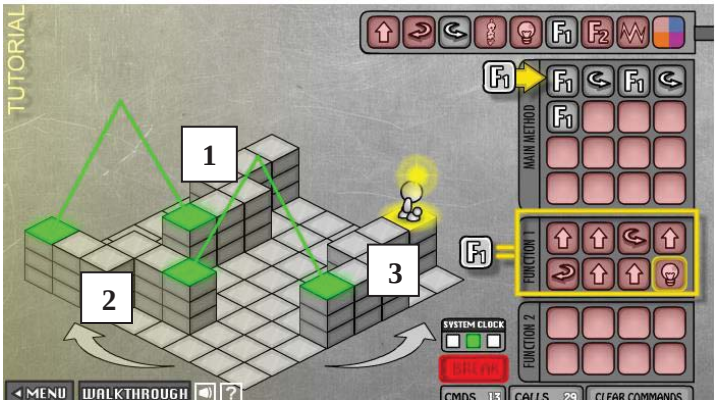


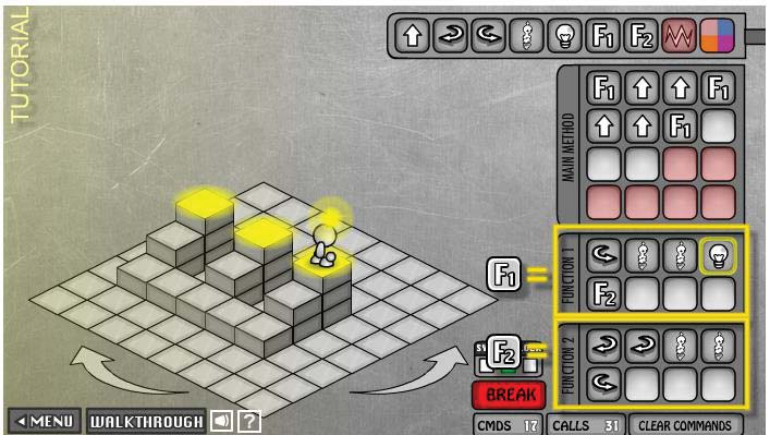
Figure 15- Functions in Light Bot

Player can group the set of commands such as a function F1. F1 can be reused as and when the same set of commands are needed. There are three identical blocks in the following puzzle (shown as 1,2 and 3 in Figure 15), F1 is set of commands to go through one block, in main method player has calls F1 three times to reach the blue tile. In between the call of each F, the turn-left command is called to start entry of the robot in the next block.

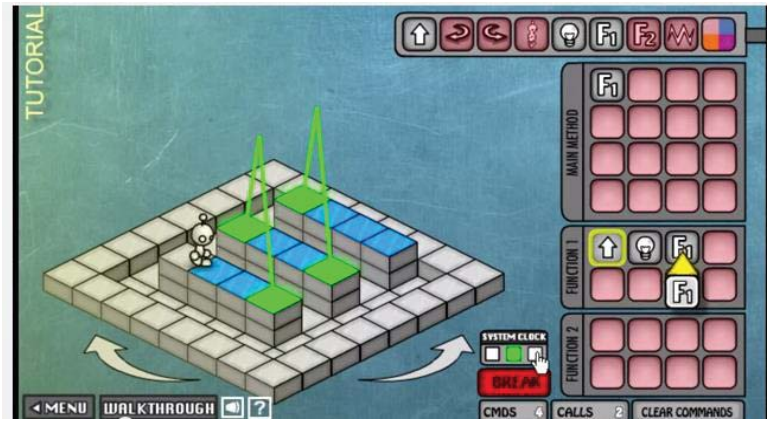
iii) Loops and recursion:

Figure 16 illustrates how player can construct loops and recursion to solve the puzzle. Figure 16(a) is taken from the level 6 of 'Basics' stage. It illustrates the nesting of functions where F1 calls F2. Figure 16(b) shows the level 1 of second stage 'Recursion', where the robot needs to

repeat only two commands repetitively (Move forward and Light-up) which resembles loops in programming terms . Player has used recursion to form the loop, as F1 called itself. The puzzles in Figure 16(b) could have multiple solutions, but the game mechanics is set in a way that player has to use recursion and loops to solve it.



(a)



(b)

Figure 16- Loops and recursion in Light Bot

iv) Conditional flow:

Complexity increases with higher levels in the Light Bot game. The third stage 'Conditionals' is combination of looping, recursion and conditions. Figure 17shows the level 1 of 'Conditional' stage, where the purple tile (shown as 'A') uses conditional statement ('if the tile is purple, turn right'). Conditions can be created using coloured command block as shown in function1.

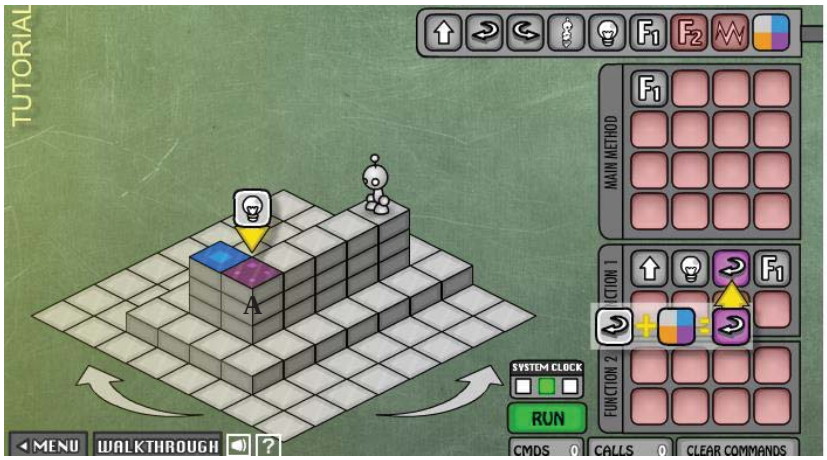


Figure 17- Conditions in Light Bot

Some limitations of Light Bot game identified in literature are as follows. The game does not explicitly make a difference between different programming constructs (e.g., Recursion and a loop). Further, the game does not create a competitive environment like a multiplayer mode(Kazimoglu et al., 2012). However, the current study found the game most suitable for novices, since it teaches fundamental concepts of programming in a simple manner with minimal use of extraneous detail (Bromwich et al., 2012). Further, the game is relevant to curriculum topics and covers all topics which are considered as minimum requirements of the unit considered. The game was next mapped with the chosen study module (programming) based on the NZQA curriculum.

3.5.2 Mapping of educational game to the curriculum contents

As we mentioned in the previous section, PlayIT are running three computing courses, namely, National Diploma in Computing (level 5), Diploma in Computer Networking and Security (level 6) and Diploma in Networks and Security (level 7), Figure 18summarises the course structure at PlayIT. Among all the three courses, only one course includes programming; which is 'National Diploma in Computing' at level 5. This course contains modules such as database, hardware, networking, software engineering and programming. The curriculum components in these modules are mainly introductory. Each module contains one or more unit standards (US). The programming module consists of two US, 6774 and 6776. Unit standard 6774 is based on basic level programming using procedural or event driven approach which is a prerequisite of US 6776. This study used US 6774 contents for conducting the game intervention experiment.

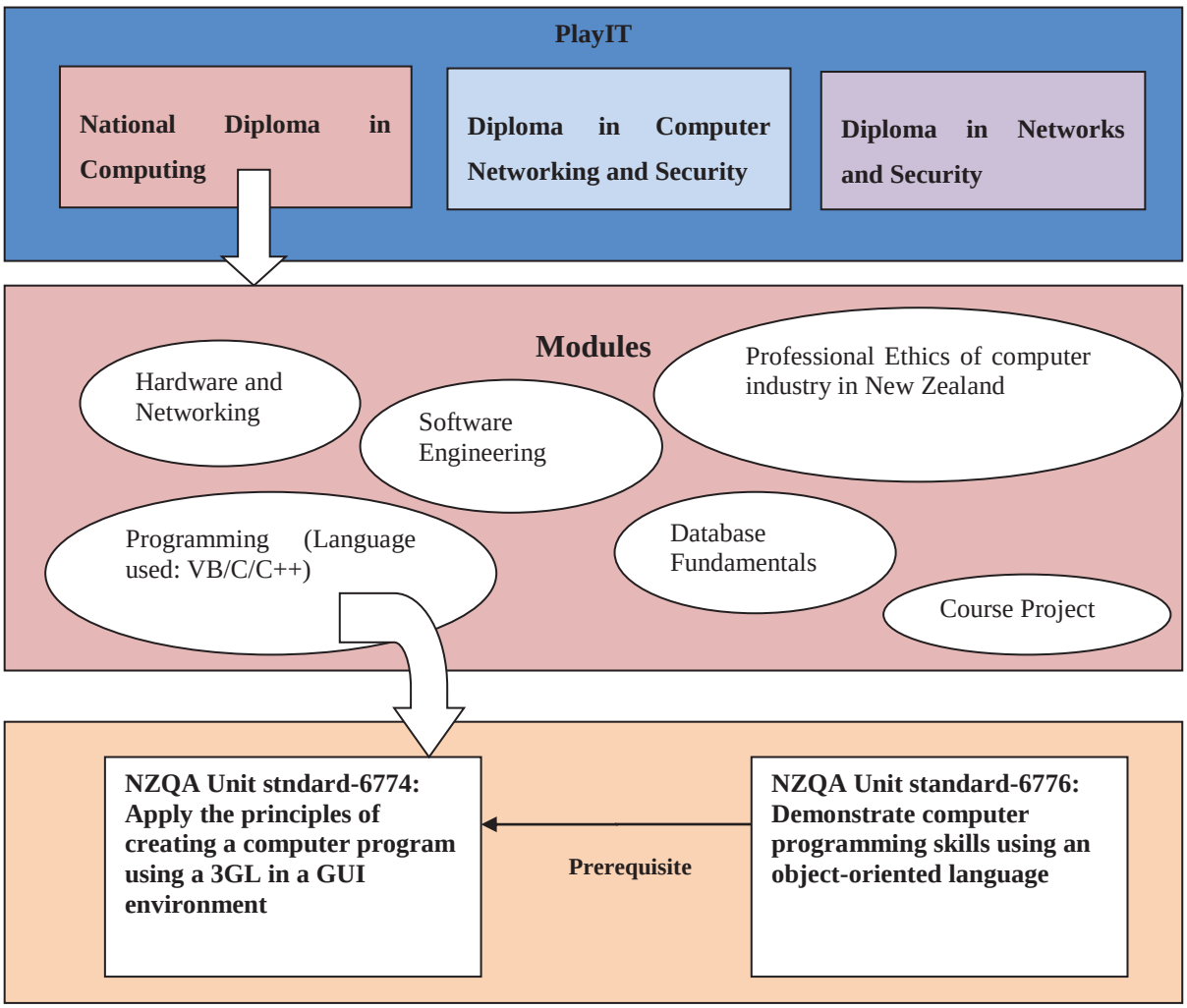


Figure 18- Course structure at PlayIT

Programming is broad topic and contains many more sub-topics. However, the fundamental components comprise sequential logic flow, if-then-else, loops, functions and recursions. Programming concepts covered in US 6774 are similar to the control flow concepts of Light Bot 2.0. Figure 19 shows the one to one mapping of these contents with the stages of Light Bot 2.0. The Light Bot game is divided into four stages. Each stage is sub-set of the next stage. So all the concepts covered in 'Basic' stage are used again in the next stage and recursion which has further addition of loops and recursion. Similarly the third is 'Conditional' which includes concepts of 'Basic' and 'recursion' along with conditional statements.

In the early study phase of the US 6774 students are taught how to write, debug, execute and test the program. This early phase is aligned with the first stage named 'Basics'. Other curriculum contents of US 6774 such as functions, procedures, loops and conditions are also designed to different stages with gradually increasing complexity. The last stage of the game ('Expert') combines all the concepts.

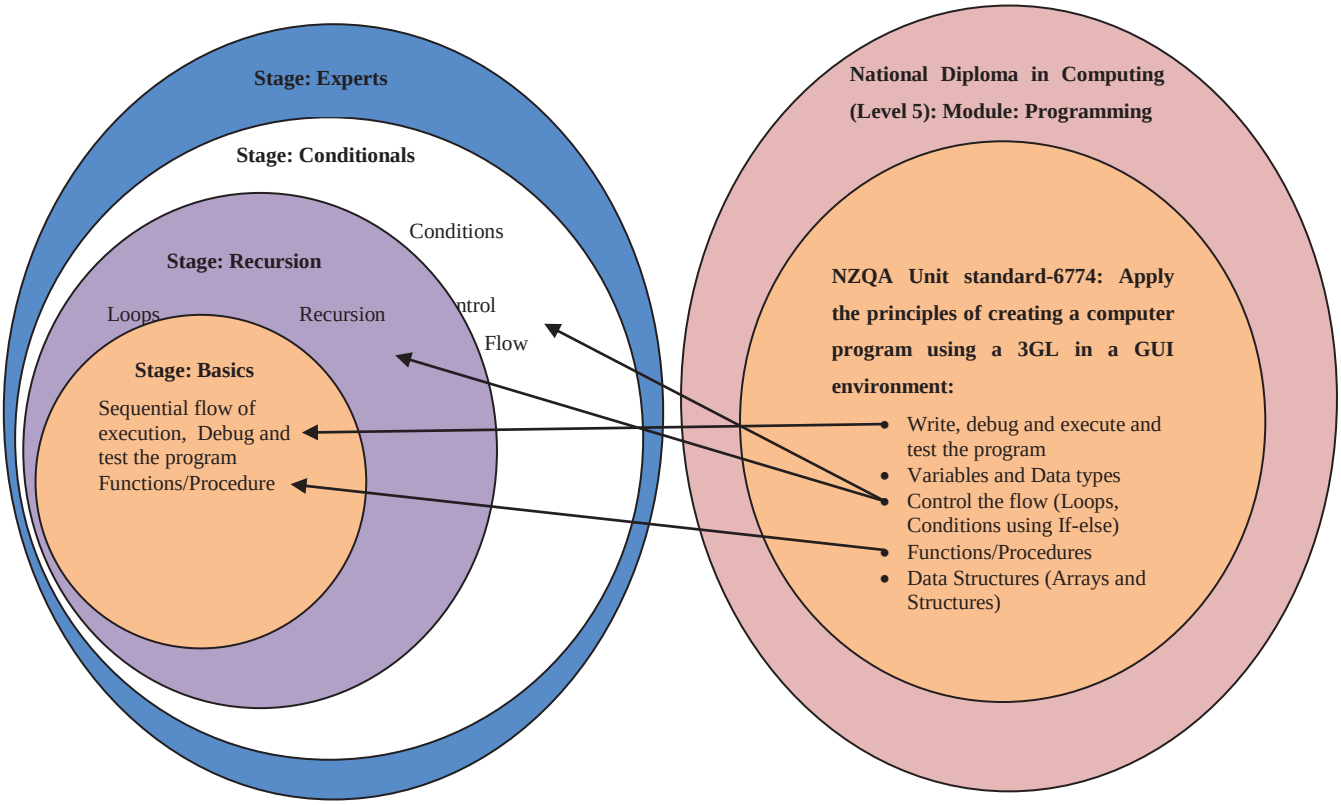


Figure 19- Mapping programming module to Light Bot stages

Light Bot 2.0 does not cover variables and data types and data structures (e.g., arrays). The reason behind this may be Light Bot teaches programming using non-code approach where the player programs the robot using icons which are visual elements. Concepts like variable, data types and data structures require knowledge of some code. However, Light Bot provides enough help to students so that they can understand logic behind programming construct, which would make it easy for them to understand technical syntax terminology later.

3.5.3 Case study participants

Participants at PlayIT were selected using purposive sample technique considering several criteria. All the participants must be international students studying in National Diploma in Computing (Level 5). In addition, two separate student cohorts were selected Participants were grouped into these two cohorts according to the stage of study at PlayIT. One cohort had started programming module and second cohort had attended all the classes of the programming module but had not been assessed yet. In other words a student who is half way through the programming module did not participate. The purpose behind this was to examine the effect of GBL in two different scenarios: first, when students do not have prior knowledge of educational content of the game, and second, when students have prior knowledge of programming aspects. The following table shows the cohort design and the size of each cohort.

	Cohort 1	**Cohort 2**
	Students had not attended programming Classes	**Students had completed programming Classes**
Number of Students	**20**	**24**

Table 3- Student cohorts

Cohort one comprised of 20 students who had not yet started studying the programming module. All the students in this Cohort 1 had not attended classes for 'Programming' module or they had never learnt programming not even during their previous qualifications. These students had started study at PlayIT just a week or two weeks earlier, so were in the initial phase of the level 5 course. Cohort 2 had 24 students who had attended the complete programming module but were yet not assessed. In other words Cohort 2 students had attended classes of 'Programming' module or they were taught programming using traditional classroom method but, they had not yet given the final assessments of programming module yet. However, a requirement for completion of the level 5 diploma course for both cohorts was the final assessment which included the programming module.

