Investigating the ways of how e-learning enhances teaching and learning of computer science at tertiary institutions in New Zealand.

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Abstract

E-learning is increasingly used in education in order to enhance the learning process for students and ensure that they enjoy the learning activities. The current research aims to investigate how e-learning and technology in education can enhance education, learning process, and teaching for computer sciences in 8 selected tertiary institutions in New Zealand; AUT, Massey University, Wintec, University of Auckland, Waikato University, Unitec, University of Canterbury and University of Otago.

The research involves survey of 50 computer science students and 16 computer science lecturers in tertiary institutions in New Zealand through an online survey questionnaire related to e-learning. Interviews of 8 computer science lecturers have also been conducted. The collected data was then analysed and results were interpreted.

This research will help in identifying methods to create collaboration between teachers and student in various tertiary institutions for computer science courses. The research will also analyse how modern teaching methods could improve teachers competencies to teach and enhance students and improve educational environment for computer sciences. The research shall also propose a scalable model of applying e-learning in computer science domain.

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Naif Saeed Aldhahri

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Chapter 1: Introduction

E-learning activities are increasingly being adopted by universities all over the world and therefore research needs to be conducted in order to assess the quality as well as the efficacy of these e-learning initiatives and teaching methodologies in enhancing the academic performance as well as engagement among the students (Lam, 2011). E-learning technologies come with many advantages over traditional learning technologies with the power to access the study material at any time, repeat the class concepts and use innovative techniques to drive student learning. Some of the challenges faced by students in e-learning technology are related to their proficiency in using computers (Czerkawski, 2010).

This research study has been conducted in 8 tertiary institutions that are based in New Zealand and takes into account the role of computer science lecturers as well as students in e-learning initiatives and factors that can lead to superior academic performance for computer science. Since the study includes computer science students in New Zealand, it is expected that they have a high proficient use of computers in comparison to the students with other courses. Also, the fact that computer science students are more likely to use computers for e-learning makes this research study even more relevant.

The current research study will play an important role in providing valuable insights about the attitudes of computer science students towards e-learning activities and will also assess the factors that affect lecturer use of e-learning initiatives. The research study will therefore play an important role in assessment of the achievement gap for academic performance of New Zealand university computer science students by understanding the difference between lecturer and student perception of e–learning. It will help future researchers in better quality assessment and design of e-learning courses for computer science students and will also assist teachers in devising better teaching strategies for computer science students.

1.1 Research Question

The research question for the current research study are:

a) What are the challenges and barriers related to computer science teaching in New Zealand?

b) How e-learning approaches can be used to address these barriers?

1.2 Aims and Objectives

The research aims to investigate the ways of how e-learning and technology in computer science education can enhance education, learning process, and teaching in tertiary institutions in New Zealand.

The main goals of e-learning as a learning method are:

- To create collaboration between teachers and student in various universities.
- To study how modern teaching methods could improve teachers competencies to teach and enhance students and improve educational environment.
- To propose scalable model of applying e-learning in science domain.

These goals will offer insights about the prospects of information technology and e-learning in improving teachers teaching methods as well as students learning methods in New Zealand.

The research will serve the following objectives:

- To identify the challenges and barriers related to computer science teaching in New Zealand
- To suggest e-learning approaches that can be used to address these barriers

1.3 Target Audience

The target audience for the current research study are the computer science students and lecturers in various tertiary institutions in New Zealand.

Chapter 2: Research Methodology

This chapter provides an overview of the research methodology used for the current research study.

2.1 Choice of Methods

Exploratory research methodology or qualitative research method as well as quantitative research methodology have been used for the current research study. An advantage of using exploratory for qualitative research method is that it allows the researcher with the flexibility to conduct the research as per the needs of the research (Zikmund & Babin, 2006). Using exploratory research, I have been able to form a methodology that allows to answers the research question: How e-learning and computer sciences in education can enhance education, learning process, and teaching in New Zealand tertiary institutions. A qualitative analysis has been used in order to validate and provide useful insights about the primary data through interviews with computer science lecturers and surveys with students and lecturers in New Zealand.

Quantitative research is used to quantify relationships between variables (Nykiel, 2007). Quantitative analysis has been used to analyse the data collected since it allows one to test hypothesis and establish facts and makes predictions with information that can be tracked over a time period. Some of the advantages of using quantitative research are that its results are highly reliable and also these results may be extended to the entire population (Nykiel, Handbook of Marketing Research Methodologies for Hospitality and Tourism, 2007).

The research involves primary as well as secondary data analysis. An advantage of secondary data analysis through literature review is that it helps in understanding what the past researchers have studied about the research question so far and therefore it helps in laying a strong foundation for the current research by taking guidance from the limitations and strengths of past research work (Wrenn, Stevens, & Loudon, 2013). Additionally, a literature review also

helps in understanding of the theoretical frameworks related to the research that help in a better understanding of the topic involved. Secondary data is readily available for the researcher and can be accessed at low cost (Stevens, 2006). It helps in saving time required for the research study. Quantitative research also has certain limitations. It is focused on a particular subject and its results cannot be generalized (Rubin & Babbie, 2009). The research is based on a limited sample of respondents and assumes the results to be generalized for a larger population. This is a major limitation of quantitative research.

Primary data analysis will also be used in the current study. Primary data involves the collection of data specifically for the research purpose. Some of the advantages of primary data are that it is collected for the specific research purpose unlike secondary data that may have been collected by past researchers for some other research purpose and may not be fully relevant for the research study (Patzer, 1995). Some of the disadvantages of using primary data for the research purpose are that it may involve high cost and time to collect primary data (Wiid & Diggines, 2010).

2.2 Research Process

Primary data for the current research has been collected through questionnaires method where 50 students and 16 lecturers from various tertiary institutions in New Zealand including AUT, Massey University, Wintec, University of Auckland, Waikato University, Unitec, University of Canterbury and University of Otago have been surveyed through structured questionnaires that required answers to specific questions related to e-learning methods. An advantage of using questionnaire for data collection is that it allows data to be collected with higher response rates and low response errors and also allows direct interaction with participants (Seale, 2004). Since the sample size for the lecturers was small, structured interviews have also been used to interview additional 8 lecturers. Snowball random sampling technique was used to select respondents for data collection.

2.3 Data Collection and Source

Sixteen computer science lecturers have been surveyed and 8 have been interviewed as part of the study. Fifty students from different tertiary institutions in New Zealand have been surveyed. Online questionnaire for lecturers as well as students has been used to collect data. In order to collect data, I sent emails to all lecturers from all tertiary institutions who teach or taught first year Computer Science papers to fill up online questionnaires and also included a link for students to share it with their peers to fill up. The 16 lecturers who agreed to answer the questionnaire were self-selected. I used a combination of a convenience and judgement sampling method to select the participants (lecturers) for interview. For the interview, I visited the tertiary institutions to interact with computer sciences lecturers.

The research tools used include:

a) Interview for lecturers.

b) Online questionnaire for lecturers

c) Online questionnaire for students

I have met face to face with lecturers and done interviews that were voice recorded. Then the records have been Tran scripted to text to be analysed and discussed in the thesis.

Lecturers who participated in the interview have signed a consent form. I have given information sheet about my thesis to all the participants. Also the research ethics has been approved.

2.4 Data Analysis

The collected data has been analysed using statistical techniques and the results have been discussed in detail with recommendations and conclusion provided for the research study.

2.5 Validity and Reliability

The validity and reliability of data has been ensured by collecting data from reliable and valid sources. Major type of response error may have been eliminated by conducting face to face interviews and online surveys that leave no space for such errors.

Chapter 3: Literature Review

E-learning is most commonly known as learning method that uses the modern technology and computers that involves themed teaching and learning process. E-learning is also referred as a learning or training method that is done from home via internet or on web based platforms. It is also referred as virtual learning or online learning. The definition of e-learning provided by Romiszowki and summarize the following:

E-learning involves the use of information and technology in the learning systems and processes (Romiszowski, 2004).

The new era of digitalization and penetration of internet along with supporting technologies has led to change in way knowledge is imparted by teachers and learned by students and learners. These changes have led to cognitivist approach where learning is a process in which offered knowledge is processed by learners and students. The cognitivist approach is encouraged by the practical application and not by theoretical application that are used in the behaviourist approach. The behaviourist approach is mainly focused on objective aspect of education, under this approach, the students need to develop practices on their own. This make student and learner only learn theoretical part of given subject; as such, the student and learner do not learn to apply given knowledge to practical use. The gained knowledge is only processed and applied to practicable use only when student or learner in employed (Ally, 2004). With cognitivist approach, the knowledge is processed with better understanding. Better understanding also leads to individual differences in learning curves and creates variety of learning styles amongst students and learners. With this approach, the learning material that is given to students and learners motivates them to process the knowledge not because they need to, but because they want to, thereby creating self-motivation. This leads to adopting the learning material to the learning style of students and learners making it interesting and diverse enough to interest students and learners from a diverse background (Holmes & Gardner, 2006).

To use this method property all old and new information needs to be clubbed to maintain the interest of students and learners in learning process.

Constructivism learning approach mainly focuses on past experience of students and learners, their interest in gaining new knowledge and how it can be improved, it considers that the learning process needs to be contextual. Here lies the role of the teacher, the teacher should not limit the dissemination of knowledge to the students and learners, but his/her role is to engage students and learners actively and use them to apply their experiences to the current learning situation. This way the students and learners improve their reasoning skills (Holmes & Gardner, 2006), making the learning process active and encouraging the students and learners to interact and participate in learning process and its activities. Doing so, enables the students and learners to develop and learn the practical skills and contextualize these skills. Focus on the student's and learner's context makes constructivism best suited approach for the e-learning method as it provide engagement and motivation to all participants in the learning process (Ally, 2004).

The government of New Zealand has expressed its interest in e-learning and has acknowledged its significant prospects for teachers and students. The e-learning introduces innovative and new way for spreading and gaining knowledge with help of computer tools and software. E-learning also helps to share learned knowledge amongst students (Ministry of Education, 2007). Several education programs that share same goals and ideas have already started; these programs help the implementation of e-learning in to the education system in New Zealand (Ministry of Education, 2007).

Currently available IT resources can offer new way methods of knowledge acquisition for students. The IT resources should be assessed and build in a way to facilitate pedagogical methods and use them to enhance successful educational competencies (Webb, 2005). The teachers' main goal should be to use these IT resources and new methods presented in e-learning to complete and accomplish goals with students. Teachers should be motivated by this

methodology (Wallace, 2004). Goal of integrating IT technologies in teaching is straightforward, and can be easily achieved when all required technology, resources and infrastructure is available to teachers and students. However, it must be considered that this goal is not so easy achievable and should be strategically planed.

3.1 E-learning knowledge delivery versus the traditional classroom knowledge delivery

The table below compares online e-learning knowledge delivery versus the traditional classroom knowledge delivery (Shaw, 2007):

Table 1 Comparison of Online and Classroom Education

Online delivery	Classroom delivery
Closer control over the quality of teaching and assessment because all student-teacher interactions are recorded and available for audit.	What happens in classrooms is difficult to monitor and audit.
Every student is taught by a specialist teacher.	Science teachers may be weak in specific disciplines and there can be teacher shortages in some universities. Teacher education depends largely on the provisions in universities and teacher unions.
The specialist workforce that develops around the management and development of the website forms a focus for teacher education.	Teachers are responsible for student management and many other non-teaching tasks.

Efficiency in the use of the teachers' time. Teachers only teach and assess.	Curriculum drift can occur as teachers emphasise the topics that interest them and stray from the course requirements. This can motivate students.
The curriculum is delivered to the student in a uniform way with an assurance that each topic receives its correct curriculum weighting.	Marker drift can occur when teachers mark tests for whole classes. Internal moderation may prevent this.
The presence of the highly specific markers' schedule facilitates accurate assessment question-by question.	Heads of departments may influence the assessment practices of teachers.
It is possible for lead teachers to insert messages into the marking schedule to improve assessor performance.	Moderation requirements generally require the keeping of student tests (usually in paper form), and the management of moderation is a burden for teachers.
Information for the moderation of assessments is readily available. A moderation report can be printed for any selected student by clicking a button.	The making of comparisons generally requires a specific research project with a data collection phase.
Reports that make comparisons of students, particular questions, particular makers, or universities, are readily produced.	Teachers have to record student achievement. Many use 'mark-books'. It is necessary to accumulate and transcribe to a central system the marks given by teachers.

Student achievement accumulates as the teachers assess. There is no teacher administration.	There is often a delay in reporting the final reset to an individual when students are assessed in groups.
The final result is immediately reported to the student.	It is necessary to have a number of students interested in a particular course before a university can offer that course.
Courses are available to all students nationally.	The cost of science teaching and assessment is often dispersed within the various budgets of the university.
It is relatively easy to measure the cost of teaching each student.	The cost of course delivery is often unknown because accounts do not distinguish teaching duties from university overheads and the teachers' pastoral duties. The benefits of studying for students are greater than those of course delivery.
The cost of course delivery is significantly less than that in a normal university. The benefits delivered for these costs are restricted to the delivery of the course content and assessment.	Teachers and students work the same hours at centralised locations. They place pressure on road transport and incur environmental costs.
Teachers may work from their own homes according to a roster. Students usually work from universities or their own homes.	

3.2 Current state of e-learning in New Zealand

The tertiary education system structure in New Zealand consists of:

- Universities;
- Polytechnics;
- Industry owned training and learning organizations;
- Private training and learning organizations;
- Wananga, Māori education organizations.

The phenomena of adapting e-learning is explained as the link among individual and new technology and his response regarding new technology used in learning process (Marton, 1986, in Stein et al., 2011). To ensure proper adoption and development of e-learning in education, government needs to involve its resources towards integration of e-learning by drafting favourable policy, making monitory contributions, and developing the infrastructure. New Zealand already has a favourable policy that allows integration of e-learning method to all layers of education, where the higher education is main target (Ministry of Education, 2014). The concept of e-learning was implemented more than 10 year ago but the first strategy was developed in year 2004. New Zealand government created and invested in various funds, these funds are created to develop the e-learning in education sector, technology and infrastructure. From the technology and infrastructure standpoint, it was necessary to develop the information system for sharing, collaboration, and better involvement of both students and teachers. (Tallent-Runnels, et al., 2006). The similar approach was done in the US (US Department of Education, 2014) and Australia (Jebeile, 2003).

Collaboration among students and teachers was also mentioned by Wenger et al. (2009) where he suggested the collaboration should be made when creating the learning base for students. The learning base should be based in the context of the community. To ensure that the learning

base performs as expected, it needs to adapt to students' habits and actions (Anderson, 2008). Orienting on performances of learning base creates practicable advantages, which are missing, in human processing model, students and learners are driven by creativity. E-learning has been most beneficial to students, but only if it is implemented as an online solution. This type of e-learning was most adopted by student community (Kennedy, Judd, Dalgarno, & Waycott, 2010). E-learning allows students and learners with special needs or students in rural areas to educate themselves from comfort of their homes. Students and learners across borders also have opportunity to attend lectures and access education that is not available in their country or it is not available in preferred language, this allowed better education for the Maori and Pasifika students (Fletcher, Nicholas, & Davis, 2011).

From technology and infrastructure stand point, universities in New Zealand require faster internet connection or local connection between universities since they need to stream data for online education from the internet. Faster connection to internet or to shared education database would allow access to varieties of online education content or centrally obtained services. While the faster connection to internet or shared education database would be quite helpful, the investment in modern technology like interactive whiteboards would be a better choice and it would be a significant advancement in education in New Zealand. The introduction of new IT technology is not simply one teacher's decision to use it in only his/her classroom, as this will bring inconsistency in universities. The decision should bring in to the consideration wider infrastructure; in addition, the IT based e-learning and activities should be controlled by one IT framework (Selwyn & Facer, 2007). The teachers' utilization of IT should be endorsed, and wider organization method is required to adopt the changes (Selwyn & Facer, 2007). This and other topics related to teachers' knowledge, self-assurance, professional growth, and technological setup were discussed on the nationwide assessment of the PCs for teachers plan performed at a University in New Zealand (Cowie, Jones, & Harlow, 2011).