Students' participation in the classroom-based game intervention was voluntarily. Each student was given on assurance of anonymity prior to the conduct of the game-play. Researcher provided information sheet to all the participants containing brief overview of the study, the purpose of the study, basic details of researcher and university officials to whom participants may contact in

case the participants were not satisfied with the conduct of the game-play intervention. The participant's rights were also listed in the information sheet including the right to stop their participation at any time.

3.5.4 Game-Play Design

The game intervention experiment was conducted in May 2014 where the Light Bot game was played by both student cohorts in two separate settings in a classroom lab environment. Cohort 1 comprise of 20 students, who had not attended the programming classes. The second cohort comprised of 24 students. Cohort 2 was different from the first cohort by only one aspect, that is, these students had completed the 'Programming' module so they had some basic knowledge about programming. Students of both the cohorts were given basic manual explanting how to play the game (refer Appendix B(1)). In order to manage consistency in game-play and to achieve gradual understanding of programming concepts, the game-play was designed.Figure 20 illustrates the game-play design used in this study.The order of the game and the time set for tasks was slightly different for the two student cohorts. This was because the game tasks were aligned with basic and advanced concepts of the subject modules for the two groups. As explained earlier, the game contains four stages Basic, Recursion, Conditionals and Experts. Each stage has six levels with gradually increases complexity. ‘Expert’ is a combination of all previous stage concepts and does not add any new programming concept. So, the 'Expert' stage was made optional. Students were allowed to play 'Expert' level, only after completing the game-play designed for this setting. That is why 'Expert' stage is not included in Figure 20as it is out of the planned intervention design. The game mechanics of the Light Bot game allowed the player to move any time between different stages.

Game-play session lasted for an hour for both cohorts. The contact hours allocated for the programming unit standard (NZQA Unit 6774, pg. 53) is 140 hours. The game-play was designed differently for each cohort. Game-play design for Cohort 1 was designed to gradually introduce the complexity of the programming constructs.

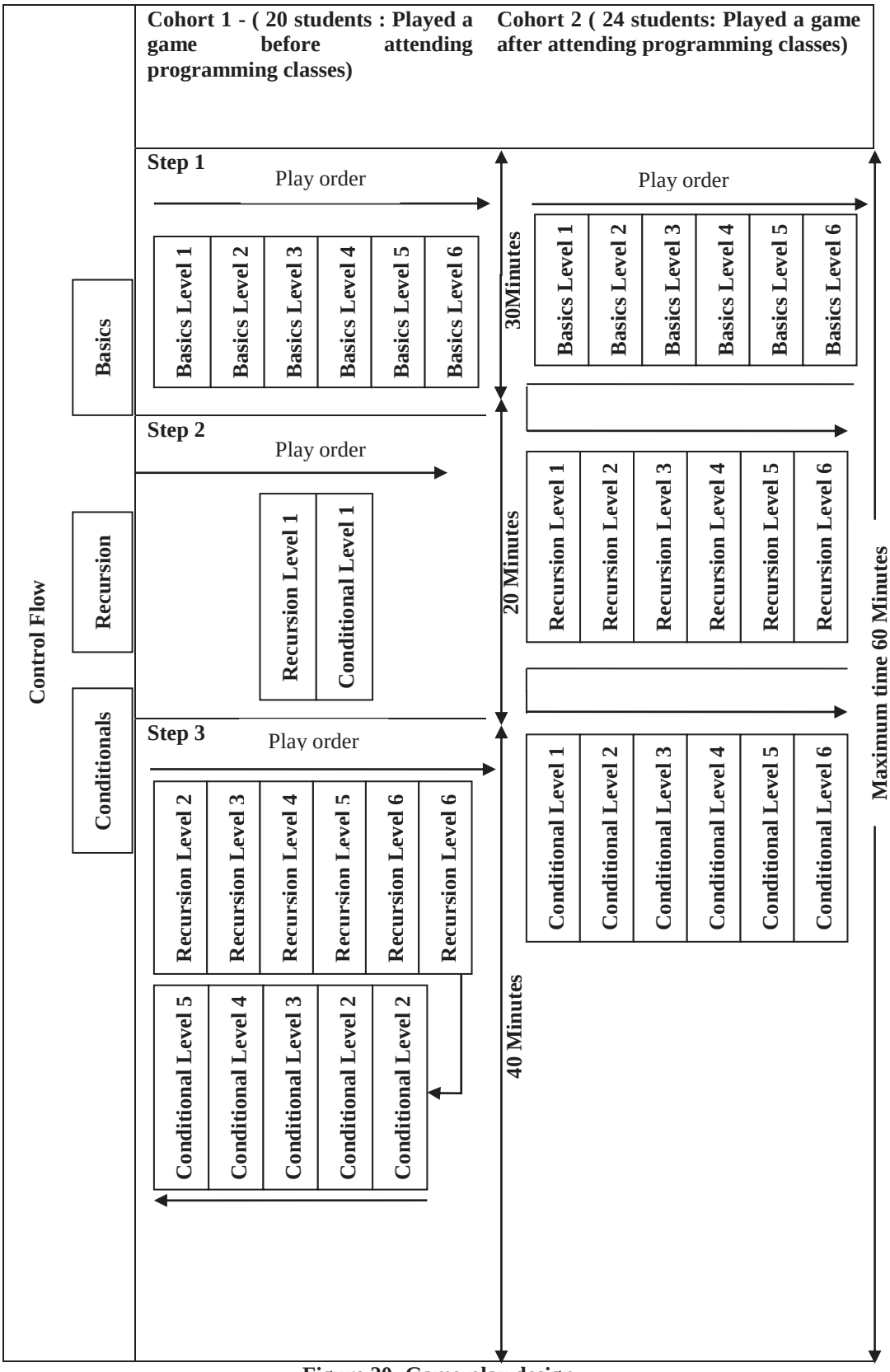


Figure 20- Game-play design

The students were asked to play the "Basic" level first, since contents in basic stage are required to understand the contents of the subsequent stages. Further, it was compulsory to play 'Basic' stage in order to move up to higher levels as it helped students to gain understanding progressively. After achieving basic level, the Cohort 1 students were asked to play the first level of 'Recursion' and then the first level of ‘Conditionals’.

Again, the reason behind this order was to cover all programming topics defined in the mechanics of the game. Students can have required understanding of all the topics. Moreover, if a student used most of the allocated time in playing one, particular stage repeatedly then he/she might not be able to give fair feedback for all the stages. The feedback form also had a question to assess their learning after playing the game (since these students had yet not attended the programming module). If student would be free to play any stage or level in irregular pattern then they might miss out any topic taught by different stage and would not be able to answer the question correctly. After playing the first level of 'Recursion' and then the first level of ‘Conditionals’, students were allowed to play remaining levels of 'Recursion' and 'Conditional' stage, however, they must play in order from lower level to higher as shown in Figure 20.Cohort 2 students were explicitly asked to play the game in order, e.g. 'Basic': Level 1 to 6, then 'Recursion': Level 1 to 6 and so on.

When Light Bot 2.0 is played through Armor games, the player can submit the score, share the score and can view other players' profiles. However, to do this he/she must register to the website, and can submit the score only after the completing all the stages of the game. During the game-play intervention, students were provided this information, and asked, if they would like to share their scores with other players or not. After playing the game both the group of students were given 15 minutes to fill the feedback forms (designed using Google Forms). Different feedback forms were prepared for both cohorts because the researcher wanted to analyse students experience separately based on their course completion stage (refer Appendix B(2) and (3)).Questions were mostly aimed at understanding student perceptions of the fun elements in the game, and whether they found the game difficult, or, whether the concepts on loops, conditionals or recursion were clear after the game had been played. Further, only students in Cohort 1 were asked a technical question pertaining to learning of programming constructs based on the contents of the game.

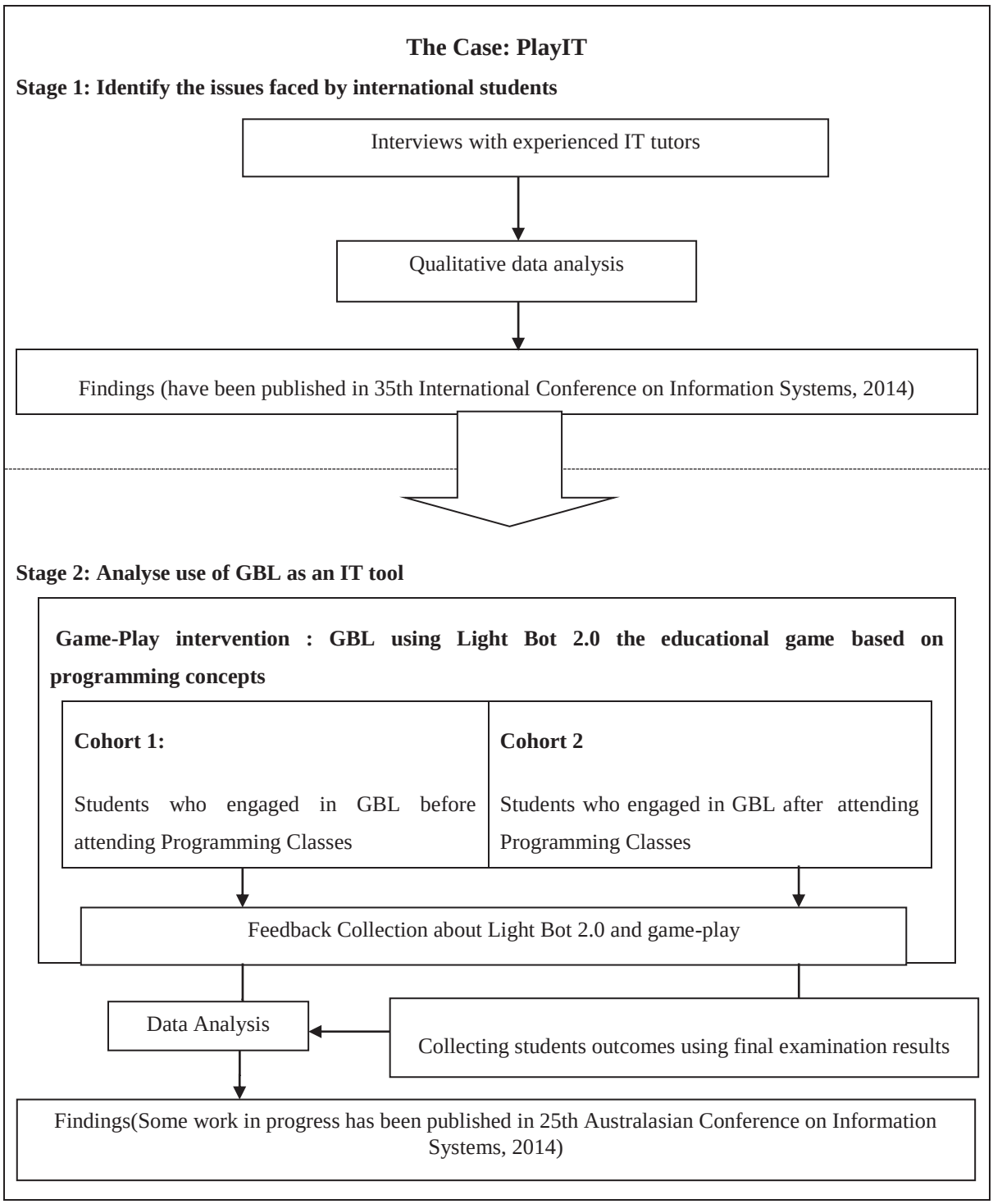


Figure 21- Research design of the study

After completion of the final examination of the 'programming' module, another survey was conducted again. This time students from both cohorts were given a common feedback from, asking them how GBL helped enhanced their learning experience (refer Appendix B(4)).Some

questions were aimed to get evidence on student's soft skills development too. The learning outcomes was later analysed with the final exam results of the students who took part in game intervention.

Figure 21shows whole research design summarising stage 1 and stage 2 of the study which is an extension of the Figure 9. PlayIT case was designed to examine use of IT tool to enhance learning experience of international students. In stage 1, interviews were held at PlayIT, which revealed issues and suggestions. Interview findings have been fed into stage 2,where a game intervention strategy was applied at PlayIT to analyse use of GBL in learning programming concepts.

3.6 Data analysis methods

Data analysis is the crucial part of the qualitative study which begins with the organising the data (Cohen, Manion, & Morrison, 2007). Each interview was transcribed immediately afterwards to help maintain closeness to the empirical data. Moreover, extensive notes were taken during interviews to maintain uniformity and to get better understanding of the data derived from transcription. The nature of interviews with the tutors was semi-structured; hence the same questions were asked. This facilitated comparing of responses. Interview data analysis included tactics such as counting frequencies of occurrence of ideas, generating themes, building a logical chain of evidence, and identifying relations between variables, were employed to analyse transcribed data(Cohen et al., 2007).Student data was collected using three feedback forms, in which questions were aimed to understand students' learning experience through GBL. Most of these data were qualitative by nature and they were in the form of ranked or categorical variables. To summarise the inferences, statistical methods were used such as frequencies and correlation to identify the strength and the association between variables, such as how strongly they are related and whether the relationship is positive or negative(Cohen et al., 2007).

Figure 22 depicts the data analysis process of current study. Two main events occurred in the study, namely interviews and classroom game-play intervention. Interview data presented tutors' perceptions while interventional data validated tutor perceptions with student perceptions. The next chapter discusses the data analysis techniques used in stage one and stage two of this study.

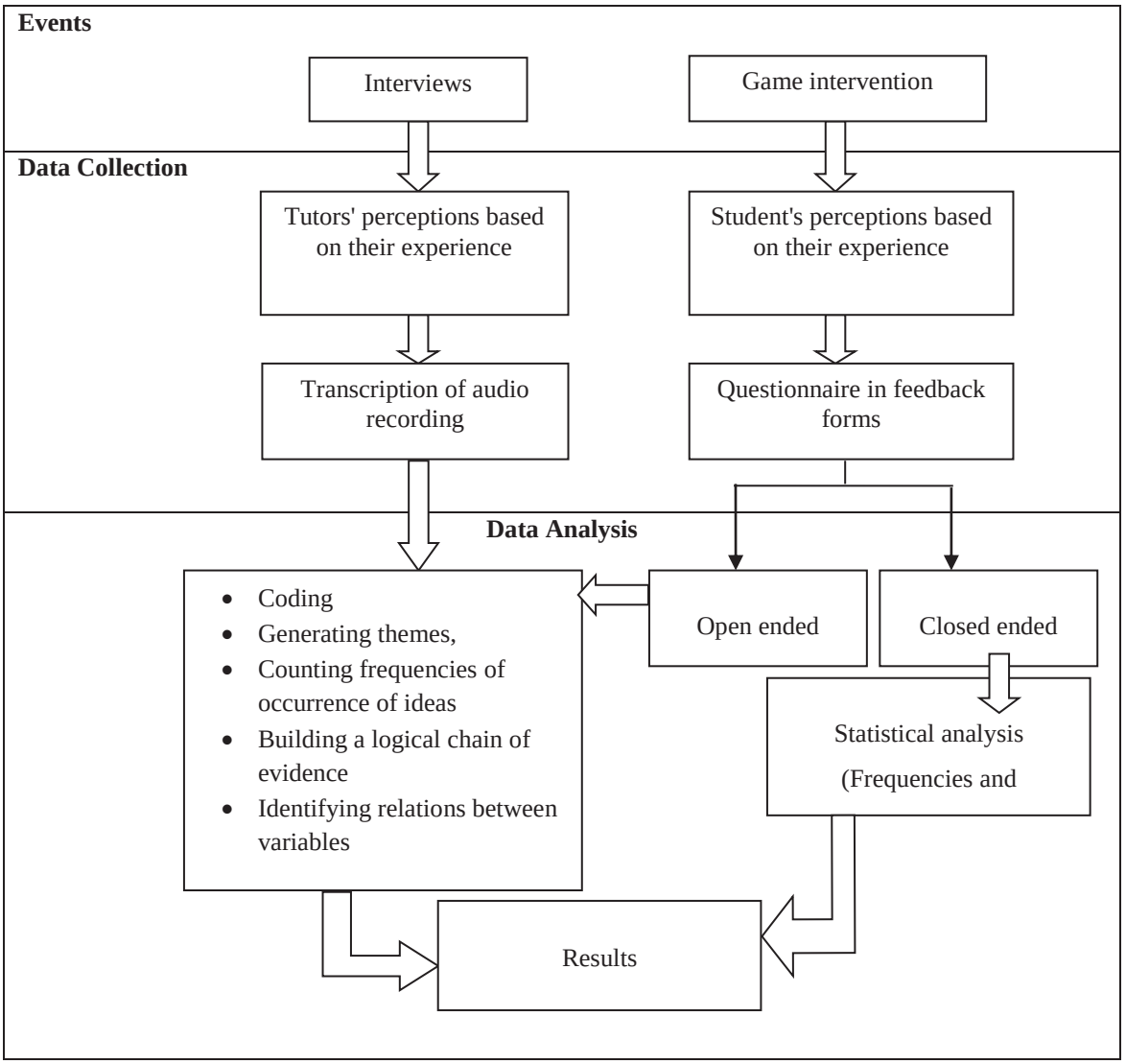


Figure 22- Data analysis process

CHAPTER 4: Data Analysis and Results

4.1 Introduction

Data analysis begins with the organising data to provide reference points of view. These views are then used to extract meaning using some rationale.(Cohen et al., 2007)presents five ways of organising and presenting data analysis, i) by group, ii) by individual, iii) by issue, iv)by research question and v) by instrument. The first approach categorised gathered responses based on the groups of participants. The second approach lists the responses in sequence according to participants' number. In the third approach responses are grouped together based upon some identified issue. Analysis by research question draws all the relevant data together for the issue of concern, to bring coherence. All relevant data from various data sources are collated to give a conclusive answer to the research question. For example, the numerical data related to a particular research question will be followed by descriptive text to assist in interpretation. The last approach involves grouping participant's responses by research instrument (e.g. interview, survey, tool, algorithm, etc.).The last approach often uses a combination of other approaches (i.e., group, individual issue).Responses gathered in the current study are organised and analysed using three different approaches. The study has used two types of instruments, interviews and survey questionnaire. At the first level, researcher organised data by instruments (refer Figure 22). Interview data is further organised and analysed by issues (level 2) and the survey data is further organised by group (level 2).