3.3 Integration of e-learning in mainstream classroom

With new technologies like Web 2.0, incorporating e-learning in education should not only be considered because of the students' educational process, but also because their integration in the education system and learning process. Technologies like Web 2.0 can allow students and learners to participate and improve literacy (Haythornthwaite & Andrews, 2011). Web 2.0 can be used by students and learners to share learning objective via various blog posts, but at other hand this participation can cause more complication with teachers

The use of Web 2.0 technologies in e-learning creates dependency in software and infrastructure. From infrastructure standpoint the usage of Web 2.0 technologies are depended on fast broadband internet. Web 2.0 technology still offers the best solution for internet base communication and collaboration between industry, teachers and students (McLoughlin & Lee, 2008). In addition to Web 2.0, other new technologies and modern hardware can be used to improve the learning process in education. Most commonly used new hardware is advanced cameras, sensors, and other data acquiring devices. This hardware can be used to conduct more advanced studies in universities and universities. Integration of e-learning and utilization of modern hardware and devices in the learning process is presenting great prospect for the education system.

With the integration of e-learning in the mainstream classrooms, identification of teacher's viewpoint on how e-learning can be integrated with science and its traditional usage in the classroom should be considered. These viewpoints should be considered as efforts to integrate e-learning in scholarly and non-scholarly studies. The main goals of these efforts were the integration of e-learning in science classes as it would provide much needed experience in this area. Viewpoints and feedback provided by teachers, various global studies, and researches on the subject of integrated e-learning would be used to create a modern integration transition (Webb, 2005). Many studies and researches have been done on topic of acceptance and

adoption of e-learning and acceptance of new methods of learning in education. Major research has been done by Moreno et al. (2007) on topic of acceptance of e-learning method in Australia. In this study, undergraduate students had opportunity to learn lectures on the web. The results revealed that the teachers had concern that e-learning over the web will induce lack of communication with other students. In addition, teachers were also concerned about the lack of creativity and that e-learning will affect the way knowledge is shared among students. Another concern was the administrative use which is more different that traditional administrative use in traditional methods of teaching.

In similar research done in China (McConnell & Zhao, 2007, in Stein et al., 2011) for the use of IT technologies in teaching methods and cooperative teaching, it was established that the learning had significant value to the lecture and way the students accepted the knowledge. The research also established that the use of new technologies and new methods as e-learning in teaching produced new concerns. These concerns were about bringing the new methods and technologies in mainstream classrooms and that methods like e-learning lacked in the cultural and organization elements of learning. One of the concerns was that e-learning as a method is lacking direct face-to-face interaction, and that this face-to-face interaction between students and teachers is key to better education. This was one of the main problems in acceptance and promoting e-learning method of teaching in mainstream classroom.

A study carried out in Bahrain has come to calculation that developing infrastructure for e-learning requires large investment not only for technology and mainframe infrastructure but it also require large number of participants. The teachers and students that experimented with e-learning as method of learning in Bahrain, stated that this new method is beneficial and useful in education system (Jamlan, 2004).

Research conducted by Marshall (2010), applied the e-learning methods in the tertiary education in New Zealand, the results revealed that to successfully conduct e-learning method

organizational and practical issues need to be resolved. With organization and practical issues, various operational issue were also faced when implementing e-learning methods, infrastructure, and technology in the tertiary education institutions. The operational issues with implementation could be resolved but they required intervention of the right authorities.

This research discovered that main factors that influenced acceptance of e-learning method, technology and infrastructure were:

- Time of exposure;
- Lack of expert leadership;
- Planed strategy and operation outcomes;
- Lack of motivation and support;
- Risk acceptance.

To lower the risk of low motivation from poorly written education content, the designing and implementation of e-learning system should be put great effort. Effort should be focused on customization of learning content for differing types of students and learners, the designers of content need to have an understanding of variability and use different ways to make content more appealing for students and learners and increase their motivation.

The main risk during the implementation of e-learning method as learning platform was the use of the innovative technologies, because used adoption of these technologies takes time. The implementation would affect the education institutions, student community, and learning organization. To ensure a smooth transition, the strategy of implementation needs to provide for enhanced communication between teachers' community and student community (Marshall S. , 2010). Stein et al. (2011) in their research state that student community in New Zealand provided high level of acceptance when e-learning method was proposed. Student community has embraced the acceptance of e-learning in education system of New Zealand and indicated their strong support for future involvement of new technologies. They believe that e-learning

makes for more effective and intuitive education system. E-learning method was perceived as a method where technology, tools, and innovative equipment were used to enhance the education and involve students to collaborate in the process of learning.

As pointed out in the research, teachers believed that the new technologies can be brought to the existing classroom and they can enhance the current traditional learning methods, but before bringing the innovative technologies to the classrooms, identification for best purpose and usage needs to be conducted. The key to integrating e-learning in to classroom is collaboration between teachers and students (Stein, Shephard, & Harris, 2011). Research performed in Malaysia by Punnoose (2012) on e-learning tools used for education found that students were the main factors that lead to the acceptance of e-learning as learning method in Malaysia.

Factors that lead to usage of e-learning and new technologies for education by students in Malaysia were (Punnoose, 2012):

- Openness to new and innovative technologies;
- Risk taking;
- Extraversion;
- Agreeableness;
- Computer self-efficacy.

Individuals who were more open to new technologies have accepted e-learning as a chance to explore and gain new experiences. Individuals with high risk acceptance were more likely to use e-learning method even if the outcome was not too certain. The students with computer proficiency accepted e-learning methods easily since they are familiar with the innovative technology environment. Motivation need to be added when implementing e-learning method, this motivation need to be in the form of policies. The policies need to create favourable

responses from student and learning community and ensure smooth adoption of e-learning. This should eliminate threats and fears faced by early adopters of e-learning.

Focusing on community acceptance of e-learning as new method of teaching, it must not be forgotten that individual opinion also matters. As Anderson (2008) points out the reluctance or hesitation of the individuals in acceptance of technology in the learning environment is a major bottleneck for mainstreaming of these technologies into the classrooms. These changes cannot be forced on individuals but they require successful integration into the education system (Davis & Eales, 2007).

3.4 Advantages of e-learning and new technologies in teaching process

The e-learning method is traditionally referenced as distance or long distance learning process for taking online classes. E-learning enables students and learners to use new technologies and collaborate and share new information, ideas and opinions, all these feature are available from comfort of their home. E-learning as new method on learning allows students and learners to have flexible schedule and adopt the learning to their learning style. All these feature of e-learning allow students and learners to use technology to their advantage and use collaboration tools in learning process. This way students and learners have full control of learning process in comparison to the traditional learning methods. The increased control over the learning process allows students and learners to be directly included and influence the learning process. This also makes the students as facilitators to the learning process and allows educators to improve their teaching methods (Anderson, 2008).

E-learning as a method has increase education on a global scale, and doing so it has enhanced the competitiveness and employability of students and learners (Moreno, Gonzalez, Castilla, Gonzalez, & Sigut, 2007). Compared to the traditional learning methods, in e-learning, the students and learners are not limited by the time, but they can extend the time they need to complete the learning process and adopt it to their time schedule.

Another advantage in e-learning method over the traditional learning methods is that e-learning involves co-development of curricula, this involves students and learners to become more engage and enhance their conceptual understanding. Practical modules are offered to students and learners that allow them to develop skills based on their interest (Roffe, 2002).

This learning methodology allows students and learners to develop real-life skills that can be applied on real-life problems which are faced in the line of business. This types of skill is not offered by traditional methods of learning. Accomplishing this goals is possible because students and learners are no longer restricted to classrooms (Stein, Shephard, & Harris, 2011). Development of learning management systems like Moodle, Blackboard and iWeaver can improve communication, sharing, and collaboration between students and teachers. This also allows students to access the lectures as well as enable them to be assessed online at their own convenience (Garrison, 2011). Collaboration between students on their courseware and progress is also possible. The iWeaver learning management system enables students to learn programing, from theory of programing to practical use and application (Wolf, 2003). Comparing to the traditional methods the e-learning method implemented in iWeaver can provide better learning experience and environment to students and learners.

Methods applied in e-learning are not based on traditional classroom methods but are based on interaction and collaboration between students and teachers and the outcome is strictly based on collaboration (Anderson, 2008). The ability to not be limited to classroom allows students and learners to continue education and still be employed.

With considering all differences in both traditional learning methods and e-learning methods, if e-learning is to be successful, it need to ensure that the standards of education system are used and maintained to provide quality of education while maintain education as social context and not an individual activity (Clark & Mayer, 2011). The traditional learning methods are sometime not available because of financial and economic reasons. E-learning has ability to

provide education to those who cannot be a part of the education system and allows them to pursue a career so that they can financially provide for their education (Holmes & Gardner, 2006).