This chapter describes the interview data responses and highlights teacher perceptions and recommendations on issues. Further section reports the feedback results gathered from each cohort of the student. Finally, the chapter describes the feedback collected from all students after they had completed the final assessment of programming module. The feedback reveals student's experience and outcomes gained through GBL.

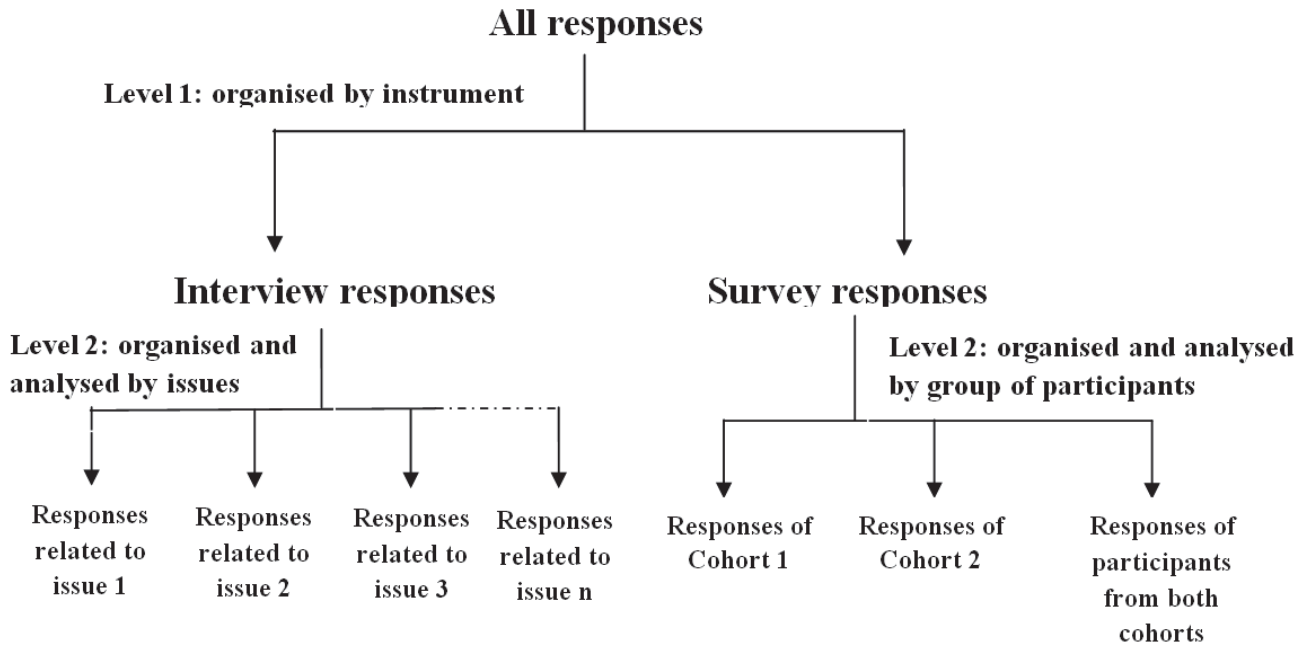


Figure 23- Data organising and presenting approaches used in the study

4.2 Interview findings

Transcribed interviews and notes taken by researcher were the main data sources at this stage. At first the data was coded to figure out certain theme and area of discussion. Then the coded material was combined with comments and notes taken by the researcher. Further, the combination of other tactics were applied (in iterative manner) to reach at results, such tactics includedcounting frequencies of ideas occurrence, building a logical chain of evidence, and identifying relations between variables(Cohen et al., 2007). Moreover, the categorisation of interview questions also facilitated data analysis. Accordingly, results were categorised as, i) learning issues faced by international students, ii) Social issues faced by international students and iii) suggestions to mitigate identified issues.Learning issues are those which relate to lack of understanding of course contents as laid out in the curriculum of a foreign country. Learning issues affect a student's academic performance in the study program. Social issues are not directly related to the curriculum contents, rather are based on real life challenges faced by students in their day-to-day activities in a foreign land. The key findings from interview data are presented below.

Sr.	Issue
L1	**Lack of interest in course contents** *"The technology moves so fast so when students realise that what they are studying is out dated now then their motivation goes down drastically....we have moved from hubs to switches, but hubs were taken out* [of the curriculum] *only two years back."* *"Lack of interest is because they are new to the country and for them it is a big shock, a big shift, so until they get acquainted to washing clothes, being away from family they are lost."* *"I have noticed in many organisations that the quality of tutors is not up to the mark and that can affect students' interest in learning."*
L2	**Difficulty in understanding conceptual topics due to lack of analytical and logical skills** *"Having no previous experience they cannot relate conceptually to many models like OSI model which is the basic reference model in networking."* *"They cannot analyse the course material, like when we give them assessment book they have difficulty in understanding difference between 'explain' and 'describe'."* *"....also when the class strength is over 30 and with limited time available, tutors really cannot give too much individual attention."*
L3	**Difficulty in transferring theory knowledge to practice** *"Things like hardware which exist are easy to relate, which students touch and visualise, but theory part which you cannot touch, is where the students lack confidence in analysing, for example the structure of programs, or things like syntax which are difficult to reason."* *"International students mostly come from dependent societies. Their parents decide everything for them from country to college to degree to fees. So, they don't know the whys. Why I will need this? Why is it important? Why is it used?"*
L4	**Difficulty in relating course contents to real industry use** *"When they actually get into a course, they don't know where will they employ their skills? Where this skill will be usable? They don't know its applications."* *"They lack understanding how NZQA unit standard based framework work, and what the differences are between NZQA diploma courses with other college qualifications."*
S1	**Linguistic inequality** *"Language is a huge barrier – so not knowing the normal business way of talking or contacting the people, they become either too informal or too formal."* *"Some are scared of stereotypes associated with accents and this makes them hesitate in contacting people."*
S2	**Cultural diversity** *"Many students find problems to interact with people of other cultures. So they do not take the initiative to start conversation with them."* *"Coming from a dependent society, they have all kind of support, but here they have to earn, manage daily tasks such as cooking and cleaning, things they have not experienced before. Then to understand how things work here is hard, starting from learning our driving rules to how to conduct ourselves in interviews."*

Table 4- Interview data summary

4.2.1 Learning challenges/issues

Responses mentioned that students studying in ICT courses face many learning issues, such as, difficulties to understand conceptual topics which are intangible (e.g., algorithms and protocols). Tutors listed models (OSI/TCP-IP), algorithms, protocols, logical flow of the programs (debugging and testing), relationships and normalisation in database tables, loops, recursion, and object oriented concepts etc. as areas perceived to be difficult by students. These are abstract concepts, which cannot be visualised. Programming was considered to be one of the difficult subjects in computing courses (comparatively more difficult than the hardware and networking subjects). The reason behind the learning issues might be the lack of skills such as analytical and logical skills, reasoning skills and also some soft skills such as communication skills, presentation skills and project management skills. Further, one tutor mentioned that students often lack decision-making skills because most of the international students are coming from the dependent society where the crucial decisions of their life (such as selecting major area of the study) are taken by their parents. According to another tutor, students lack understanding of industry perspectives, for example why they need to learn particular topic and what the industry requirements related to that topic are. In addition, English is not the first language of international students. So sometimes students have difficulty in understanding the language used in assessments. For example, students cannot understand difference between 'explain' and 'describe'.

Three out of five tutors mentioned 'lack of interest in subjects' as the biggest challenge resulting demotivation. Tutors summarised the lack of interest due to lack of English language proficiency. International students are new to country, hence they have big shock first with country shift and then they transit from dependent to independent society. One of the tutors pointed out learning issue regarding transfer of theory knowledge to real world practice. Again the reason behind this is lack of confidence and interest, and also as students struggle to cope in new country settings. One more challenge/issue for the international students is difficulty in understanding the language of course material. However, tutor described this as an impact of lack of English proficiency rather being a learning issue.

4.2.2 Social issues

All the tutors found language inequality or lack of English proficiency as the major issue. Cultural diversity was pointed out by four out of five tutors; it includes problems in adapting new life style and living environment, feeling home sickness, lack of confidence while interacting with other cultures, etc.All the tutors agreed that the cultural diversity influences social issues. Moreover, even when language inequality is not a barrier, like in case of students with good English proficiency, even they take some time to get a good command on spoken language. This is due to language constructs (words and accents) in new culture. Table 4summarises the interview responses (using verbatim interview data) with findings from literature.

In light of the literature available, the participant's responses have re-affirmed learning and social issues for international student. Total four learning issues and two social issues have been identified from the five interviews. What really matters next is how to address these issues. Accordingly, the next interview question asked participants what recommendations they could suggest to resolve some of the issues which they have identified.

4.2.3 Suggestions to mitigate issues

Suggested tools to mitigate social issues include providing online information about the multicultural environment, education system, transportation system, employment system, etc. Recommendations for the learning issues comprise use of the e-learning approach, use of online tutoring, access to online resources of course material, and blended learning. Four out of five tutors suggested game based learning and described it as an effective tool. Interview questionnaire too included some questions regarding use of GBL. Response mostly favoured GBL, though some responses mentioned risks, such as incorrect selection of the game, cost of the games etc. In addition, tutors suggested programming and database modules to apply GBL as they are relatively more intangible topics. Cisco Aspire, Cows and Bulls, and Alice were suggested examples of useful games. Table 5 summarises participant's recommendations.

Recommendation
Use blended learning concepts *"Use blended learning which is partly classroom teaching and partly computer based learning which can be done from home as well."* *"....make video recordings of tutors covering a topic and make it available online, so students can refer it repeatedly. Obviously we share slides and other material, but when the tutor talks, he brings in reasoning, gives real time examples, and connects the subject to the study outcomes."* *"When the concept is slightly difficult to grasp such as programming or database, if the visual delivery methods could be developed to suit those entry level students, then they would not find it as difficult as they normally do."* *"We can try videos or animation for example to explain how packet is built up and how it traverses through the network."*
Conduct review of course content *"It is good that NZQA have started allowing colleges to build their own courses up to mark with industries..... NZQA is currently going through a large targeted review of qualification, which will definitely help students."* *"If NZQA provides options of industry based projects during final year of course then it will help students to relate study with the industry criteria."*
Game based learning *"Using games in teaching is very good idea. Like in gaming we have stages to achieve one after another, we could design learning activities for small business solutions leading towards enterprise solutions. That will keep students motivated and interested."* *"Using games is an effective way to visualise non tangible components like loops and protocols."* *"CISCO learning academy use a game called CISCO Aspire. Here you are given a task to connect a computer to a network... and if you find that it doesn't connect because the computer doesn't have network card, then you are given some fiction money. You can then go to a store, where you have to choose the right component from hundreds of components. Then you add your network card to the machine.... so GBL is very effective because they [students] have to identify the components. Students can apply what they have learnt, so its action learning even if it is a game."* *"GBL is cost effective way in terms of practical implementation and probably avoid damage to our equipment."* *"GBL will make students interact socially with each other more."*
Provide online information *"We can tell students about New Zealand's different kind of websites.... so they know what the systems are for house renting, employment rights, weather etc. This would make students more familiar to the local environment."* *"We can create a website where students can know about New Zealand, know about transportation, where they can go for IRD accounts, job searches, etc."*

Table 5- Recommendations from study participants

Table 5 offers rich insights on tutors' perceptions for resolving these issues. Tutors are the front line staff in direct contact with students. Their recommendations suggest applications using game simulations and visual animations to teach ICT courses rather than the just using traditional

classroom methods. The next section elaborates the findings from the stage 2 game intervention design.

4.3Stage 2 - Findings from Game intervention

This section presents findings derived after applying statistical methods to quantitative data gathered through survey. Descriptive statistical methods are used in analysis, such as central tendency and correlation coefficients. Results are interpreted and then discussed. The current section is divided into four sub-sections; the first section is outline of the results belongs to the feedback given from the Cohort 1 students who played Light Bot 2.0 without prior knowledge of programming. The second sub-section is the results from the feedback of Cohort 2 students who had prior knowledge of programming when they played Light Bot 2.0. The third section describes findings of correlation methods applied on results. The last section presenting the results from feedback collected from students after completion of their final assessment for programming module.

4.3.1 Feedback results of the Cohort 1 students

Students in this cohort played Light Bot before attending programming classes. Out of 20 students, 12 students had prior experience of playing educational games which is 60% of this group of students, though none had played the game Light Bot. Students were asked to rate the *degree of liking* for four types of games, 'Puzzle','Role-Play','Action/Adventure', and 'Sports'. The five scale likert type questions (Jackson, 2011) were used,values ranged from 5- 'like it extremely' , 4- 'like it very much', 3- 'like it moderately', 2- 'like it slightly' and 1-'Do not like it at all' were used. The highest average *degree of liking* is 4 - 'Like it very much' for two game types, 'Puzzle' and 'Adventure'. This shows that game modes related to puzzle and adventure were considered to be livelier than other modes (i.e., role play and sports, refer Figure 24).

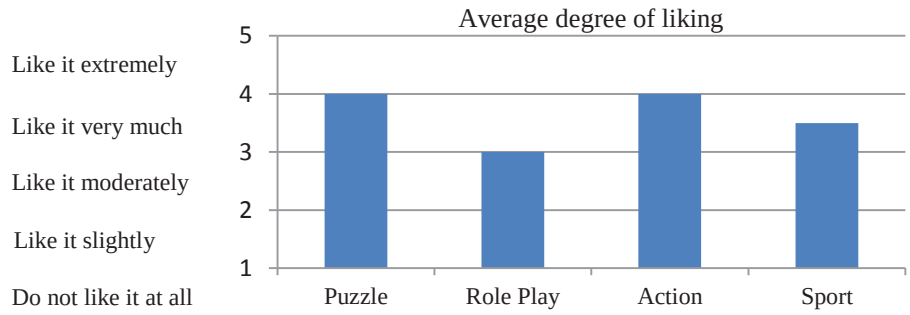


Figure 24- Average degree of liking for each game type

The Light Bot game covers many programming topics namely basics, functions, recursion and conditionals. Figure 25 shows that around 50% students rated recursion and conditionals topics as 'moderately tough' and 'very tough' respectively.