3.5 Adoption and implementation of e-learning

To make adoption process easier, the innovative technologies used in e-learning method should be designed with goal to enhance the learning process and engage the students to the learning process. The process of adoption should be guided and supervised by professional development and should be accompanied with strategically organised content management system (Cohen & Nycz, 2006). From the student community's perspective the better engagement, collaboration, and communication will lead to the better and positive outcome of e-learning process. The positive outcome is more likely if the new technology is used properly. Only the student community's positive feedback and engagement can create the needed environment for e-learning and future adoption, acceptance, and development of e-learning. To endorse new trend in education like e-learning, the global adoption and integration is one of the factors that have influence on reforms of e-learning not only in New Zealand's education institutions but in global scale (Anderson, 2008).

The adoption of e-learning technologies in traditional classroom will lead to implementation of project and peer-to-peer learning methods both for the teachers and the students. This implementation of project and peer-to-peer learning methods will allow the use of new technology in learning process and enhance it, the benefits will be both for teachers and students (Wilson, 2008). To increase the adoption rate of e-learning in classrooms favourable policies and professional development will be needed, this influence will increase the penetration of new technology in classrooms and improve education (Wilson, 2008).

Challenges may be faced when implementing professional development that is required for better integration of new technologies for e-learning. There are organizational and educational

forces that ensures professional development included in implementation of e-learning (McPherson & Whitworth, 2008). To implement these changes and improve the process of adoption motivation policies will need to be created, these policies need to be favourable for both the student and teacher community. Any process that involves changes includes an element of risk; as such, education environment will be at risk that can lead to uncertain outcomes; therefore, risk management strategies needs to be created (Marshall S. , 2010).

As traditional learning methods are based on face-to-face communication and interaction between students and teachers, they require physical presence of both teachers and students. This essential condition of traditional education methods may represent limitation to some students and learners because of factors like disability, time, and finance. Combining e-learning and face to face communication is commonly referred as integrated learning method (Littlejohn & Pegler, 2014).

Because of learning and integration with practical applications is most beneficial from implementing e-learning due it higher requirement for practical application, it is more suitable for higher education. Sometime due complexity of practical application it is difficult to implicate in the traditional learning method. This limitation in implementing this complex practical application can be solved by offering and implementing e-learning methods with direct collaboration with industry. This way, the requirement for these complex practical application will be met (Tyler-Smith, 2006). To create and integrate learning method we need to understand and highlight the parts of the learning process that are best delivered with face to face method and understand and highlight the parts of the learning process that are best delivered with e-learning method. Doing so, will create best learning experience for both students and teachers (Zimitat, 2004).

Integration of e-learning in to traditional classroom brings new technology to the table and this shows a gap about how student are adopting to new technologies. Student and learners that are

more familiar with computer technologies adopt quicker than those who are not do not, and this creates a challenge when using new technologies (Zhang & Nunamaker, 2003). Because of these challenges, collaboration on single e-learning platform can enhance experience and increase adoption and implementation. This collaboration should be between both teacher, students, and individuals who have access to industry. The current methods have been criticized because education institutions are preventing other from being included in education system (Stigler & Hiebert, 2009).

Collaboration on single e-learning platform can ensure proper collaboration and connection with industry, this way, teachers can be with direct contact with industry and take up role that will ensure the content and education is relevant to the need of the industry. This approach will ensure best education for students and prepare them for real life situations and problem solving. This will provide proper link between industry and students. This link can be speeded to their counterparts from other universities across the globe, enabling collaboration on e-learning platform across the globe. Enabling universities to reform their education and teaching methods (Anderson, 2008; Garrison, 2011).

Because teachers are not always available to students' queries, real-time discussion should be replaced by the asynchronous communication. This leads to variable methodological approach in e-leaning (Littlejohn & Pegler, 2014). Variable methodological approach in e-learning categorizes e-learning as modular method as individual can more adopt and customize the learning material and content to his needs and requirements. This customization feature makes e-learning more interesting and allows students to actively engage in to discussions and learning process. Customization also opens space for students to design and speed up the learning curve and content of education.

In China, use of cooperative and customized learning process with help of technology improved the learning experience for students (Jian-hua & McConnell, 2007). Learning process

can be improved by introducing computer based learning systems and artificial intelligence. Computer based learning systems with artificial intelligence are also known as Intelligence Tutoring Systems or ITS (Graesser, McNamara, & VanLehn, 2005). This Intelligence Tutoring Systems could be used to replace learning materials that have been changing every year. The process of replacing learning material would not be instant and it would require many years. Intelligence Tutoring Systems are used as "back bone" of development of e-learning. ITS assures that the developed environment performs more and that the environment is improving motivation and intuition for students.

One of the function of ITS is to suggest material for lectures. Intelligence Tutoring Systems needs to perform tests a regular basic to ensure that suggested material for next lecture will be well processed by students. Basic testing provide flexibility and maintains learning curve for students, this way, students learn at their own pace and without any pressure by teachers. This process also allows students to revise learning material as many times they need. Limitation to ITS is that development of ITS is limited to high objectivity environment (Vovides, Sanchez-Alonso, Mitropoulou, & Nickmans, 2007). Meanwhile customized learning material could be created that can improve learning experience and would be created with collaboration industry, teachers and students.

Students should be allowed to customize their content; customization content should be based on user's preferences, experience and objectives (Brusilovsky, 2001). Letting students to customise their learning process may lead to unsupervised learning. Study performed by Bayne (2004) suggest that the some students do not want to customise their learning process and they prefer supervised learning. Supervised learning can have significant influence on students; some students require more assistance (Kim & Schniederjans, 2004). Traditionally teachers are referred as role models in education, with introducing of e-learning this is changing, individual teachers are fearful of this change that e-learning brings. As traditional classrooms are being

replaced by e-learning and modern classrooms, losing role model function and students influence is one of the fears. While traditional classrooms are changing the e-learning method still provide the environment where teachers can engage and provide communication with students (Marshall & Mitchell, 2005).

3.5.1 Sharing the experience

It is clear that communication between industry, teachers, and students is important. New technologies and IT are offering teachers new methods to share their experience with other university teachers. Teachers can use "wiki" style web page to share their notes and experience related to learning process or specific science topic.

"Access to the work of people doing exciting things ... you're sharing ideas with a wider range of people ... we've found it useful for teachers to be able to talk to other teachers at the same level" (Education Gazette, 2008, p. 1).

"... having the wiki space ... it's a vehicle for sharing information and what we are doing... the feedback from parents was great ... they were really excited about how enthused the kids were, they were all coming home from university talking about it. One mum who has three children at university said they were all talking about the same thing ...asking each other questions, getting on the wiki ... with the wiki they [parents] can see what we're learning ... they can get on at home. "" *(Falloon, 2011, pp. 44-45)*

New Zealand government sponsored IT program have helped with this communication and interaction between teachers. This initiative allowed idea sharing, collaboration, and issue solving through IT infrastructure (Sahin & Ham, 2010). Science teachers in New Zealand require resources to create motivation within the students and supervision for utilizing scientific data in to the education system (McGee, Cowie, Hill, Harlow, & MacKenzie, 2003).

Similar to teachers “wiki” web page (Education Gazette, 2008), in the collaboration between Scion Crown Research Institute and a 5/6 years combined class, students were asked to build class “wiki” style web page (Falloon, 2011). The created wiki page provided communication and collaboration among the students, teachers, and parents. Creating wiki also provided improvement for students’ science knowledge and literacy competencies (Falloon, 2011).

3.5.2 E-learning experience in classroom

Collaborative studies have been conducted on how IT implementation and new technologies can be utilized to enhance, improve the learning process, and promote science in classrooms (Otrel-Cass, Cowie, & & Khoo, 2010). Various IT technologies have been integrated in to the class room to help learning process for learning geology, erosion, and land formation. The activities that involved learning process were both conducted in and outside of classroom (Otrel-Cass, Cowie, & & Khoo, 2010).

For outside learning activities students were assigned to visit a river. Their assignment was to take photos and videos of the riverbank, these photos were later used as learning material in classroom. Photos were processed and used as learning material with help of interactive whiteboard. This method helped students with learning process as they were been on the river site and they are seeing some random photos of river. (Otrel-Cass, Cowie, & & Khoo, 2010). In next step, students were provided with rocks to analyse. For analysis they utilized a computer aided microscope which was used to analyse interior configuration of the rocks. During the analysis interactive video of how rocks are created and how external forces inter act in their creation was showed (Otrel-Cass, Cowie, & & Khoo, 2010). Instead of old paper geological maps they utilized Google Earth and other digital maps to show origin of rocks and earth structure (Otrel-Cass, Cowie, & & Khoo, 2010).