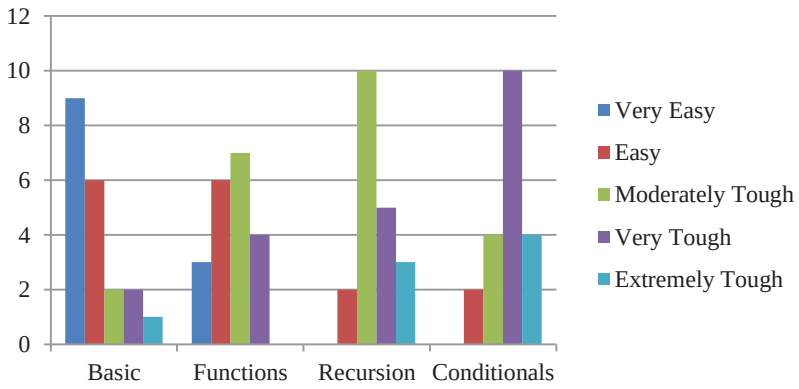


Figure 25- Students count based on degree of difficulty for each topic

Moreover the average *degree of difficulty* is lowest as 2 ('Easy' for Basics topic) and highest as 4 ('Very tough' for 'Conditionals' topic)(refer Figure 26). It is important to mention that Light Bot is designed in a way that 'Conditionals' stage includes recursion concepts too. This makes 'Conditionals' stage more complex than just using normal control programming structure. In terms of programming constructs, sequential logic flow involving functions (or basic stage) was rated as easy, while recursion logic was rated as moderately difficult, and conditional (or advanced stage) as very difficult (refer Figure 26).

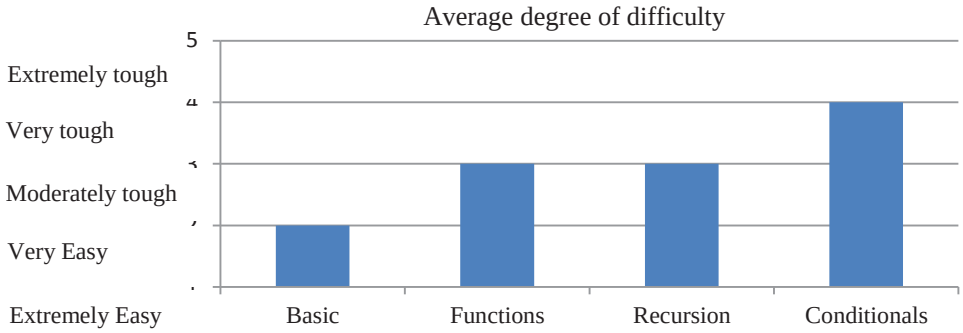


Figure 26- Average degree of difficulty for each topic

Students rated *degree of understanding* for three topics using three scaled likert type question (3-Understand very well, 2-Understand moderately well and 1-Understand least). This question helped to gauge students' understanding before classroom learning. In addition, Figure 27 shows that the highest average degree of understanding is 3 ('Understand very well') for the topic 'Functions. For both the topic 'Recursion' and 'Conditionals' average degree of understanding is same as 2 ('Understand moderately well').

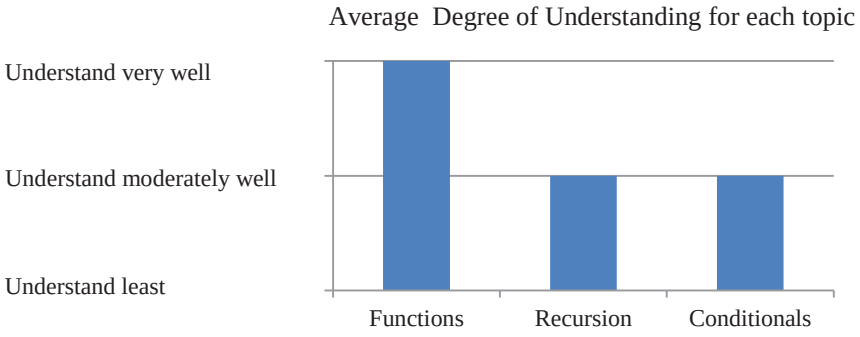


Figure 27- Average degree of understanding for each topic

Moreover data suggests that over 50% of students understood recursion moderately. Since, the students from Cohort 1 had not learnt programming, no definite statement can be made if the *degree of understanding* rated by student is high because they understood the topic properly, as it is the students' perception that they have understood the recursion concept (refer Figure 28).

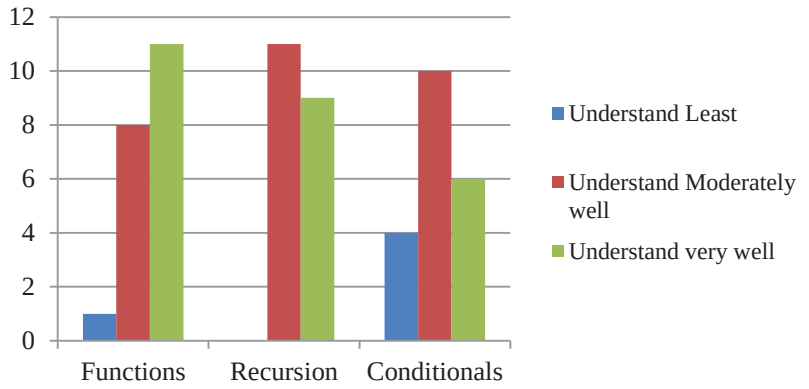


Figure 28- Students count for each topic based on degree of understanding

In order to assess students' correct understanding through game-play, a course related question was posed: 'What is recursion?' Three choices were provided, i) Two functions are called together, ii) Function is called by itself and iii) Two functions are called serially. Out of 20 students, 13 students could answer the question correctly. This throws some light on the level of understanding of course contents, that is, around 65% students may have understood recursion correctly.

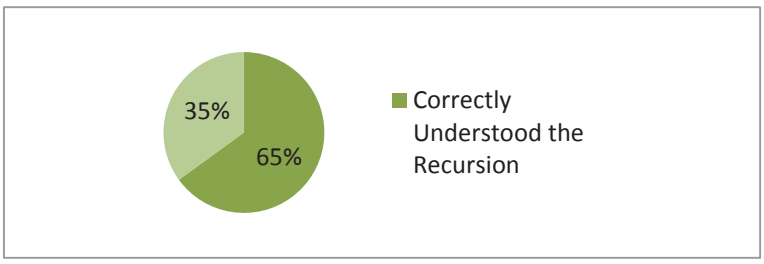


Figure 29- Pi-Chart: Students count based on correct understanding of recursion

The *degree of fun* was rated for the game using five values, 1-Boring, 2-No fun, 3-Do not care either way, 4-Good fun and 5-Really enjoyable. The overall *degree of fun* rated by whole group is 4-Good fun; with more than 50 % students rated the game as 'good fun'. This encourages use of Light Bot for educational purposes.

As mentioned, students were asked whether they had previously played any educational game or not. If *degree of understanding* would be considered, students who have played the educational game before had gained *average degree of understanding* higher (3) than the students who have

not played any educational game before (2).However, students perception for the *degree of difficulty* is equal (3) for both categories of students. Further, the *average degree of fun* while playing the game is 4 or good fun for both categories (refer Table 6).

Variable	Category 1: Students who have played academic games before	Category 2: Students who have never played academic games
Degree of overall understanding	3- Understand very well	2-Understand moderately well
Degree of overall difficulty	3- Moderately tough	3-Moderatey Tough
Degree of fun	4-Good fun	4-Good fun

Table 6- Average degree of understanding, toughness and fun based on the student's category

Students were asked to rate the *degree of agreement* for two statements i) "I think programming would be interesting" and ii) "This game is helpful/effective to learn programming". Five scaled likert type question was designed with values as 1-Strongly disagree, 2-Disagree, 3-Neither Agree nor Disagree, 4-Agree, and 5-Strongly agree. The average *degree of agreement* for the first statement is 4 which is 'Agree'. Further, total 85% students rated 'Agree' or 'Strongly agree'. This implies that the Light Bot can help tutors to achieve positive attitude towards programming before the subject is taught. The average for *degree of agreement* for the second statement is again 4-'Agree', this shows that such games are effective to learn programming from the learners perspective.

Participant Number	Response for the question : Briefly describe your experience while playing this game
1	*"It was very interesting and i think that if studies would convert in to a game then it will become very easy to understand any topic taught by tutor/faculty."*
2	*"It was fun playing the game while learning side by side."*
3	*"Enjoy and positive towards learning programming."*
4	*"verry good"*
5	*"it was fun while playing game"*
6	*"It was too boring"*
7	*"it was too boring...i m hungry grrrrrr"*
8	*"very good"*
9	*"yes i enjoy it alot"*
10	*"it was good game, i enjoyed it very much"*
11	*"It was interesting. it would b good to learn programming"*
12	*"it was good"*
13	*"This game really amazing i really like this and it is good for beginners and it is good game for programming module thanks a lot"*

14	*"When I started, it was boring, but once I achieved levels, I wanted to go ahead, and now I understand what recursion is"*
15	*"I don't like such games....."*
16	*"I enjoyed a lot, this is the first educational game i played"*
17	*"It is good start to learn programming, i was fearful of programming, but now it does not seem so bad"*
18	*"Like to play such games, but i think it would be better if played after learning programming"*
19	*"Programming is horrible!!!!"*
20	*"I enjoyed recursion part – it was so brain storming"*

Table 7- Open ended question response - Cohort 1

One open-ended question was asked, where students were asked to describe their experience while playing the game (refer Table 7). Student responses varied from "*boring*" to "*interesting*". Positive feedback included comments such as "*I was fearful of programming, but now it does not seem so bad*", "*I enjoyed recursion part – it was so brain storming*" and "*When I started, it was boring, but once I achieved levels, I wanted to go ahead, and now I understand what recursion is*". Other positive terms such as "*amazing*", "*interesting*" and "*fun*" were sprinkled across the feedback form. However, 20% of the class was not too keen on educational games and their open ended text answer had comments like "*I don't like such games*", "*Programming is horrible*", "*I would prefer to play this game after I have learnt programming*" and "*It was too boring*". The overall feedback of the Cohort 1 was positive though.

4.3.2 Feedback results of the Cohort 2 students

The first question asked students the levels to which they had achieved in different stages. The highest level value reached was 6 for 'Basics' stage, and the lowest level value is 2 for 'Conditionals' stage, while 'Recursion' and 'Experts 'reached level 3. Overall, the whole class had completed higher levels in 'Basic' and 'Recursion', but had achieved lower levels in 'Conditionals' (refer Figure 30). This implies that the 'Conditionals' stage would be the most difficult stage. It should be noticed that in Light Bot game mechanics, 'Recursion' is included in 'Conditionals' and be the reason for lower levels in 'Conditionals'.

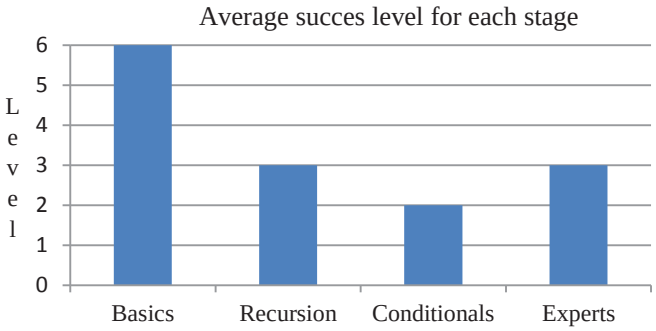


Figure 30- Average success level for each stage of Light Bot 2.0

Students were asked to rate the *degree of agreement* for three statements i) "The game is helpful/effective to learn programming", ii) "Concepts of programming become more clear by playing this game than from classroom learning" and iii) "Such games should be included in course curriculum as learning activity/method".

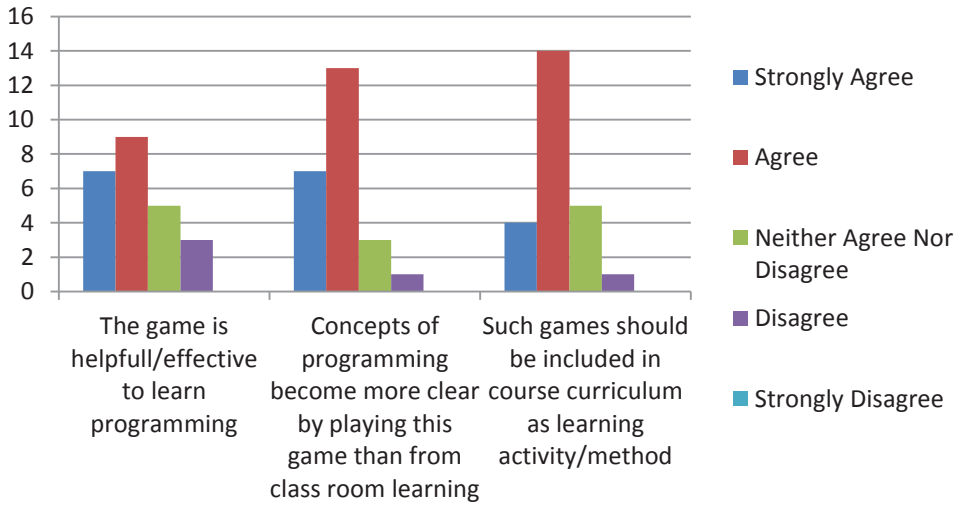


Figure 31- Students count showing degree of agreement for the given statements

Largely, the group agreed that the game was effective in learning programming concepts. Out of 24 students, 13 students (i.e., more than 50%) agreed that playing the game had brought more clarity to their earlier taught concepts (refer Figure 31). Further, 14 students agreed to include gaming elements in the curriculum. Further, the average for *degree of agreement* is 4 ('Agree') for all three statements, which shows overall class inclination for GBL.

For the *degree of game relevance* to programming, a five point likert scale was used (5-'Extremely relevant', 4-'Very Relevant', 3-'Moderately Relevant', 2-'Slightly Relevant' and 1-'Not Relevant' at all). 58% students rated the game as very relevant (4), 25% students rated the game as moderately relevant, and 20% rated the game as extremely relevant to programming. In addition, no students found the game not to be relevant at all. However, a small percentage of the students (17%) found the game to be confusing.

Students were given a list of statements and were asked to select as many statements as they agree with. Table 8 lists those statements and the percentage of students who agreed. Around 96% of students could relate the game to the classroom topics, but 8.3% of students found the game to be a waste of time. More than 50% of students agreed to take part in a forum to help other students understand programming. Around 67% students were keen to share their score with others, and 75% students said that they enjoyed simply playing the game, rather than think about applying programming concepts while playing the game**.**

Given sentences	**Percentage of students agree with**
I could relate the game to the classroom topics	96
I enjoyed simply playing the game rather than applying it to programming concepts	75
I could not understand some concepts during classroom learning, but this game made it clear	37.5
I found the game to be waste of time	8.3
I liked comparing my score with others	67
I would like to take part in forum	58.3

Table 8- Students' agreement with given statements in feedback form

In regard to open ended question, positive feedback included comments like *"It helped me refresh my programming skills", "I liked the logic", "The game was pretty enjoyable", "Very relevant", "Makes me more confident"* and *"Good leisure time".* Other not so positive comments included *"Did not help me", "bit confusing"* and "*I don't know if I liked it or not"*. However, the general consensus on the usefulness of the game to the understanding of

programming constructs was overwhelmingly positive. Table 9 lists the responses for the open ended questions.

Participant No.	Did you find the game confusing?	Why you find the game confusing?	How this game helped you?
1	No	N/A	*"The commands given in this game are relevant to the commands used in programming."*
2	No	N/A	*"This game very helpful to learn programming commands as we can say keywords."*
3	No	N/A	*"To pass my leisure time."*
4	No	N/A	*"The game is very powerful for new students to improve logic."*
5	No	N/A	*"Game mechanics is very relevant to programming."*
6	No	N/A	*"This Game is helpful for new students, By playing this type of game students can improve logical skills."*
7	No	N/A	*"My concepts become clear."*
8	No	N/A	*"I could understand programming properly with this game."*
9	No	N/A	*"It will help us in improve my problem solving skills and logic..."*
10	No	N/A	*"It helped me to clear all my concepts. It has also helped to understand all the commands logically and sharpen my logical skills."*
11	No	N/A	*"This game is helpful for me to understand the function, looping and other concepts that we need in programming language. I strongly recommend that this game should be included in course content."*
12	Yes	*"The conditional stage was confusing because it included recursion as well, but any how i solved it but not properly. In fact conditions are soooo easy in real programming."*	N/A
13	No	N/A	*"This game was pretty enjoyable and it helped me refresh my programming skills again Thank."*
14	Yes	*"Game is bit confusing, Tools were limited and combination of recursion and*	N/A

		conditionals statements are confusing ex. conditional level 3 to 6."	
15	No	N/A	*"Did not help me nor confused me."*
16	No	N/A	*"Improves my logic skills."*
17	No	N/A	*"Help me To recall recursion again."*
18	Yes	*"I find conditional stage confusing because tutorial doesn't teach how to change colour of square."*	N/A
19	No	N/A	*"Neither confusing nor help me."*
20	No	N/A	*"It helps me to think logically and there were many options to solve a level but which one is shortest was challenge Good one ....."*
21	No	N/A	*"I don't know if I liked it or not!!!!!!!!!"*
22	Yes	*"Conditional statements have colours which is confusing."*	N/A
23	No	N/A	*"I was bit confused in recursion but after playing this game i am confident for my understanding now."*
24	No	N/A	*"Makes me more confident in programming concepts."*

Table 9- Response for open ended questions-Cohort2

4.3.3 Correlations between variables

Collected data contains two types of measures, nominal and ordinal. Nominal variables are based on fixed categorical values like nationality which can be American, Chinese, and Indian etc. The nominal variables having only two categories are called dichotomous variables. For example, gender can be male or female. This study included two sets of dichotomous variables, where the students were asked if they had played any educational game previously or not and if they found the game confusing or not. It may be noted that although the question 'what is recursion?' uses nominal variables with three possible values, it cannot be used for any analysis other than correct answer (please refer Appendix B(2) for more details).In an ordinal scale, variable's values are shown in order of degree. For example students' performance in exam can be reported by using ranks, like highest score, second highest, and so on. Ordinal data are normally referred to as

ranked data because they are ordered from highest to lowest or from biggest to smallest. The data thus collected from Likert scale is ordinal, as it refers to ranked data (Jackson, 2011).