"*Just as usual, the teachers had to plan their teaching carefully, with a clear structure and purpose, and to consider the learning objectives for the science unit. However, in addition they had to think about what the various ICTs could offer to their students, and the skills that the students needed so they could use these tools and resources. The effectiveness of the ICTs the teachers used to support learning about landforms and erosion of rocks depended on more than teachers knowing how to use technology. It also required of them how to use it to support the specific learning needed for the earth science*" (Otrel-Cass, Cowie, & & Khoo, 2010, p. 21).

Supported by the New Zealand's "Ministry of Education's m-Learning Capability Pilot Project", student used their smartphones to capture videos that have been later used in their education (Wright, 2010). Captured videos were then shared among students for self-assessment, review, and social education. This method allow student to improve communication skills in learning process. This way the technology that students already owned was utilized and students had their university work with their reach.

In collaboration amongst Scion, the Crown Research Institute and the students of 5/6 in a university Scions equipped university with the following equipment: 4 PCs, four computerized-supported microscopes, an advanced camera and 3 digital cameras (Falloon, 2011). By equipping universities, classrooms interaction with technology increased. Accessibility to IT is important to teachers regarding their professional knowledge; it allows teachers to interact with students in more efficient and interactive way.

"... having access to the laptops was brilliant. I could have all the children in groups on a computer, answering specific questions ... there was no point in going down to the gully and putting food in the traps when we didn't know what the predators like to eat! I couldn't have

done it without the technology, a lot of it, and having the night camera and being able to get real footage ... that was huge" . (Falloon, 2011, p. 43).

A study conducted by Otrel-Cass, Cowie and Khoo suggested how IT technologies and IT applications can applied and used for interactive presentation of knowledge for students and learners. The interactive presentation using the IT applications would take place dynamically in science lessons (Otrel-Cass, Cowie, & Khoo, 2011). The situation provided by Study conducted by Otrel-Cass, Cowie and Khoo included science class where students study condensation created on the exterior of the cold glass. The condensation was demonstrated using a time lapse video (Otrel-Cass, Cowie, & Khoo, 2011).

"The use of time-lapse videos is not novel in science classrooms, but Tina's timing of its use and her connecting the video with a real experience made this episode significant" (Otrel-Cass, Cowie, & Khoo, 2011, p. 22).

The web based astronomy classes was proposed by the study centre in 2007. The table below compares the online and traditional classroom experience of students (Shaw, 2007).

Table 2 Comparison between online and tradition classroom experience

Online experience	Classroom experience
Work sessions can be of any duration.	Work sessions are of 45 minutes.
Work sessions can begin at any time of the night or day.	Work sessions are structured into specific times during the day.
There is little opportunity to move outside of the set content.	There is scope to build upon student interests.

The motivational techniques are set as a part of the delivery system.	Teachers can vary motivational techniques.
Summative assessment occurs as an integral part of learning (page-by-page).	Summative assessment is an 'event,' frequently at the end of a week or a term.
A second-order form of personal relationship may develop with the teacher.	Genuine personal relationships are facilitated by direct personal contact.
The teacher responds to the student within a few minutes in every case. There is only one channel of communication.	Teachers sometimes do not respond to individual students and the time taken to respond depends on the nature of the student's submission (for example, an oral question or an examination script).
Assessment occurs as each concept is studied by the individual.	Assessment occurs when the timetable allows, with the curriculum accumulated by the group.
The teacher sees every statement the student makes and can comment on it.	Teachers often collect work from students and view it after the class is complete.

Progress is reported question-by-question and a graph shows the student exactly how far they are through the course.	Students can become unaware of their individual achievement when taught in a group.
Course completion produces an immediate congratulatory statement, and an invitation to enter the next course.	There are usually delays before the results of courses are known.

3.5.2.1 "Problem-Based Learning in Teams" project

"Problem-Based Learning in Teams", also known as PROBLIT was the program created to utilize IT in the education system, the main goal of PROBLIT was to utilize IT and offer students valid and better access to information. Groups of students were selected to participate in PROBLIT program, the main criteria for selecting students was talented and capable science students from several universities.

Selected students had at their disposal IT tools like electronic mail and video conference for communication and collaboration purposes amongst themselves and other selected groups of students. The e-mail and video methods of communication and collaboration were used to resolve issues; exchange of information and knowledge gained in learning process were the main advantages of this educational practice (Lowe, Taylor, & & Buntting, 2011).

Beside electronic mail and video conference used for communication and collaboration, other technologies were used to help improve and interact in to learning process and assignments. To help with energy and movement topic, "How do Glider pilots use the principles of the conservation of energy to enjoy long extended flights?" videos of glider flights we showed to

students for observation purpose, this way the observation could be done in three dimensional space. The glider was equipped with global positioning system for gathering data like speed, height and position; gathered data were used calculations in physical computations and statistics analysis (Lowe, Taylor, & & Buntting, 2011).

"Problem-Based Learning in Teams" project was one of the examples where IT and modern technology can be used to improve learning experience and allow students to interact and solve assignments.

3.5.2.2 RIGEL project

RIGEL is and cell sensor tool created and manufactured by a group of students for Beijing Olympics sporting events. The RIGEL sensor cell adoption and integration into the e-learning was tested by students of a group of 7-8 science class (Fenton, 2008). The first step of integrating RIGEL in the e-learning process was familiarizing students with RIGELL and learning all its capabilities and utilization purposes. The next step was integrating RIGEL and using it to the forthcoming science fairs.

The integration was separated into five stages and it consisted of (Fenton, 2008, p. 42):

1. Brainstorming ideas for events that use RIGEL sensor units
2. Get into teams to develop a specific activity (decide rules, prizes, banners/signs/artwork, what sensors or programming is needed for sensor units, etc.)
3. Trialling the events and improving where necessary
4. Putting on a performance - running the 8 events as the Olympic 'officials' and technicians while two other classes participate as competitors
5. Students carrying out a PMI analysis of their activity

The RIGEL sensor was used for following scenarios:

- Treasure hunt – the RIGEL sensor was used to find treasure chest, treasure chest was equipped with a device that emitted the radio signal. RIGEL sensor was configured to be used as a radio wave tracker that allows students to find hidden treasure.
- Obstacle course – the RIGEL sensor was configured to act as touch sensor, it was used to deter which team completes the course first.

The table below shows examples of authentic learning in RIGEL project (Fenton, 2008, p. 43):

Table 3 Example evidence of authentic learning from primary students [59, p. 43]

Indicators of authentic learning	Examples from data
Real-world relevance	Using tools, equipment or processes students see as "sophisticated" or "high tech", e.g., RIGEL
Sustained investigation	Activities engage the student over the period of days and involved work from home
Reflection (metacognition)	Student PMI analysis, student peer review "that was good/bad/would be better if..."
Interdisciplinary perspective	Students adopt diverse roles and think in interdisciplinary terms. Students fabricate prizes and artwork for the Olympic Games, students take role of teacher/instructor
Polished products	Activities culminate in the creation of a whole product, valuable in its own right. Two classes participated in an event created and supervised by the Year7/8 class.

Multiple interpretations and outcomes	Students had to work in teams, discuss what their event would be, test, and modify if necessary, their events prior to the Olympics Day.
Informal learning	Students reported knowledge they have picked up from the activity that was not explicitly taught, e.g., how the sensors worked or could be configured for their event.

The student experience in RIGEL project was described by students in the following interview

> *"I don't think people realised how strongly they were going to be drawn into it (the technology). When we started we had no idea we would make games. When they started thinking about the Olympics everyone got really excited and then we came up with a really strong product with their games (activities) ...I reckon they'd do it again." (Fenton, 2008, p. 43)*

3.6 Collaboration with scientists with use of video conference

Critical method for improving science education is to allow collaboration and communication between students, teachers and scientist. Useful IT tools can allow students and teachers to access science experts. This accessibility can significantly improve students' involvement and focus on science in the education system (Gluckman, 2011). Students in Wellington utilized IT tools like video conference to communicate and collaborate with research professionals. The IT video conference tools were used to create links between students and professional scientist (Falloon, 2012). The use of IT video conference tools in the education system is not new, video

conferencing has been used as a popular method of delivering lectures from remote locations or for a mass audience across globe.