In this study for instance, *degree of agreement* is ordered from highest to lowest as 5-'Strongly agree', 4-'Agree', 3-'Neither agree nor disagree', 2-'Disagree', and 1-'Not agree at all'. The Likert scale ranked various aspects of GBL from largest to smallest such as degree of fun, and degree of relevance. Table 10 lists all the variables included in this study with their types and possible values. Correlation method is employed to analyse relations between variables.

Variable	Type	Values
Degree of liking for the game-type	Ordinal	5- 'like it extremely', 4- 'like it very much', 3- 'like it moderately', 2- 'like it slightly', 1-'Do not like it at all'.
Degree of overall difficulty faced by each student for all stages as whole	Ordinal	5- 'Extremely tough', 4- 'Very tough', 3- 'Moderately tough', 2- 'Easy', 1- 'Very easy'.
Degree of overall understanding percept by each student for all the topics as whole	Ordinal	3- 'Understand very well', 2- 'Understand moderately well' and 1- 'Understand least
Correct answer for question "What is recursion?"	Nominal	1- 'Two functions are called together is recursion', 2- 'Function is called by itself is recursion' and 3- 'Two functions are called serially is recursion'
Degree of fun while playing the game	Ordinal	5- 'Really enjoyable', 4-'Good fun', 3-'Do not care either way',2-'No fun', and 1- 'Boring'
Degree of agreement for the given statements	Ordinal	5- 'Strongly agree', 4- 'Agree', 3- 'Neither agree nor disagree', 2- 'Disagree', and 1- 'Not agree at all'
Experience in playing an educational game	Dichotomous	1- 'Yes' 0- 'No'
Student found the game confusing	Dichotomous	1- 'Yes' 0- 'No'
Degree of relevance of the game to programming concepts	Ordinal	5- 'Extremely relevant', 4- 'Very relevant', 3- 'Moderately relevant', 2- 'Slightly relevant' and 1- 'Not Relevant at all'
Average success level of all stages	Ordinal	6, 5, 4, 3, 2, 1 (Complexity rises from lowest to highest levels)

Table 10- Variables in the study

Table 11 describes types of correlation coefficients (ϒ) used in the study. Further, the type of correlation coefficient decided is based on the type of the variables. For example, if variable 1 is

of type ordinal (degree of relevance) and variable 2 is of type dichotomous (student found the game confusing or not) then rank-biserial correlation coefficient has been used to analyse results. The Spearman's correlation coefficient method (Υ_s) and rank-biserial correlation coefficient (Υ_{rb}) method have been used to analyse any sort of relationship between the two diverse data sets.

Variable 1	**Variable 2**		
	Dichotomous	**Nominal**	**Ordinal**
Ordinal	Rank-biserial Correlation Coefficient (Miller, 1998; Yount, 2006)	Rank-biserial correlation Coefficient (Miller, 1998)	Spearman's correlation coefficient(Jackson, 2011; Yount, 2006)

Table 11- Correlation coefficients used in the study

Relations are first described as positive or negative. In case of positive relationship, if the value of variable 1 increases, the value of variable 2 increases. Oppositely, if the variable 1 tends to increases, the variable 2 tends to decreases in a negative relationship(Jackson, 2011; Yount, 2006). Relations can be ranked in the following order: perfect (Υ=1), strong (Υ>= 0.7), substantial (Υ> = 0.5), moderate (Υ>= 0.3), weak (Υ>= 0.1) or none (Υ>= 0.0) (Jackson, 2011; Miller, 1998).Following is the statistical analysis of the feedback data indicates magnitude of relationship between the variables for Cohort 1and Cohort 2.

Statistical Analysis Cohort 1

Spearman's correlation coefficient method (Υ_s) is used for ordinal values in which students had ranked their perceptions of the GBL experience using Likert scale. Rank-biserial correlation coefficient (Υ_{rb}) is used for finding the relation of nominal values to ordinal values. There are two nominal values, first in which students were asked whether they had previously played any educational game to which they could answer either yes or no and the second is correct answer of the question 'what is recursion?' to which students could select any one option from given three options.

Table 12 shows the magnitude of relationship between the *degree of fun* and other variables (*degree of agreement, degree of overall difficulty, degree of overall understanding, past experience in playing educational games* and *correct answer to the question).*

Variable 1	Variable 2	Relationship
Degree of fun while playing the game	*Degree of agreement* for the statement : "This game is helpful/effective to learn programming"	+ strong ($\Upsilon s = 0.761$)
	Degree of agreement for the statement : "I think programming would be interesting"	+ strong ($\Upsilon s = 0.700$)
	Degree of overall understanding	+ substantial ($\Upsilon s = 0.525$)
	Degree of overall difficulty	none ($\Upsilon s = -0.072$)
	Past experience in playing educational games	none ($\Upsilon rb = -0.025$)
	Correct answer for question "What is recursion?"	none ($\Upsilon rb = -0.064$)

Table 12-Υ_s and Υ_{rb} for Degree of fun

The *degree of fun* is strongly related to the *degree of agreement* for both the statements: "This game is helpful/effective to learn programming" and "I think programming would be interesting" as Spearman's correlation coefficient is +0.761 and +0.700 respectively. This implies that as the fun to play the game increases, student's agreement for the given statements increases strongly. Spearman's correlation coefficient for the *degree of overall understanding* is +0.525 which shows positive moderate relationship. This implies that as the overall understanding increases, the fun to play the game tends to increase moderately. There is no relation found between the *degree of fun* and *degree of overall difficulty, past experience in playing educational games* and *correct answer to the question* as the values of Υ_s and Υ_{rb} are less than 0.1.

Table 13 illustrates the magnitude of relationship between the *degree of overall understanding* and other variables such as *degree of agreement, degree of overall difficulty, past experience in playing educational games* and *correct answer to the question.* The *degree of overall understanding* is substantially related to the *degree of agreement* for the statement: "I think programming would be interesting" as Spearman's correlation coefficient is +0.597. The *degree of overall understanding* is moderately related to the degree of agreement for the statement: "This game is helpful/effective to learn programming "with Υ_s+0.700. The positive value implies that as the understanding of topics increases, student's agreement for the given statements increases. Spearman's correlation coefficient for the *degree of overall difficulty* is -0.329,which shows a negative moderate relationship. This implies that as the overall understanding increases, the overall difficulty to play the game tends to decrease moderately. There is no relation found between the *degree of overall understanding* and either *past experience in playing educational games* and *correct answer to the question* as the values of Υ_s and Υ_{rb} are less than 0.1.

Variable 1	Variable 2	Relationship
Degree of overall understanding	*Degree of agreement* for the statement : "I think programming would be interesting"	+ substantial (ϒs = 0.597)
	Degree of agreement for the statement : "This game is helpful/effective to learn programming"	+ moderate (ϒs = 0.406)
	Degree of overall difficulty of game	– moderate (ϒs = – 0.329)
	Experience in playing an educational games	none (ϒrb = 0.025)
	Correct answer to question "What is recursion?"	none (ϒrb = – 0.004)

Table 13-Υ_s and Υ_{rb} for Degree of overall understanding

Table 14 shows the magnitude of relationship between the *degree of agreement* for both the given sentences and other variables such as *degree of overall difficulty*, *past experience in playing educational games* and *correct answer to the question.* The *degree of agreement* for the statement: "This game is helpful/effective to learn programming" is substantially related to the *degree of agreement* for the statement: "I think programming would be interesting" as Spearman's correlation coefficient is +0.665. The *degree of agreement* for the statement: "This game is helpful/effective to learn programming" has negatively weak relation with the *degree of overall difficulty*(ϒs = –0.151).There is no relationship found between the *degree of agreement* on second statement and the *degree of difficulty* as the value of $\Upsilon_s$is less than 0.1.

Variable 1	Variable 2	Relationship
Degree of agreement for the statement : " This game is helpful/effective to learn programming"	*Degree of agreement* for the statement : "I think programming would be interesting"	+ substantial (ϒs = 0.665)
	Degree of overall difficulty of game	weak (ϒs = – 0.151)
Degree of agreement for the statement : "I think programming would be interesting"	*Degree of overall difficulty* of game	none (ϒs = – 0.069)

Table 14-Υ_s and Υ_{rb} for Degree of agreement on given statements

Table 15 shows the magnitude of relationship between the *degree of overall difficulty* and variables such as *past experience in playing educational games* and *correct answer to the question.* Further, relation between *degree of difficulty* for 'Recursion' stage and *correct answer to the question* 'What is recursion' is also analysed. However, no relation is found between these variables.

Variable 1	Variable 2	Relationship
Degree of overall	*Experience in playing an educational games*	none (ϒrb = – 0.052)

difficulty	*Correct answer to question* "What is recursion?"	none (ϒrb = - 0.043)
Degree of difficulty for 'Recursion' stage	*Correct answer to question* "What is recursion?"	none (ϒrb = – 0.062)

Table 15-Υ_s and Υ_{rb} for Degree of overall difficulty and degree of difficulty

Statistical analysis Cohort 2

For Cohort 2 students, Spearman's correlation coefficient method (Υ_s) is used for ordinal values where students ranked their perceptions of the GBL experience using Likert scale. Rank-biserial correlation coefficient (Υ_{rb}) is used for nominal values where students were asked whether they found the game confusing or not.

Table 16 shows the magnitude of relationship between the *degree of game relevance* to programming and other variables (*degree of agreement, student found the game confusing).*The *degree of game relevance* is substantially related to the *degree of agreement* for both the statements: "This game is helpful/effective to learn programming" and "Such games should be included in course curriculum as learning activity/method" as Spearman's correlation coefficient is +0.543 and +0.429 respectively. This implies that as more students find the game to be related to programming concepts, their agreement to the given statements increases substantially. However, Υ_{rb} is 0.0 for the variables *degree of game relevance* and *student found the game confusing,* implies that even if student can relate the game to programming concepts, he/she might face confusion in game-play or wise versa.

Variable 1	Variable 2	Relationship
The *degree of game relevance* to programming	*Degree of agreement* for the statement : "This game is helpful/effective to learn programming"	+substantial (ϒs = 0.543)
	Degree of agreement for the statement : "Such games should be included in course curriculum as learning activity/method"	+ substantial (ϒs = 0.429)
	Student found the game confusing	none(ϒrb= 0.0)

Table 16-Υ_s and Υ_{rb} for Degree of game relevance to programming

Table 17 shows the magnitude of relationship between d*egree of agreement* for both the given statements and other variables such as *average success level of all stages* and *student found the game confusing.*

Variable 1	Variable 2	Relationship
Degree of agreement for the statement : " This game is helpful/effective to learn programming"	*Average success level* of all stages	– weak (ϒs = -0.202)
	Degree of agreement for the statement : "Such games should be included in course curriculum as learning activity/method"	none (ϒs = 0.062)
	Student found the game confusing	none (ϒrb= 0.0416)
Degree of agreement for the statement : "Such games should be included in course curriculum as learning activity/method"	*Student found the game confusing*	none (ϒrb = – 0.0833)

Table 17-Υ_s and Υ_{rb} for Degree of agreement on given statements (Cohort 2)

The *degree of agreement* for the statement: "This game is helpful/effective to learn programming" is weakly related to the *average success level* of all stages as Spearman's correlation coefficient is -0.202. The *degree of agreement* for the statement: "This game is helpful/effective to learn programming" is not related to any other variable. Similarly there is no relationship found for the *degree of agreement* on second statement to any other variables.

Finally, no relation is found between *average success level of all stages* and *student found the game confusing*(refer Table 18). This implies that even if student found the game confusing he/she may get higher success level in game-play or may not.

Variable 1	Variable 2	Relationship
Student found the game confusing	Average success level of all stages	none (ϒrb= 0.072)

Table 18-Υ_{rb} for Average success level of all stages

4.4 Effectiveness of GBL

All the participants were invited to give the feedback second time asking them which areas GBL helped them to improve their skills after completing their final assessment of programming module in Oct 2014. Out of total 44 participants (Cohort 1 and Cohort 2) only 15 students gave feedback. Moreover open ended questions helped to know how GBL assist students besides facilitating the study. Following is the results from collected data from the last feedback.

Most of the students who gave feedback had been in New Zealand from more than six months but less than a year (13 students). Further, 14 out of 15 students were in part-time employment

and one student was not employed. Six students had downloaded Light Bot 2.0 in their personal devices, and all 15 students had discussed this game with at least one person. Table 19 shows the number of students who have discussed the game with different group of people such as classmates, family members, friends, tutors, people of other nationality, and others.

Students discussed the game with...	Number of students
Classmates	13
Family members	3
Tutors	4
Friends	8
People of other nationality	4
No one	0
Other	2 (with employer and online group members)

Table 19- Students count according to group of people they discussed the game with

Moreover out of 15 students, 11 felt confident in explaining programming concepts of Light Bot game to their classmates. Students were asked to rate the *degree of agreement* for two statements i) "Light Bot 2.0 has helped me to understand programming terminologies" and ii) "This gaming experience has helped me in presentation assignment of programming module". Largely, the group agreed (11 out of 15) that the game has helped them in understanding programming terminologies. There was also much agreement that such experience has helped in presentation assignment of programming module.

Participant Number	Response for the question : Briefly describe your experience while playing this game
1	-
2	*"Yes it's entertaining I enjoyed a lot and it's very interested."*
3	*"It helped me to understand programming."*
4	*"It helped me to think more logically."*
5	*"I went over the game again and again which put my confidence up for assignment presentation."*
6	*"I have [an] online account for game, I teach game to [other] members to get points and free passes."*
7	*"I included this game to slides, teacher asked me to explain some words [which] I did and feeling awesome."*
8	*"It helped to understand the loop concept in detail and forming a structure of the programming concepts."*
9	*"It helped in knowing the basics of programming."*

10	-
11	*"Ya it explains the concept of programming."*
12	*"I feel more relaxed about programming."*
13	*"It explains the concept of programming."*
14	*"It explains the concept of programming."*
15	*"Yes it helps me to get other programming skills which are useful for me because some concepts are bit tricky but Light Bot definitely helped me."*

Table 20- Students response on how GBL assisted them

Open-ended question were also asked, the questionnaire asked them to describe how the Light Bot game assist them in other way besides facilitating study. Table 20 lists all the responses. Several feedback shows how GBL has helped students in ways other than the learning, such as, *"I went over the game again and again which put my confidence up for assignment presentation.", "Yes its entertaining I enjoyed a lot....",* and *"I have [an] online account for game, I teach game to [other] members to get points and free passes."*

Next, results of programming module of whole class have been used to determine students' outcomes. According to NZQA structure, assessment procedure is competency based (achieved or not achieved) rather than the achievement based (grades or marks). There were total three assessments given to the students in unit standard 6774 (part of programming module). Each student is given a maximum of three attempts to clear each assessment. If student clears all the assessments in first attempt then only he/she can be awarded 'Achieved in first attempt' as overall result of the module. If any of the assessment is been cleared in second attempt then overall result would be 'Achieved in second attempt', similar for the award 'Achieved in third attempt'. To clear the whole unit successfully, student must pass all the assessments in at most three attempts.

At the PlayIT case, total 71 students studied US 6774 during February 2014 to August 2014. Total number of students successfully completed the unit was 65 out of 71 (91% pass rate). Out of those 65 students, 43 students had participated in the classroom-based game intervention (66 %). The pass rate of the participants was 97% which is 6% more than that of the whole class. Table 21 shows the students' counts of whole class, participants, and non-participants. These counts are based on the number of attempts to pass the assessment. The students (whole class) who passed the assessment in first attempt were mainly study participants (38 out of 50). Further,

around 44% non-participants passed the assessment in first attempt, while approximately 86% game-play participants passed the assessment in the first attempt, which is showing significant difference.

Attempt	Considering all the students	Considering non-participants	Considering game-play intervention participants		
			Total	Cohort 1	Cohort 2
First Attempt	**50**	**12**	**38**	18	20
Second Attempt	**11**	**6**	**5**	1	4
Third Attempt	**4**	**4**	**0**	-	-
Failed	**6**	**5**	**1**	1	0
Total	**71**	**27**	**44**	**20**	**24**

Table 21- Summary of programming module results

The next chapter discusses the implications of the statistical data values in detail for all three feedbacks. The discussion includes students' outcomes which have been used to provide some insights on the effectiveness of GBL. The next chapter discusses how GBL have been used to alleviate learning and social issues of computing students.

CHAPTER 5: Discussion

5.1 Introduction

International students face many challenges in different educational and societal settings of the host country. The current study identifies some of the learning and social issues faced by the international student community. Further, the study examines how digitally mediated teaching and learning pedagogies can be used to enrich student learning experience.

Two research questions were posed to investigate these issues faced by international students:

RQ. 1. What are the issues faced by international students pursuing NZQA based courses, in information and communication technologies?

RQ. 2. How can IT tools be used to overcome these issues and enhance the overall student learning experience?

The study has utilised a case involving the information and communication technology (ICT) education sector to answer the above two research questions. This section elaborates the findings of the study and discusses what one could infer from this research. The chapter is divided into several sections. The first section answers RQ1 by discussing the interview findings, and mapping of those findings with existing literature. The second section answers RQ2 by discussing the feedback of students on the use of GBL in a classroom environment. In the last section of this chapter, how GBL helped to mitigate identified issues is discussed.

5.2 Stage 1 findings

Interview responses indicate many social and learning issues faced by international students in New Zealand pursuing NZQA based ICT courses. Interview data also reveals suggestions to resolve the issues based upon tutor's reasoning behind the issue. This section elaborates four learning and two social issues according to the themes found in interview data. Identified social issues are, i) Linguistic inequality and ii) cultural diversity. Identified learning issues are, i) The lack of interest in the course contents, ii) Difficulty in understanding conceptual topics, due to a

lack of analytical and logical skills, iii) Difficulty in transferring theoretical knowledge to a practical exercise, and iv) Difficulty in relating course contents to real industry use.

5.2.1 Social issues

Previous chapter has listed social issues identified from interviews (Table 4). Table 22 maps related literature addressing similar issues.

Issue	Participants' Response	Literature
S1: Linguistic inequality and English language proficiency	*"Language is a huge barrier – so not knowing the normal business way of talking ....they become either too informal or too formal."* *"Some are scared of stereotypes associated with accents and this makes them hesitate in contacting people."*	(Ippolito, 2007; Johnson, 2008; Ramachandran, 2011; Sawir, 2005; Wei et al., 2007)
S2: Cultural diversity	*"Many students find problems to interact with people of other cultures. So they do not take the initiative to start conversation with them.* *Coming from a dependent society, they have all kind of support, but here they have to earn, manage daily tasks such as cooking and cleaning, things they have not experienced before. Then to understand how things work here is hard, starting from learning our driving rules to how to conduct ourselves in interviews."*	(Berry, 2005; Johnson, 2008; Kondakci, Herman Van den Broeck, & Yildirim, 2008; Mattu, 2002; Ramachandran, 2011; Reynold & Constantine, 2007; Segal & Mayadas, 2005)

Table 22- Social issues mapped with literature

These issues are discussed next.

S1: Linguistic inequality and English language proficiency

Adjustment in a new place often starts by communicating with the local people. Especially it helps migrants, if they can explain their queries in an understandable way and can ask for information from local people. Lack of communication brings other challenges, such as missing of crucial information and getting some wrong information, due to poor questioning skills. Lack of English proficiency then results into lack of communication skills and self-confidence. Most of the daily aspects of migrants are affected by this issue, whether they are interacting with the local people daily or are hunting for jobs. In education particular, where language is the primary medium to transfer knowledge, linguistic inequality becomes a great challenge. One study shows that in the first year of study, students had understood only between 20 to 30 percent of lecture contents (Johnson, 2008). Another study indicates that non-English speaking international

students often struggle in an English-speaking educational environments (Holmes, 2004; Ippolito, 2007). Sometimes despite some proficiency in English language, further practice is required in speaking the language fluently. International students usually develop this skill slowly. Linguistic inequality is highlighted in this study, as difficulty in understanding accents of the local people, students being labelled in a stereotypical box, and the lack of comprehending the use of local words (e.g., "brolly" instead of umbrella, "dairy shop" instead of local corner shop, etc.). A study done by Ramachandran (2011) states that international students are unfamiliar with the pace, accent, choice of words and terminologies used in everyday activities. Participants' response for this issue was that different stereotypes are labelled based upon their country of origin. This often creates a sense of insecurity among these people. They cannot comprehend whether they should be formal or informal. Further, the failure to balance their tones in communication, then leads them to either be too informal or too formal. Some are scared of stereotypes associated with accents which then makes them hesitated in contacting or engaging local people.

S2: Cultural diversity

Another social issue recognised in this study, is the cultural diversity amongst international students, and fitting in with the local culture. Culture is a mix of strong belief, attitude and habits which are planted in one's mind from an early stage in life and very hard to change subsequently. When international students coming from diverse religious beliefs, human rights and value systems in the host country, it initially shocks them, which makes it challenging for them to adapt to the new environment.

One participant from our study identified that most of the international students come from a mono-cultural environment, where they may have never experienced interaction with other cultural groups, so it is not easy for these students to adjust in a totally new environment. It may be noted that most students at PlayIT had come from Asian counties. Extensive research is available, confirming cultural diversity as a major issue faced by international students, often described as a culture shock (Pyvis & Chapman, 2005; Rientieset al., 2013; Sawir et al., 2008). Further, cultural diversity prompts loneliness, often considered as type of acculturative stress which is the mental difficulties faced due to unfamiliar culture surroundings or in adapting to a new culture (Berry,

2005; Wei et al., 2007). In absence of a familiar culture, family and educational environment, students often feel isolated and as a result they become home-sick. One remarked:

> *"Coming from a dependent society, they have all kind of support, but here they have to earn, manage daily tasks such as cooking and cleaning, things they have not experienced before. Then to understand how things work here is hard, starting from learning our driving rules to how to conduct ourselves in interviews."*

Social issues often serve as hindrance in study life. International students lack of English proficiency skills, in turn affects other aspects of their social and study life. Social issues normally have some direct or indirect effect on learning, resulting in poor educational performance (Sawir, 2005; Swami, 2009). Literature reveals several examples of learning issues which stem from social issues such as lack of understanding and difficulty in using course materials, etc. (Andrade, 2006; Holmes, 2004; Kelly & Moogan, 2012; Li & Gasser, 2005). One of the tutors explained linguistic inequality. *"When we give them assessment book they find difficulty for example, they do not know what the difference is between 'explain' and 'describe'?"*Linguistic inequality and lack of English language proficiency result in lack of communication skills, which is a deterrent in study path. At PlayIT several unit standards of the ICT course contains presentation based assessment, in which students are asked to prepare and deliver a presentation on selected topics. Students must have acceptable communication skills so that they can explain their topic in an understandable way.

In many countries, classroom teaching is mainly conducted using the local language, which in turn influences the student's reading, writing and communication methods. This has further implications in the thinking process in a different country context. One of the tutors commented *"...lack of interest in lecture most probably is because English is not their first language...."* If students cannot understand what is being taught or explained, he/she may lose interest in the subject. Several literatures has pointed out that lack of interest in the studies also arises due to loneliness or acculturative stress stemming from cultural diversity(Berry, 2005; Sawir et al., 2008).Further, the cultural diversity can also affect student's performance in other ways. For instance, the ICT curriculum designed by NZQA includes many unit standards with emphasis on soft skills and ethics requirements to work in the New Zealand IT industry. One such unit

standard (US 6882) in Level 5 ICT course is based on resolving computer users' problems in a help desk support technician role (www.nzqa.govt.nz/nqfdocs/units/doc/6882.doc). The learning outcomes of this unit standard state that "Personal communication techniques are employed, that allows the users to feel the problem will be resolved to their satisfaction". But, inadequate linguistic capability and cultural diversity could serve as barriers here. Even if students have sound technical knowledge to employ personal communication techniques, they must know how to greet customers according to New Zealand culture.

NZQA courses are broken down into multiple unit standards, which cumulatively build on each other for achieving a particular outcome. And if a student misses the first unit because of some reasons, such as being new to the country or learning to cope with the system around them, this can then affect their second and third unit standards. *"They really find it tough and then they probably try to push themselves into an uncomfortable spot and ultimately they give up."* (interview participants' response). Thus, social issues are critical since they affect learning aspects.

5.2.3 Learning issues

Previous chapter has listed learning issues identified from interviews (Table 4). Table 23 maps related literature addressing similar issues.

Issue	Participants' Response	Literature
L1: Lack of interest in course contents	*"The technology moves so fast so when students realise that what they are studying is out dated now then their motivation goes down drastically....we have moved from hubs to switches, but hubs were taken out* [of the curriculum] *only two years back."* *"Lack of interest is because they are new to the country and for them it is a big shock, a big shift, so until they get acquainted to washing clothes, being away from family they are lost."* *"I have noticed in many organisations that the quality of tutors is not up to the mark and that can affect students' interest in learning."*	(Berry, 2005; Chin, 2008; Connollyet al.,2006; Piteira & Haddad, 2011; Prensky, 2003; Sarkar, 2006; Sawir et al., Nyland, & Ramia, 2008)
L2: Difficulty in understanding conceptual topics due to lack of analytical and logical skills	*"Having no previous experience they cannot relate conceptually to many models like OSI model which is the basic reference model in networking."* *"They cannot analyse the course material, like when we give them assessment book they have difficulty in understanding difference between*	(Butler & Morgan, 2007; Connolly & Stansfield, 2006; Dekeyser et al., 2007; Kriz, 2003; Piteira & Haddad, 2011; Tan et al., 2009)

	'explain' and 'describe'."	
L3: Difficulty in transferring theory knowledge to practice	*"Things like hardware which exist are easy to relate, which students touch and visualise, but theory part which you cannot touch, is where the students lack confidence in analysing, for example the structure of programs, or things like syntax which are difficult to reason."* *"International students mostly come from dependent societies. Their parents decide everything for them from country to college to degree to fees. So, they don't know the whys. Why I will need this? Why is it important?....."*	(Janitor et al., 2010; Sarkar, 2006; Stolikjet al., 2011)
L4: Difficulty in relating course contents to real industry use	*"When they actually get into a course, they don't know where will they employ their skills? Where this skill will be usable? They don't know its applications."* *"They lack understanding how NZQA unit standard based framework work, and what the differences are between NZQA diploma courses with other college qualifications."* *"Industry gives more importance to the certification of companies like Microsoft and CISCO."*	(Connolly & Stansfield, 2006; Xie et al., 2008)

Table 23- Learning issues mapped with literature

L1: Lack of interest in course contents

Lack of interest is an obstacle which affects the students' motivation to study. Lack of interest in ICT courses is a general issue (Chin, 2008), and many students entering the IT field study soon find it dry and boring, which lowers their motivation and interest in learning (Prensky, 2003; Sarkar, 2006). Tutors agreed that international students often lack interest towards ICT course contents. This could be because NZQA curriculum for ICT subjects is outdated and not with current industry standards and technology shift. As stated by one participant, *"It is said that one and half of the year of an IT application is one lifetime of a human"*. Thus, as a result of lack of interest, learner's motivation goes down. Moreover, employers often give more weightage to product centric certification courses, such as Microsoft Certified Solution Expert (MCSE) and Cisco Certified Network Associate (CCNA), rather than their NZQA based ICT qualification. The NZQA course components are not product centric, so it is difficult for the IT industry to evaluate candidate based on his/her grades in NZQA qualifications. After coming to the host country, when the student realises the importance of IT certification, they get discouraged in the enrolled course which further results in lack of interest in the course contents.

Further, adjustment to the new environment in the early days creates a lack of interest in studies, *"because they are new to the country and for them it is a big shock, a big shift, so until they get acquainted to washing clothes, being away from family they are lost"*. As a result student often struggle to pay attention to the class in their early days. If student did not show interest, to an earlier taught concept, then he/she cannot create interest in subsequent components which are depending on the previous one. Lack of interest can be found because of difficult explanation given by teaching staff or by uninteresting teaching methods (Piteira & Haddad, 2011). One of the tutor mentioned; "*I have noticed in many organisations that the quality of tutors is not up to the mark and that can affect students' interest in learning"*. Sometimes tutors cannot understand students' needs or their level of understanding, or sometimes, the tutor's explanation skills may not be up to the mark which may again be the reason why the students did not pay attention in the classroom in the first place.

L2: Difficulty in understanding conceptual topics due to lack of analytical and logical skills

Students generally require analytical and logical skills to get through most of the computing subjects. Analysing, identifying and solving the problem (using logic/reasoning) are core activities in the computing field. Students have considerable difficulty in analysing problems when there is no single, simple or well-known solution. They often display an inability to translate classroom examples to other domains with analogous scenarios, betraying a lack of analytical or problem-solving skills (Connolly and Stanfield, 2006). Tutors' observation shows that students cannot understand intangible components, because of their lack of logical skills. Furthermore, students struggle to understand course material due to lack of analytical skills. In addition, if an international student does not have an IT background, he/she may find it very challenging to understand the conceptual topics. *"Having no previous experience they cannot relate conceptually to many models like OSI model which is the basic reference model in networking"*. Developing students' analytical and logical skills is rather time consuming. One of the tutor confessed that, to pay attention on each individual student is difficult, especially since the class size is more than 30 and they have limited time and resources.

L3: Difficulty in transferring theory concept to practical exercise

Theory concepts are intangible topics which cannot be visualised, for example, topics like object-oriented abstraction and database normalisation. These topics require logical thinking, as most concepts are embedded in applied hard and soft topics (Neumann et al., 2002). These concepts cannot be visualised through traditional classroom teaching methods, and remain elusive to students who have little or no previous IT background. This is a challenge for both students and tutors, as they struggle to come to a common understanding. Students struggle to design a logical scenario in which requires more thinking skills than visualisation skills, and such topics need extensive explanation and repetition by tutors. If students cannot fully understand such intangible theory components, it would be hard for them to put those components in practice. Tutor's observation supports literature findings that even if students understand theory concepts properly, it is bit tricky for them to perform practical exercises, based on that particular concept (Janitor et al., 2010; Sarkar, 2006; Stolikj et al., 2011). For example students may understand inheritance among classes in object oriented structure is, but they may not be able to identify the group of classes from a defined problem where inheritance can be applied. The identified cause behind this issue is the non IT background of the students. However, after spending reasonable time (several months or a year) in an IT course, students can develop the skills to develop the necessary scenario for conceptual topics.

L4: Difficulty in relating course contents to real industry use

Students do not know the purpose and importance of particular course components. One tutor considered reasoning that often international students come from more dependent societies than domestic students; hence their subject choice (ICT) could be influenced by their parent's decisions rather than their own interests. And, without interest and prior knowledge, these students struggle to apply learning components to real practice. *"Why I will need this? Why is it important? Why is it used?"* Lack of understanding of the education system, was also one of the reasons behind this issue. Every country has its own education system with different types of assessment methods and criteria. As one of the tutors mentioned; *"They lack understanding how NZQA unit standards based framework work and what the differences are between NZQA diploma courses compared to other college qualifications"*. An understanding of the education system helps students to set goals and to set pathway to achieve that goals. If the student is not

aware about how he or she is being assessed and what the learning outcomes of the course are, it would be difficult for them to decide their competency areas. This could then result in failure to relate study component to specific fields in the IT industry, which can have further impact in job interviews. Interviewees (students) will not relate questions asked by the interviewer (prospective employer). An existing study defined capability of IT personnel expected by employer as 'the ability to acquire and apply skills in different setting', which shows the criticalness of this issue (Bullen et al., 2007).