> *"Video conferencing invites the delivery of lectures. It is essentially a presentation medium as well as being a minimally discursive one … (it) as a medium, offers less than a lecture in terms of pedagogy, and wins mainly on the logistical value of bringing people together across a distance"*
> *(Laurillard, 2002, pp. 157-158)*

The collaboration was done through workshops and performed via video conference and usage of virtual laboratories. Workshops were done in a way that professional scientist usually presented papers on a specific theme and using virtual labs the professional scientist usually demonstrated lap procedures and experiments. Falloon (2012), also discussed more direct methods for collaboration between students and professional scientists, but video conference method was chosen because it have less probable impact on scientist work.

> *"concerns about the sustainability of more direct participation models—either scientists working in classrooms or students working in labs and the probable impact such models would have on scientists' work" (Falloon, 2012, p. 9)*

The need for this type learning process was pointed out by students; via student surveys, they expressed the need for this type collaboration and communication with professional scientists in the form of workshops. The workshop content was adapted to students' evaluation assignment. The workshops were remarkable place where students can see professional scientist conduct lab experiments and lab procedures and how helpful it was for students'

evaluation and examination. The workshops and virtual labs have significantly improved student's university work and it was related to the practice.

The current practices for using video conferences and tools in teaching process are in development and currently have some issues with creating real discussion in the video conference lesson between scientist and students. Teachers agreed that the creating real discussion between students and scientist is an issue; however, they do not think of it as a major issue and it does not have huge impact on video conference lessons (Falloon, 2012). One of the issues with preparation of video conferences was time consumed during the preparation for the video conference lesson by scientist. As mentioned in experience from scientist bellow, the amount of time to prepare was six times larger than the actual lesson. This included the logistics for setting up virtual lab, setting up a video conference infrastructure, setting up apparatuses for experiments and technical assistance. The time consumption was a major issue as this video conference lesson was not done by regular bases.

Below are reactions from students, teachers, and scientist about their experience in video conference workshops.

> *"I thought the labs were great. It was good seeing how scientists really do this stuff, and that it's happening here (in New Zealand) … but I'm not sure how useful it will be for the exam. We don't get to do this sort of thing (practical work) for our Standard. (Student G, interview, July 2010)."*
>
> *(Falloon, 2012, p. 7)*

> *"… I think they (the students) got stage fright (laugh). They're not like that usually in class … they're actually quite a vocal lot. We got some really good stuff out if it though (lab 2), after it had finished! We talked for about*

half an hour on the techniques and how they're being used in Liz's research. It's really good for the students to see and hear it first-hand. (Sam, interview B, July 2010).” (Falloon, 2012, p. 10)

“… we needed to do them (practice sessions). We're not teachers, and had to make sure what we were doing – especially in the labs – was OK. But they (the videoconferences) took a lot of time. Some of us had to do lots of homework, as its stuff we haven't done for a while … and we had to make up the slides. I reckon that probably for each hour or so of workshop, we had to spend six … probably more … hours preparing … plus the practice. (Tom, focus group, August 2010).” (Falloon, 2012, p. 10)

3.7 E-networked tools as learning platform

Using IT technologies like the World Wide Web or mobile technologies in education process can endorse science studies in primary classrooms. Usage of these technologies can help students with communication and accessing data, process data and share the results (Otrel-Cass, et al., 2011). The adoption of e-networked tools in learning process is most often constrained by technological, institutional, and pedagogical factors such as (Otrel-Cass, et al., 2011):

- Reliable access to technology infrastructure;
- Flexible curriculum and assessment structures;
- Understanding of the affordances of different technologies;
- Planning to incorporate technology meaningfully in their teaching;
- Progressive introduction of inquiry possibilities to scaffold skill development and transfer responsibility to students.

Students often use their mobile devices to record, videos or only audio of lecture or only take simple pictures during the lecture. This method is proven better as traditional note taking, as described by the student:

> *"It helps a lot if you are watching a [mobile phone] video, you take it in more . . . and you remember it better. We record what we see and send it to the teacher. To record the process for when we do evaluation, to give other people an idea of what it's like to do this. It's like taking notes in class just a different form. It's better to take it in a picture, as you can't explain what it's like in words always, it's easier to explain what it's like using videos." (Otrel-Cass, et al., 2011, p. 6)*

As for teachers this is new methods compared to traditional note taking, sometimes these methods are disproved by teachers, and students are not allowed to capture video or record audio of a lecture. Reaction by teacher depends from teacher to teacher. Utilization of e-network tool base in the educational process and communicates via mobile gadgets can increase student interaction within the process of learning.

Examples of e-network tools that can provide better communication, investigation and access to knowledge are listed bellow (Otrel-Cass, et al., 2011):

- Online information search engines – this includes Google Scholar, Web quests, YouTube and similar online resources.
- Online post-it notes – this includes platform as Wall wisher where students can share ideas and post questions.
- Moodle forums – and open source learning platform.
- Video conference – Skype or Google Hangouts as online tool for video conference lesions.

- Electronic mail – standard communication over electronic mail.
- Online presentation tools – this includes tools like Google PowerPoint, Prezi and Glogster.

The above mentioned tools can be combined to increase experience and performances. The usage of Moodle as a learning platform provides new prospect for the learning process, the Moulder platform integrates key components like reliability and time. Moodle allows student to share ideas, communicate with teacher and obtain feedback for current assignment or other work in progress. Moodle as a platform allows both student and teacher to participate the learning process.

> *"By having postings on Moodle it allowed students to have a variety of resources at their disposal for revision. By having these resources in Moodle, this gave the students flexibility with what time they could complete revision. Some completed this at night and others in the morning. More students attempted revision as they felt there was something to their liking and piqued their interest. Also many felt that they had enough material to revise with. It also allowed students to communicate and ask other students questions regarding their revision. This unit's assessment was the one that they performed best in out of the whole year. Many of my students felt that Moodle was a positive experience and helped bridged the gap between what happened in the classroom and home." (Otrel-Cass, et al., 2011, p. 6)*

The usage of e-network tools like e-mail and Skype for text based and voice or video based communication can allow students better communication with teachers and with professional scientists. This way students and learners can as questing, collaborate and share information or data.

The utilization of e-mail and Skype by students for communication is described below.

> *"It was pretty good as we emailed him [the scientist] and within two days he came back to us. He gave us like three website links and pdf files. He gave us heaps of information. You can't really find that sort of stuff online. Emailing someone is a really easy way to get information, expertise and advice. It is a good way to get information that you want instead of going through websites whereas emailing someone you get the depth of learning." (Otrel-Cass, et al., 2011, p. 7)*

> *"The magic of having an expert in the classroom [via Skype] whom they [students] can ask about something they are interested in, the use of technology to do something like that is immensely valuable. That would be where I see the technology won through." (Otrel-Cass, et al., 2011, p. 7)*

E-networked tool like Google Wave to see adoption in learning process and e-learning as it allow real time collaboration in the virtual classroom. Features like real time communication in a virtual classroom allow teachers and students to interact and collaborate on any project or assignment from anywhere and anytime (Heap, 2011). Google Wave allows teacher to create a wave that represents a lecture board, students can interact with this wave by collaborating in lecture board and posting comments.

Google Wave as an e-learning platform is often described as:

> *"Being merely a discussion platform, to building a communal resource for learning" (Heap, 2011, p. 631)*

Instant responses from student allow teachers to see how students understand the lecture and how students interact with the lecture.

The Google Wave lecture board presents to students at:

> *"Access to the ideas of other students, and attempts to consolidate these ideas in order to improve their own understanding, which builds the knowledge of the community of which they are a part" (Heap, 2011, p. 630)*

These ways students can follow the discussion and make further remarks.

3.8 Electronic whiteboards in classroom

Electronic white board is commonly used in e-learning. Whiteboards are touch sensitive screens that projected on the surface by projector and they work in conjunction with a computer. The main factor for using electronic whiteboard in the classroom is their efficacy in the learning process. The industry describes electronic whiteboards as following.