All the above learning issues are discussed in the context of international students. However, these issues may be found among local students too (e.g. lack of interest). Nevertheless, the reason behind the issue can be different for students from different categories (local and international). For example, as has been discussed earlier, international students may have lack of interest in ICT course contents due to their adjustment in the host country while local students may feel lack of interest if they find the course boring. Alternatively this could also be due to lack of effective delivery methods by teaching staff. For some of the issues, causes may be similar and convincing for both the students, e.g. difficulty in transferring of theory knowledge to a practical exercise, could stem from non IT background or intangibility of concepts. Similarly, most of the discussed recommendations can be put in action for all students (local and international) such as new course development, inclusion of industry based projects, blended learning and game based learning.

5.2.4 Suggestions to mitigate learning and social issues

As recommended by participants, the difficulty in transferring theory concepts to practical exercise can be mitigated by using pictorial representation and visualisation techniques such as animation. One of the participants had commented, *"Using games is effective way to visualise non tangible components, such as loops and protocols"*. This provides great motivation to use game based learning, as a pedagogical approach. One of the participant identified 'CISCO Aspire' which is simulation based educational game used by Cisco Learning Network Store (https://learningnetworkstore.cisco.com). In this game, the user is provided with a real feel of network establishment using animated objects. Further, the game includes tasks such as buying and selecting components (or tools) from an online fictional store, which the student has to

resolve by applying some taught curriculum based computer network protocols. By playing instructional games, students can visualise a scenario with real world application of components, which can help in improving understanding of applied hard and applied soft IT subjects. Game based learning seems most effective for this issue based on the fun/containing elements such as setting a goal, earning points, visual objects, animation, clearing levels etc. One tutor recommended 'puzzle' games to be effective in development of logical skills.

Recommendation	**Issue where applicable**
Use blended learning concepts	Learning issues
Conduct review of course content	Learning issues
Game based learning.	Learning and Social issues
Provide online information	Social issues

Table 24- Suggestion to mitigate the issues

Suggestion made in regard to the issue of difficulty in relating course contents to real industry use is to provide information to the student about local educational authority. Information includes course structure, rules and regulations for enrolment, performance criteria, assessment methods etc. Tutors must provide information explicitly regarding the rules, regulations and assessment methods to all students. Such information could be provided by conducting seminars, or from the education provider's website. Moreover NZQA should include industry based projects, as the practical aspects are often missed. Industry based project will give real work place experience to students, improve students' performance, and may be improve his/her final grades in the overall projects. IT industry professionals may be asked to evaluate student skill sets.

Three out of four recommendations can be used to deal with the 'lack of interest' issue (refer Table 24). Use of animation and videos can help in drawing students' attention. Moreover if the course contents have been updated with industry requirements, then student would be more interested to learn them. Blended learning was suggested as well. As discussed in literature review, virtual labs and websites are some components used in blended learning. Blended leaning tools provide access to curriculum based resources, even after the classroom hours.

Suggestions to mitigate social issues included providing online resources to make students more familiar with the host country's culture and systems. One tutor mentioned that education

providers can help international students in improving their multi-cultural interaction by providing online information about different cultures of the host country. Knowledge of culture could include information about festivals, food habits, etc.; these can help to adjust in the new cultural environment. Education providers can organise cultural activities to provide opportunities to international students for intermingling with students and people from other cultures. Also education providers could help international students in overcoming the language barrier by conducting basic language courses, such as speaking in the local English dialect, or in understanding the local jargons, alongside conduct of the NZQA recognised ICT courses. According to recommendations made by tutors, English language can be taught to international students by conducting basic language courses or by providing online material from websites. Participants also suggested special training sessions, including communication exercises to resolve language issues.

Game based learning can even help to alleviate loneliness, which may be caused due to the acculturative stress. Games increase interaction between students more so in the multiplayer settings. The collaborative multiplayer settings in games create an inviting, safe and socially motivating environment (Barnes et al., 2007). Computers can be transformed to provide interactive and meaningful social experiences, to offer a constructive approach and a common platform that provides more opportunities for building social cohesion especially among different nationalities (e.g. online gaming)(Hamalainen, 2011).

5.3 Stage 2 findings

Two cohorts of students were invited to play an educational game Light Bot 2.0, which covers core subject areas of a level 5 programming module. Students identified programming constructs to control a robot's movements. When the player applies correct programming logic rules, the robot can move on tiles, which then light up with each correct move. In this way, instant feedback is provided to the player for the correct move, which in turn motivates the player, as they try to light more tiles. The first cohort had not yet been taught the level 5 programming module, and as such had no knowledge in programming. The second cohort had recently completed the programming module and was at a later stage of study in their level 5 curriculum. Findings indicate that students from both cohorts enjoyed playing the game and they indicated

that the game had been effective in learning some of the programming constructs (e.g., functions, procedures, conditionals and recursions).

The feedback from the Cohort 1 shows that after playing the game, students perceived that programming would be interesting. Thus the game created positive attitude (towards studying programming)among the students who had yet not started the programming module. According to the tutors, programming is perceived difficult by students. Positive attitude at the start could help students to develop interest in study. After playing the game, students felt gaming elements to be an effective way to learn the programming concepts (ϒs = 0.665). Moreover, the more the students found the game to be enjoyable, the more they considered it an effective way to learn programming (ϒs = 0.761). Also, the students' perceptions on how interesting they consider programming to be, was strongly related to the proportion of fun in the game (ϒs = 0.700). Students' perception of overall understanding moderately increased when the fun element was incorporated(ϒs = 0.525). This shows the importance of fun-factor in the game. The amount of fun in the game could effect on three important aspects, i) effectiveness of game to teach programming, ii) student's perception on how interesting is the taught topic, and iii) student's perception of understanding the topic. Apart from the fun, tailoring the learning contents into the game is important too(Egenfeldt-Nielsen, 2007; Van Eck, 2006). Developers should maintain good balance of fun and learning. Further findings indicate that the more students could understand a topic (explained from the game), the more they agreed that the game is effective and the topics are interesting(ϒs = 0.597). This suggests using a game which introduces the course topics in an easy manner, so that students can be motivated to learn further.

Study too collected feedback on the programming topics covered by the game. Recursion was considered to be more difficult than sequential logic flow and functions. Moreover, the data showed no significant relationships between fun element and in the level of difficulty. Despite considering recursion as difficult topic, 65% of the students could correctly answer the assessment question: 'What is recursion?' However, some of the correct answers may have been correct guesses. Few students from Cohort 1 found the game rather boring and said that they would have preferred to play the game after completing the programming module. Study found that most of the students liked puzzle and adventure games, as this stimulated them to think along those constrained gaming boundaries.

The student from Cohort 2had completed their programming module and enjoyed applying their taught skills in a gaming environment. Positive substantial relationships exist between relevance of the gaming elements to programming module and the effectiveness of the game to teach programming (Υ_S = 0.543). Similarly, relevance of the gaming elements to programming is substantially related to student's agreement on including the game as learning activity in the curriculum (Υs = 0.429). This shows the importance of relevance of the game constructs to the real course content. Literature too indicates the relevance of the game to course contents as an important aspect for educational games, as one of the purposes of educational game is to teach the subject (Van Eck, 2006).78% students found Light Bot as 'very relevant' or 'extremely relevant' to programming concepts, in addition no student found the game to be not relevant at all. This results shows that Light Bot developer has succussed to tailor programming concepts with gaming elements. Moreover, as has been discussed in chapter 3, Light bot was used since it covered many topics of NZQA based ICT curriculum at PlayIT. Feedback too shows that 96% students from Cohort 2 could relate the game to classroom topics.

The students in Cohort 2 had achieved higher stages during game-play, which may be because of prior learning of programming concepts, although 4 out of 24 students found the game to be rather confusing. All 4 students have mentioned that mechanism of 'Conditionals' stage is the reason of confusion, and this is mainly due to combination of recursion concept with the conditions. Most of the students in this cohort said they enjoyed playing the game, rather than relating them to programming concepts. The game was enjoyable more so, since students were under no pressure of their scores being graded. Overall responses show Cohort 1 student to be more enthusiastic, than the Cohort 2 students, as results shows higher degree of relationships between variables for Cohort 1. This may be because the Cohort 1 students were at an earlier phase of study in the course, while the Cohort 2 students were nearing completion of their course. The Cohort 2 students were rather busy in preparations for their final assessments for all course modules including the programming module. So Cohort 1 students were speculating on the fun elements in programming module, while the Cohort 2 students were trying to relate the game to programming concepts, rather than considering learning as a secondary by product. However, these reasons are just speculated by researcher.

Over all feedback shows that the GBL brought fun in learning activity and increased engagement. In addition students found it helpful and effective way to learn programming. These findings are mapped with the reviewed literature to reaffirm the validity. Table 25 shows the list of literatures which discuss use of GBL to teach programming and reveal similar findings as current study.

Brings Fun	Increase Engagement	Helpful	Effective
(Barnes et al., 2007; Bishop-Clark et al., 2006; Bromwich, et al., 2012; Kazimoglu et al., 2012; Marques et al., 2012)	(Barnes et al., 2007; Kazimoglu et al., 2012; Marques et al., 2012; Watson et al., 2011)	(Barnes et al., 2007; Bishop-Clark et al., 2006; Johnsgard & McDonald, 2008; Kazimoglu et al., 2012; Li & Watson, 2011)	(Barnes et al., 2007; Bishop-Clark et al., 2006; Johnsgard & McDonald, 2008; Kazimoglu et al., 2012; Marques et al., 2012; Watson et al., 2011)

Table 25- Literature discussing the use of GBL for teaching programming

Discussed feedback is extremely useful and clearly positive. However this feedback is largely depended on the game used as a tool. If the game is not efficient or not designed properly, then this could affect the feedback negatively. Students cannot learn if the game contents are not appropriate or closer enough to the actual learning contents(Egenfeldt-Nielsen, 2007; Van Eck, 2006). Finally,in Light Bot 2.0 the execution order of commands helps user to understand programming constructs. However, students are not able to learn how to write actual code (syntax). In real programming context, the programmer has to remember syntax of the language.

5.4 How GBL helped to mitigate social and learning issues

The previous section has discussed some findings indicating that GBL helped students to learn programming. The animated scenarios in the game add to the fun element, to the otherwise unexciting settings in a traditional classroom environment. The educational games can be used to deal with the 'feeling bored' issue of students (L1). Students could understand intangible components of programming through visualising fictional problem scenarios. Students wanted to try out new thought-provoking moves in the stricter game settings, which they may not have been able to do in a directed teaching and learning environment. Educational games thus encourage players to apply their logic and reasoning to challenging situations. Such exercises could help students to develop logical and analytical skills (L2). In the puzzle settings of the game, the students used several programming constructs (loop, functions, recursion etc.). To

solve a puzzle in the most efficient way, students combined one construct to another. Students first analysed theory concepts to select the best fit then analysed different ways to combined them. By doing this exercise they applied theory concepts to practice (L2, L3). However, the game used in the study could not help students to relate the course contents to real industry use (L4).The game is based mainly on teaching of programming constructs. The game does not use scenarios of real industry, like in the CISCO games such as Cisco Aspire and Subnet game (Games Arcade, n.d.).

Most of the students, who gave feedback after final assessment, had been in New Zealand for more than six months but less than a year (13 students). Despite being new to the country, all 15 students said they had discussed the game with at least one other person. Noticeably 4 out of 15 students said they had discussed the game with people from other nationalities. In addition, students became very confident about their understanding of programming and the game-play (*"I have [an] online account for game, I teach game to members to get points and free passes", " I went over the game again and again which put my confidence up for assignment presentation"*- refer Table 20). These results indicate that GBL encouraged students to communicate with peers, friends and people from other cultures (S1, S2). The game provided international students an opportunity to interact with others, including people from different nationalities. Such encouragement and confidence help alleviate acculturative stress, which stems from loneliness and absence of familiar culture (S2). The use of educational game could be good option for tutors, which provides interactive environment especially to international students. In addition, most of the students could gain confidence in explaining the programming concepts during presentations assessment. Explanation tasks can help to improve overall communication skills. The students showed a marked increase in their confidence levels while explaining the game and a noticeable decrease in stress stemming from linguistic inequality (S1).

Apart from feedback, assessment results show that the pass rate of the participants is slightly (6%) more than that of entire class, which is not too significant. However, the participants who passed the assessment in the first attempt (86%) were 42% more than that of the non-participants (44%) (refer Table 21). The responses from second feedback show the contribution made by GBL for enhancing the students' learning experience.GBL increased motivation, encouragement and confidence among students, which are very crucial factors. 86% of students were found to be

successful in the first attempt. Students discussed and explained the game, which may have helped them to clear any doubts they may have. This could have helped students in the final assessment. However, there is no evidence which shows that GBL is the sole reason behind success levels of the participants. Because, study has not analysed factors which could affect success level, such as number of hours students spent for self-study, attendance percentage of non-participants and number of hours for additional coaching. However, overall findings indicate that GBL is a useful pedagogical approach, which may contribute to learning difficult concepts.

CHAPTER 6: Conclusion

International students add value to the host country. They are part of county's economical, educational, and cultural growth. Since last decade, international education sector of New Zealand has been contributing significantly to the economy of the country. The ICT education sector also has large number of international students. The education providers, education authorities and academic staff should work on providing more support to international students. However, to commence any type of support, they have to be aware of the issues faced by international students. This concern has helped to design first research question: 'What are the issues faced by international students pursuing NZQA based courses in information and communication technologies?' To answer this question, the study examines a case - PlayIT, which is a non-university education provider in Auckland, New Zealand. Interviews were conducted by the researcher with experienced IT tutors at PlayIT. This is described in this study as the first stage of the research. Findings from the first stage poses second research question: 'How can IT tools be used to overcome these issues and enhance students' learning experience?'This question has been answered by using GBL to bring about active learning in classrooms through the use of educational game, namely Light Bot 2.0. Two separate student cohorts pursuing NZQA based ICT National Diploma in Computing (level 5) were invited to participate in the game-play intervention. One student cohort had not yet started the programming module, while the second student cohort had recently completed the introductory module on programming. In this manner, researcher did not set boundaries to when the game based learning should be initiated.

6.1 Main findings

Study identified four learning and two social issues, they are i) Lack of interest in course contents, ii) Difficulty in understanding conceptual topics due to lack of analytical and logical skills, iii) Difficulty in transferring theory knowledge to practice, iv) Difficulty in relating course contents to real industry use, v) Linguistic inequality, and vi) Cultural diversity. As being new to the country, initially the international students face loneliness and acculturative stress stem from fitting in with the different culture of the host country. This results into lack of interest into the study. International students are very much affected by their lack of English proficiency skills,

which in turn affects other aspects of their social and study life. Linguistic inequality is highlighted in this study as difficulty in understanding accents of local people, students being labeled in a particular stereotypical box, and lack of knowledge of local words. Most of the international students come from more dependent societies than domestic students, and their subject choice in IT study are generally influenced by their parent's decisions rather than their own interests. And, without interest and prior knowledge, these students struggle to apply learning to practice. The current NZQA curriculum for ICT may be outdated and not up to the mark with current industry expectations. This results in difficulties to apply these concepts to real world scenarios. Further, theory concepts cannot be visualized through traditional classroom teaching, and remain elusive to students who have little or no previous background of IT. Students require an effective way to visualize non tangible components such as loops and protocols.

Some pedagogical practices to promote active learning by alleviating above issues in ICT courses identified in literature, are blended learning, problem based learning and game based learning. Recommendations on resolving these issues from tutors who are the front facing staff too have suggested the use of games as a pedagogical approach to enhance the student learning experience. Games can help simulate virtual environments to depict interactive problem based scenarios where students can explore classroom taught concepts. Other recommendations include conducting review of course contents and providing online information to the international students.

In the second stage, study found that GBL is a useful learning strategy both before the subject is taught and after the subject has been taught. Findings indicate that students from both cohorts enjoyed playing the game and they indicated that the game had been effective in learning some of the programming constructs.Cohort 1 students were more enthusiastic than the Cohort 2 students, with higher degree of relationships between variables for Cohort 1. The survey data from the game intervention showed that students were overall enthusiastic and motivated as they actively engaged in applying programming principles with the gaming steps. The students agreed that gaming approaches to learning can make classroom environments more fun and be an effective way for them to better grasp some of the difficult concepts. Students felt confident

about practicing the use of programming constructs in a game scenario and were eager to help others in understanding the game strategy.

Moreover, GBL can help to mitigate most of the issues which have been found in the first stage. The animated scenarios in the game add to the fun element, to the otherwise unexciting settings in a traditional classroom environment. This could help to increase student's interest in the study. Students could understand intangible components of programming through visualising fictional problem scenarios. Educational game encouraged players to apply their logic and reasoning to challenging situations, thus helped to develop analytical and logical skills. The comparison between assessment results of study participants and the rest of the class shows that GBL can be a useful learning activity since a slightly higher percentage of students achieved higher success levels in the final assessment. This study can only speculate that some elements of the game intervention strategy may have aided in higher success levels. However, this cannot be said with certainty since this is a social experiment. Apart from learning, GBL also encouraged students to communicate with peers, friends and people from other nationalities. Thus, the game provides international students a common platform to interact with others, with the result students could alleviate some of the acculturative stress which they may have faced in a foreign country environment.

Study too gives some suggestions regarding the educational game. Findings indicate the importance of fun-factor in the educational game could affect the effectiveness of game in teaching the subject. Further, the game should have enough relevance to the course contents so that students can relate it to the classroom taught concepts.

6.2 Contribution of the study

Study findings encourage belief that in applied fields of study such as ICT, the inclusion of gaming elements with traditional teaching practices will bring about more active learning. This will be beneficial for tutors too as games would enable students to grasp technology based applications quickly in a more enjoyable learning environment. This study will be beneficial for educational game designers as it indicates the importance of fun factor and course content relevance from students' perspective. Further, this study adds to ongoing teaching and learning

pedagogies, and suggests a cost effective strategy to add the fun criterion to learning. The study aims to provide insight into how education providers can support the international student community and enhance their learning and social experiences in a foreign country.

Researcher still believes that traditional classroom teaching cannot be replaced by GBL completely, since teachers play both an educator and a mentoring role. However, addition of GBL to development pedagogical activities will enhance the teaching and learning experience.

CHAPTER 7: Limitations and Future Scope

This study provides insight into how education providers can support the international student community and enhance their learning and social experiences in a foreign country. While the study provides some helpful insights, it also suffers from some limitations. This chapter discusses limitations of the study along with the future scope for further research.

The first stage of study comprises interviews with ICT tutors. Only five data sources have been interviewed. Moreover, these interviews are with tutors rather than students. Future research can be carried out to examine students' perceptions on the issues. Students' perceptions could then be compared with tutors' perceptions too. Moreover, the study does not address areas that can be generalisable to international students as a whole. For example, only those international students who come from non-English speaking country usually face English language proficiency. Students from other countries such as US and UK may not face these issues. Moreover, learning issues identified from the study are not solely associated to international students. Domestic students may face similar issues, for example, lack of interest in course contents due to uninteresting teaching methods or outdated course contents (Piteira & Haddad, 2011). Further, non-IT background of domestic student can be the reason behind lack of analytical and logical skills. Future research could obtain representative samples from international and domestic students to examine difference and similarity between identified issues.

Another limitation of the study is, tutor's responses related to social issues are more specific to international students, yet these have little relationship to ICT courses specifically. In addition, all the learning issues are not specific to ICT study. Difficulty in transferring theory knowledge to practice, lack of interest, and difficulty in relating course contents to real industry use could also exist among other fields of study. Future research could obtain representative samples from pure hard and pure soft subjects to give a holistic view of difficulties faced in learning and mastering of the subject curriculum. The effect of GBL could be examined for other computing subjects following by comparison of results for the programming module. Moreover, study reveals that the NZQA curriculum is not up to the mark of ICT industry and this is one of the causes behind lack of interest in study. However, further research could be done to confirm the

existence of the same problem in other courses designed by NZQA. The perceptions of students, academics and professionals about course curriculum can be examined too.

Findings from the second stage indicate GBL as useful learning strategy, both before the subject is taught and after the subject has been taught. Further, the study adds to ongoing teaching and learning pedagogies, and suggests a cost effective strategy to add the fun criterion to learning. This could lead to further research in designing of ICT education curriculum. Learning outcomes of different subject modules could be mapped to related gaming elements. Limitations of the study related to the Light Bot are the lack of real world scenario with game mechanics. The issue not covered by GBL is the 'difficulty in relating course contents to real industry use'. Further, Light Bot 2.0 provides problem scenarios which can be solved by using graphical commands. In this case, students cannot learn how to write actual code where they have to remember syntax of the language. Further study can be commenced to know how GBL can help students to code the program. Emphasis can be put on learning syntax and code constructs rather than the conceptual constructs. Moreover, advanced programming would involve more complicated and intensive game design, which may be perceived differently by students. Feedback gathered in the study is clearly positive. However the feedback is largely dependent on the game used in GBL. Further study can be carried out to examine results by using different games.

Another limitation of the study is not analysing the effect of one variable on another. For example, study has not analysed the effect of students' interest on social interactions and self-assessments (Huang & Soman, 2013). The study also has limitations regarding number of participants. After completion of final assessment, all the participants (cohort 1 and cohort 2) were invited to give feedback on how GBL helped them in assessment. However, only 15 students out of a total of 44 gave feedback. Though the feedback was very positive feedback, it represents only one third of the whole sample. Findings show that the students do learn from computer games, but this study is not actually comparing game based learning to traditional teaching forms (Egenfeldt-Nielsen, 2007). Before appearing for the assessment, all the participants had learnt programming also through classroom teaching. So the difference identified between the results of participants and rest of the class cannot conclude with certainty that GBL experience was the real contributor in students getting good grades.

Finally, the study does not consider gender-bias. Literature indicates gender-bias as one of the crucial consideration when using computer games in educational settings (Gros, 2007;Gunn, McSporran, Macleod, & French, 2003;Oblinger, 2004). Future research could be done in analysing feedback based on gender differences. Moreover, the severity of different issues could be examined based on the gender of computing students. The discussed limitations and implications aids in identifying areas of future research.

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APPENDIX A

1) Information Sheet and consent form

IT AS A SOCIAL AND LEARNING TOOL FOR INTERNATIONAL STUDENTS OF LEVEL 5 ICT EDUCATION: A CASE STUDY

INFORMATION SHEET

Overview

This study is aimed to gather information regarding social and learning challenges faced by international students while pursuing ICT education. Hence, we will conduct interviews and focus groups with experienced tutors who are in this field to gain first-hand information about their perceptions in regard to this. Please note, the final report based on findings from these interviews/ focus groups will make no mention of the persons interviewed. Also, any publication from this thesis in academic journals, conferences or book chapters will ensure that anonymity of all participants is maintained.

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Participant's Rights:

You are under no obligation to accept this invitation. If you decide to participate, you have the right to:

1. Decline to answer any particular question;
2. Withdraw from the study;
3. Ask any questions about the study at any time during participation;
4. Provide information on the understanding that your name will not be used unless you give permission to the researcher;
5. Be given access to a summary of the project findings when it is concluded;
6. Ask for the audio tape to be turned off at any time during the interview.

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor John O'Neill, Director (Research Ethics), telephone 06 350 5249, e-mail humanethics@massey.ac.nz".

IT AS A SOCIAL AND LEARNING TOOL FOR INTERNATIONAL STUDENTS OF LEVEL 5 TO 7 ICT EDUCATION: A CASE STUDY

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PARTICIPANT CONSENT FORM

I have been given the Information Sheet and have had the details of the study explained to me by the researcher. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I agree/ do not agree to the interview being audio taped.

I agree to participate in this study under the conditions set out in the Information Sheet.

Signature: _____ Date: _____

Full Name – printed _____

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor John O'Neill, Director (Research Ethics), telephone 06 350 5249, e-mail humanethics@massey.ac.nz".

2) Interview questions

Questions to identify learning challenges/issues

1. List some areas of computing that students find difficult.
2. What skills do you consider to be lacking in computing/IT students pursuing NZQA education?
3. What teaching challenges did you face? (Probing questions - student's lacks of interest in curricular contents, courses are too abstract and difficult to learn for the group of students from particular educational background etc.)
4. According to you what are the learning challenges faced by the international students pursuing ICT qualification of NZQA level 5 to 7?
5. What course-components are considered to be difficult by students in the courses you have taught?

Questions to identify social challenges/issues

6. What do you consider to be the social issues faced by the international students? Please discuss some causes behind these issues.
7. Do you consider cultural diversity to influence these issues?
8. What are the difficulties you faced due to time constraints and the group size of the students?

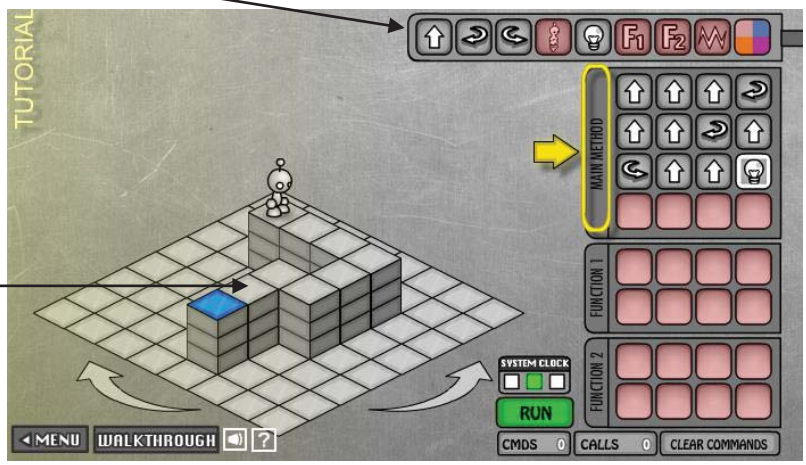
Questions to identify views to mitigate challenges/issues

9. What do you consider are the IT tools that can be used to deal with learning and social challenges of international students?
10. What is your view on using IT tools such as online/offline games to teach NZQA ICT curriculum?
11. Do you suggest game based learning for hardware and networking course? Please provide reason for your answer.

APPENDIX B

1) How to play Light-Bot 2.0

Light-Bot 2.0 is a 2D Flash game developed by Danny Yaroslavski for Armor Games. Light-Bot 2.0 is designed to teach the backbone of functional and procedural programming to players. Here a player has to navigate a robot on a given block-area (or a puzzle) to light up each blue tile in a given walking area. Player does this by arranging symbols/icons on the screen to command the robot to walk, turn, jump, or switch on a light.



Light-Bot 2.0 facilitates the learning of simple programming by linking simple commands and the actions of the robot (Light-Bot).

How to run the program: Press the green "Run" button at the bottom of the screen. Execution always starts from main method, left-to-right and top-to-bottom.

Icons and their actions:

Go one step -  Robot walks forward one step only if the next tile is at the same level as the current tile.

Turn right -  Robot turns right (90°)

Turn left -  Robot turns left (90°)

Jump -  Robot jumps one step forward when,

i) the next tile is one level higher, or

ii) the next tile is one or more number of levels lower

Light up - 

i) Robot lights up the current tile if the tile has a deep blue colour.

ii) Robot moves to next green tile if the current tile is green.

iii) Robot changes its colour to blue, orange, or purple if the current tile is blue, orange or purple respectively

Execute function 1 -  Robot will move according to the commands written in function 1 block.

Execute function 2 -  Robot will move according to the commands written in function 2 block.

Break - 

Robot will stops execution of the current function and will return back to where it left off in the previous function it was in.

Combination of colour and command: If any of the above command is coloured, it means robot will execute that command only if it is having the same colour. For example, if the jump command icon is blue, the robot will jump only if the robot's colour is also blue.

How to create coloured icon/command: Drag the icon into the program area, click the multi-colour icon  and keep clicking the command until the current icon gets the colour you want.

Reference:

15110 Principles of computing. (n.d.). Retrieved from http://www.cs.cmu.edu/~tcortina/15110sp12/lightbot/

2) Feedback Form1

Light-Bot Feedback (Before Attending Programming Classes)

Please take a few minutes to answer these questions. Your opinion will help to improve quality of teaching method and add knowledge to understand student's experience for Game based learning.

* Required

1. **Have you ever played any academic games?** *

   Mark only one oval.

   - ◯ Yes
   - ◯ No

2. **Rate the type of game you like to play** *

   Mark only one oval per row.

	Like it extremely	Like it very much	Like it moderately	Like it slightly	Do not like it at all
Puzzle	◯	◯	◯	◯	◯
Role play	◯	◯	◯	◯	◯
Action/Adventure	◯	◯	◯	◯	◯
Sport	◯	◯	◯	◯	◯

3. **How complex or tough are the following stages/topics?** *

   Mark only one oval per row.

	Extremely tough	Very tough	Moderately tough	Easy	Very easy
Basics	◯	◯	◯	◯	◯
Functions	◯	◯	◯	◯	◯
Recursion	◯	◯	◯	◯	◯
Conditionals	◯	◯	◯	◯	◯

4. **Select any one of the following based on what you have understood about recursion** *

   Mark only one oval.

   - ◯ Two functions are called together is recursion
   - ◯ Function is called by itself is recursion
   - ◯ Two functions are called serially is recursion

5. **Rate the following topics based on your understanding level for each using 1, 2 and 3.** *

Mark only one oval per row.

	3 = You understand it very well	2 = You understand it moderately well	1 = You understand it least
Functions	◯	◯	◯
Recursion	◯	◯	◯
Conditionals	◯	◯	◯

6. **This game covered some programming concepts/topics. After playing it, up to what degree do you agree with the following statement?** *

Mark only one oval per row.

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly Disagree
"I think programming would be interesting"	◯	◯	◯	◯	◯

7. **Rate the fun you had while playing this game.** *

Mark only one oval per row.

Really enjoyable	Good fun	Do not care either way	No fun	Boring
◯	◯	◯	◯	◯

8. **Up to what degree do you agree with the following statement?** *

Mark only one oval per row.

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
"This game is helpful/effective to learn programming"	◯	◯	◯	◯	◯

9. **Briefly describe your experience while playing this game** *

.....

.....

.....

.....

3) Feedback Form2

Light-Bot Feedback (After attending programming classes)

Please take a few minutes to answer these questions. Your opinion will help to improve quality of teaching method and add knowledge to understand student's experience for Game based learning.

* Required

1. **In Light bot, what level could you solve up to for each 'Stage'?** *
   Please note: If you select level 3 it means you have solved 2 and 3, since each stage must be played in sequence.
   Mark only one oval per row.

	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
Basics	◯	◯	◯	◯	◯	◯
Recursion	◯	◯	◯	◯	◯	◯
Conditionals	◯	◯	◯	◯	◯	◯
Experts	◯	◯	◯	◯	◯	◯

2. **Up to what degree do you agree with the following statements?** *
   Mark only one oval per row.

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
"This game is helpful/effective to learn programming"	◯	◯	◯	◯	◯
"Concepts of programming become more clear by playing this game than from class room learning"	◯	◯	◯	◯	◯
"Such games should be included in course curriculum as learning activity/method"	◯	◯	◯	◯	◯

3. **How would you rate this game for its relevance to programming components?** *
   Mark only one oval per row.

	Extremely relevant	Very relevant	Moderately relevant	Slightly relevant	Not relevant at all
	◯	◯	◯	◯	◯

4. **Did you find the game confusing?** *
   Mark only one oval.

   ◯ Yes *Skip to question 5.*
   ◯ No *Skip to question 6.*

If you answer 'Yes' to question 4 then answer question 5

5. **Please explain briefly why you found this game confusing.** *

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Skip to question 7.

If you answer 'No' to question 4 then answer question 6

6. **Please explain briefly how this game helped you.** *

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.....

Skip to question 7.

7. **Tick as many as you agree with**
Check all that apply.

- [ ] I could relate the game to the classroom topics
- [ ] I enjoyed simply playing the game rather than applying it to programming concepts
- [ ] I could not understand some concepts during classroom learning, but this game made it clear
- [ ] I found the game to be waste of time
- [ ] I liked comparing my score with others
- [ ] I would like to take part in forum to help others to understand programming through this game

8. **What did you not like about this game?**

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4) Feedback Form 3

Feedback to measure outcomes of GBL

Please take a few minutes to answer these questions. Your feedback will help in improving the quality of teaching methods used in course delivery and aid our understanding of how students perceive Game based learning approaches. Thank you.

* Required

How long have you been in New Zealand? *

- ○ Less than six months
- ○ More than six months but less than a year
- ○ One year or more
- ○ Five years or more

Are you employed? *

- ○ Yes I am in full time employment
- ○ Yes I am in part-time employment
- ○ Yes I am self-employed
- ○ No I am not employed

Have you downloaded this game on your own device (e.g., computer, phone)? *

- ○ Yes
- ○ No

After playing Light-Bot 2.0, did you discuss the game concepts with others?

Tick as many which applies

- ☐ Classmates
- ☐ Family members
- ☐ Tutors
- ☐ Friends
- ☐ People of other nationality
- ☐ No one
- ☐ Other:

Do you feel confident in explaining the programming concepts of Light Bot game to your class mates? *

Tick as many which applies

- Yes
- No
- Can't say

Up to what degree do you agree with the following statements? *

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
"Light-Bot 2.0 has helped me to understand programming terminologies"					
"This gaming experience has helped me in presentation assignment of programming module"					

Besides facilitating study for the level 5 programming module, did the LightBot game assist you in any other way? Please explain. *