> *"They serve to raise the level of student engagement in a classroom, motivate students and promote enthusiasm for learning. In at least one case, the addition of an interactive whiteboard positively influenced student attendance. Interactive whiteboards support many different learning styles and have been successfully employed in hearing and visually impaired learning environments. Research also indicates higher levels of student retention, and notes taken on an interactive whiteboard can play a key role in the student review process. In addition to student learning, observations also indicate that designing lessons around interactive whiteboards can help educators streamline their preparation and be more efficient in their ICT integration." (SMART Technologies, 2004, p. 10)*

The electronic whiteboard have the most impact in Secondary school and High school (Glover & Miller, 2001). Teachers adopt the use of electronic whiteboard very well and use them properly in their pedagogy. Electronic whiteboards are commonly described as an efficiency, increasing method in learning process and allowing teacher to adopt new learning styles. Electronic white boards play facilitating role in classroom instruction, social learning and interaction with new technology (Glover & Miller, 2001).

3.9 Issues in e-learning method

With the adoption of e-learning teachers are faced with new issues, most issues are with integrating new methods in teaching. One of the common problems was with using digital learning material. Compared to the traditional textbook the teachers know on what page students are and from where they are getting information and facts. With the IT based textbook they can use multiple sources for getting information and that is causing problem with teacher helping them out (Wallace, 2004).

"Student work can be located anywhere in a nearly limitless information space, with the physical manifestation varying with each page change" (Wallace, 2004, p. 476)

Students now have access to limitless resources on the internet and they are not limited to universities recommendation of education literature. This can create variations in power relationships amongst teachers and students. Using other resources other than recommended can alter the focus of students but it can also create self-motivation in students and allows them to seek more knowledge (Wallace, 2004). Because of issue like this, university and education organizations have significant role in helping teachers endorse their professional knowledge and offer them best working environment.

3.10 E-learning in Computer Science Education

One of the most popular systems for supporting the e-learning of computer programming include automatic assessment platform or online judge. Such a system allows assessment of the submitted computer programs on the basis of pre-defined requirements and parameters (Swacha & Baszuro, 2013). Some of the standard parameters for assessment include program efficiency and accuracy in addition to coding style and plagiarism detection. These methodologies however lack teacher instructions to students and scope of teacher-student interactions. A possible solution to address the issue is to integrate the online learning system of online judges into existing learning management systems.

Another research study by Wolf (2003) has proposed cognitive theory of media learning which supports the idea that certain kind of media are instrumental in promoting learning, while the availability of large number of media sources together have a negative impact on student learning for computer education. Research by Dobrzański, Brom, & Brytan (2007) compares the traditional teaching with modern e-learning and points out the limitations of e-learning in lack of communication between teachers and students, an aspect which is present in traditional teaching methodology. Researcy study by Rohde & Thomas (2003) outlines the advantages of e-learning for computer science students in the form of better flexibility in learning and disadvantages in the form of reduced social interactions due to online learning.

Additionally, research study by Alshalabi & Elleithy (2012) points out the necessity of peer interactions, student-teacher interactions and feedback mechanism in e-learning for computer education courses.

Computer programming is different from other science courses as proficiency in other fields does not guarantee success in computer science programming. There is lack of existing effective tests to ascertain one's aptitude for computer programming. The sudden sense of radical novelty is a challenge for many learners since they need to think about code mechanics

while having little experience in the field (Scott & Ghinea, 2013). Additionally, computer science students need to be accustomed to complex programming languages such as allowed syntax and rules (Kelleher & R., 2003). These aspects need to be integrated in their learning system and it can be a challenge for new learners in adapting to the new computer languages. Some of the common barriers for use of e-learning for computer science educators include lack of proper training related to use of technology, poor internet and networking access, inadequate hardware and software, concern for student access and lack of motivation and incentives to switch to e-learning (Gamdi & Samarji, 2016).

Chapter 4: Data Analysis & Discussion

The current chapter provides an analysis of the collected primary data including survey of 50 computer science students and 16 computer science lecturers, and interview of 8 computer science lecturers in New Zealand.

4.1 Student Profile

Institutions Students Were Studying At

Out of 50 participants, 16 are from Waikato University, 14 from AUT and rest students from Massey University, Unitec, University of Canterbury, University of Otago, Wintec and University of Auckland (Figure 1).

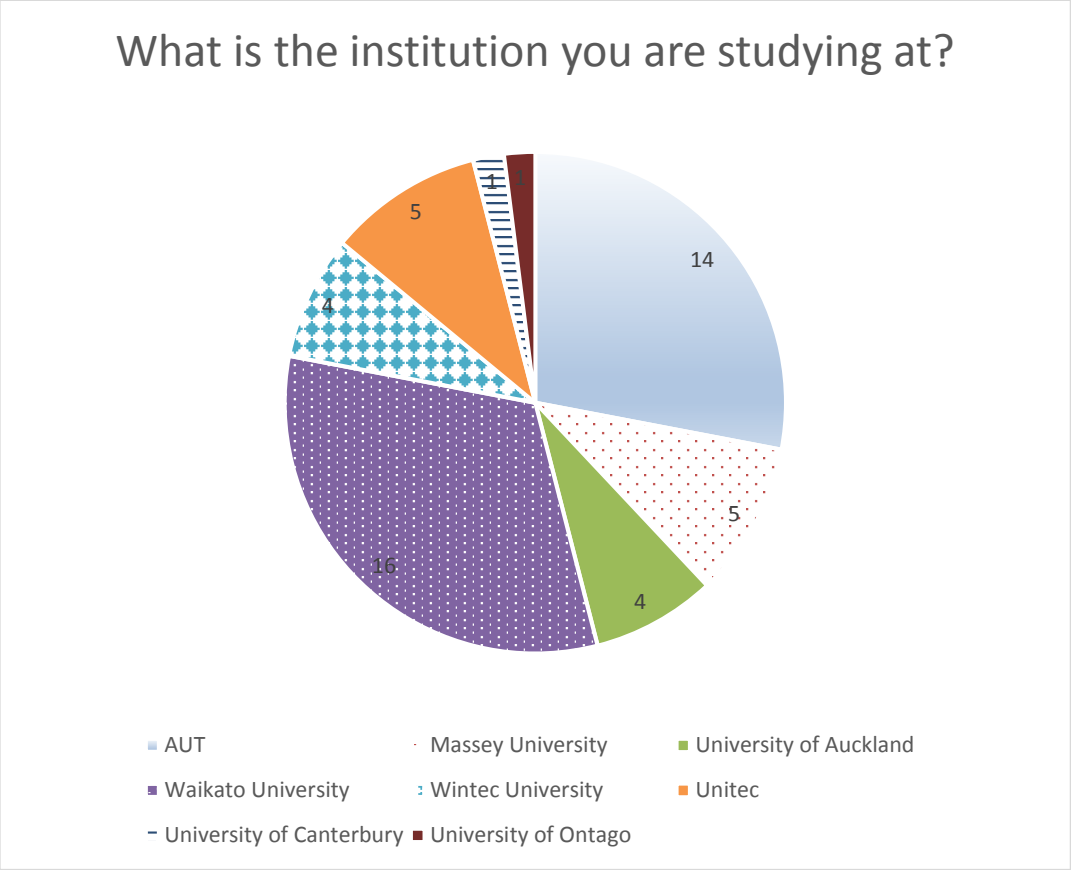

Figure 1 Institutions Participant Students Were Studying At

Proportion of domestic or international students

Ten respondents involved in the research were domestic students and rest 40 were international students.

Gender Diversity

The research involved 38 male participants and 12 female participants.

Age Group

Majority of the participants were in the age group older than 25 Y.O. (28) followed by the age between 20-25 Y.O. (21) and below 20 Y.O. (1).

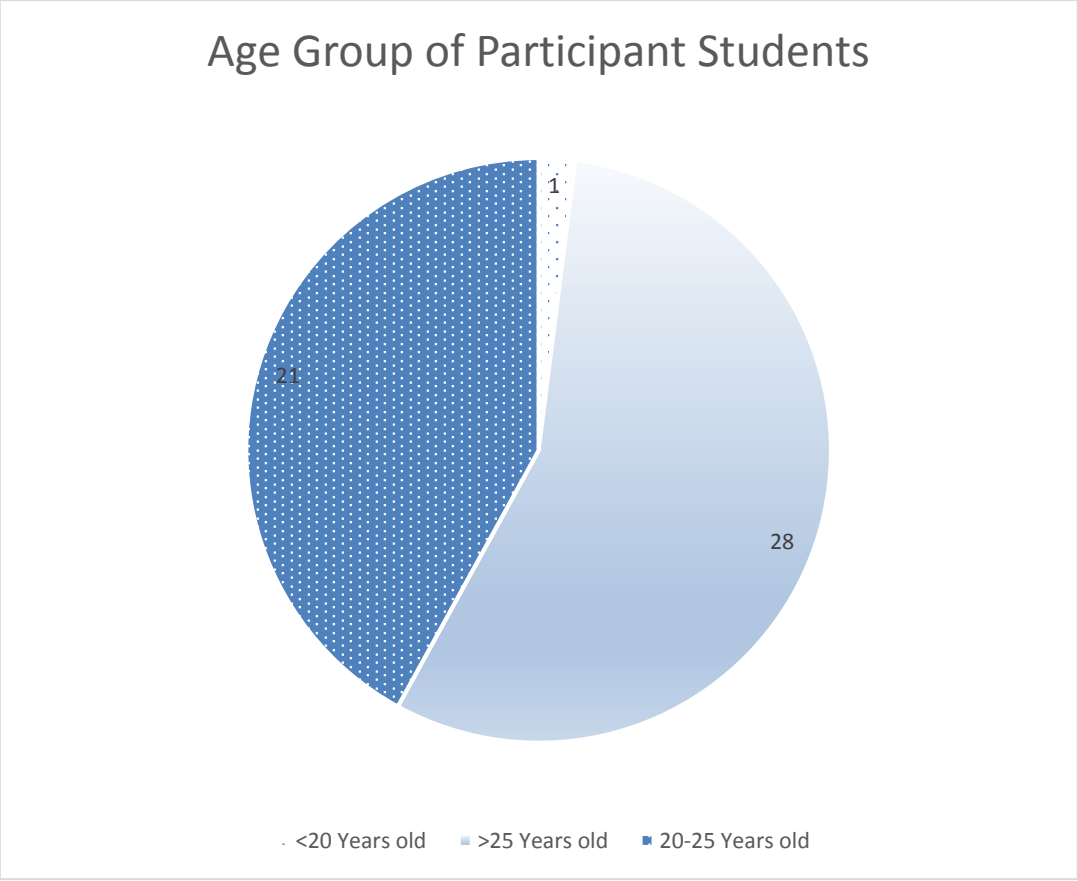

Figure 2 Age Group of Participant Students

Time period students studied computer or IT courses at school

Out of 50, 27 participants studied computer or IT courses at schools for more than 2 years, 9 for less than 1 year, 7 for 1-2 years and 7 did not study IT or computer courses at school.

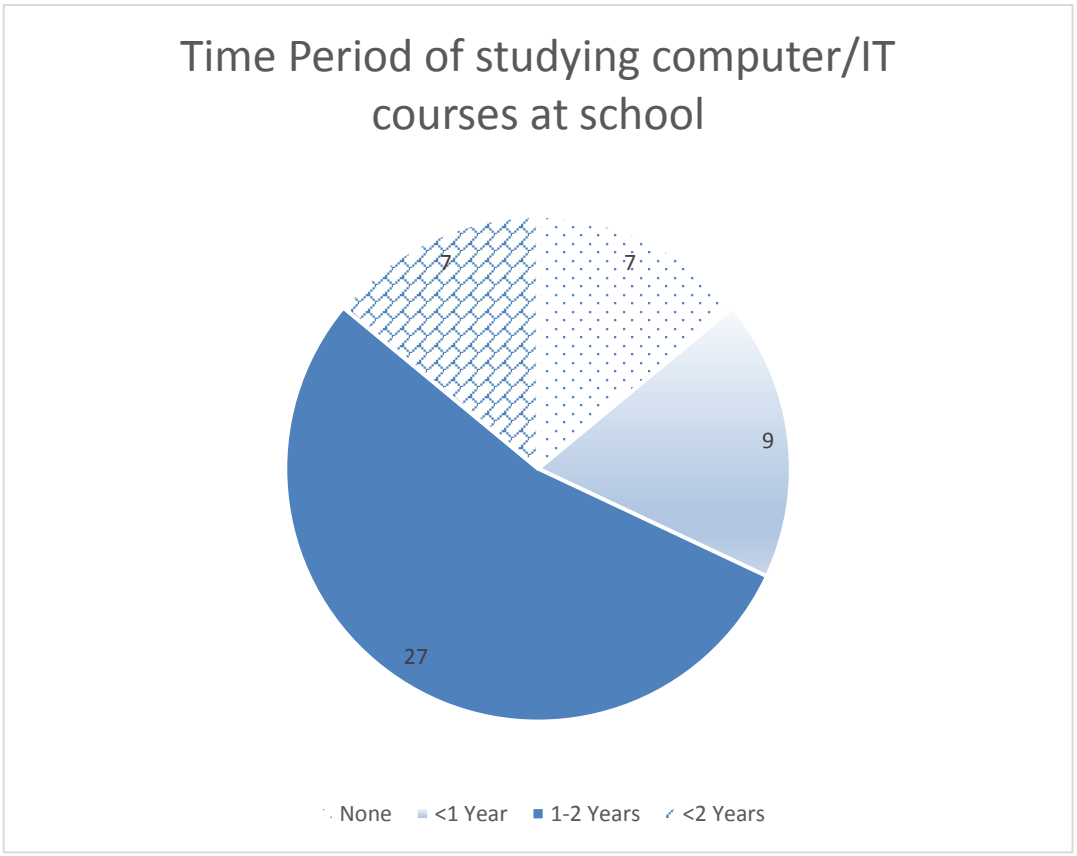

Figure 3 Time Period of studying computer/IT courses at school

Amount of computer science course based on computer aided learning

Out of the 50 participants, 20 said that 50-75% of their computer science course is based on computer aided learning such as online tutorials, quizzes, lecture notes, instructional materials, and other techniques. 12 participants said that 75-100% of their computer course was based on computer aided learning aids, while 10 said that 25-50% of their computer course was based on computer aided learning aids. Eight participants said that 0-25% of their computer course was based on computer aided learning aids.

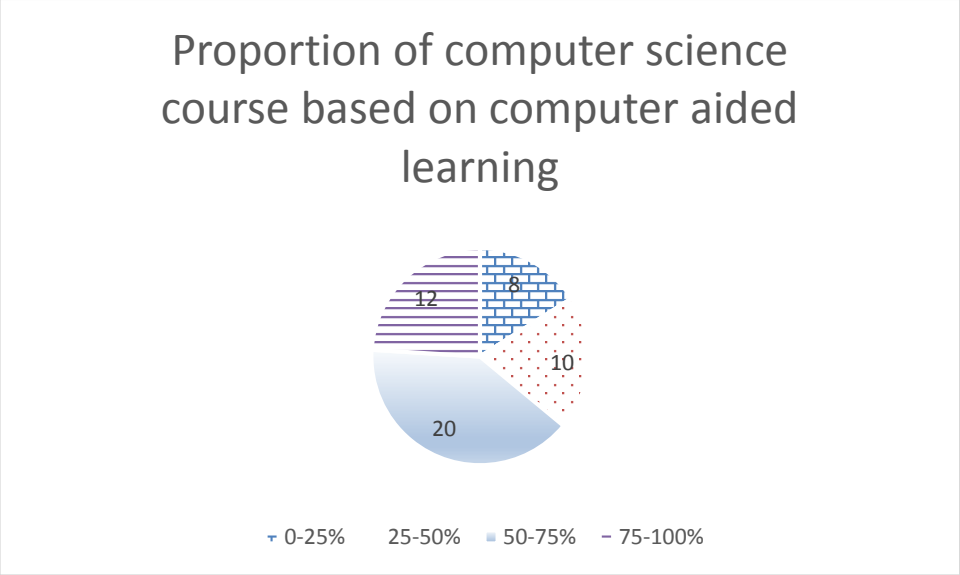

Figure 4 Proportion of computer science course based on computer aided learning

4.2 Student Research Data

Would students prefer their course material based on computer aided learning techniques such as online tutorials, quizzes, lecture notes and instructional materials?

Majority of the participants (23) said that they would prefer 50-75% of their course material based on computer aided learning techniques such as online tutorials, quizzes, lecture notes and instructional materials. 14 students suggested that 75-100% of their course material should be based on computer aided learning, 10 of them suggested that 25-50% of their course should be based on computer aided learning and 3 of them preferred 0-25% of their course based on computer aided learning.

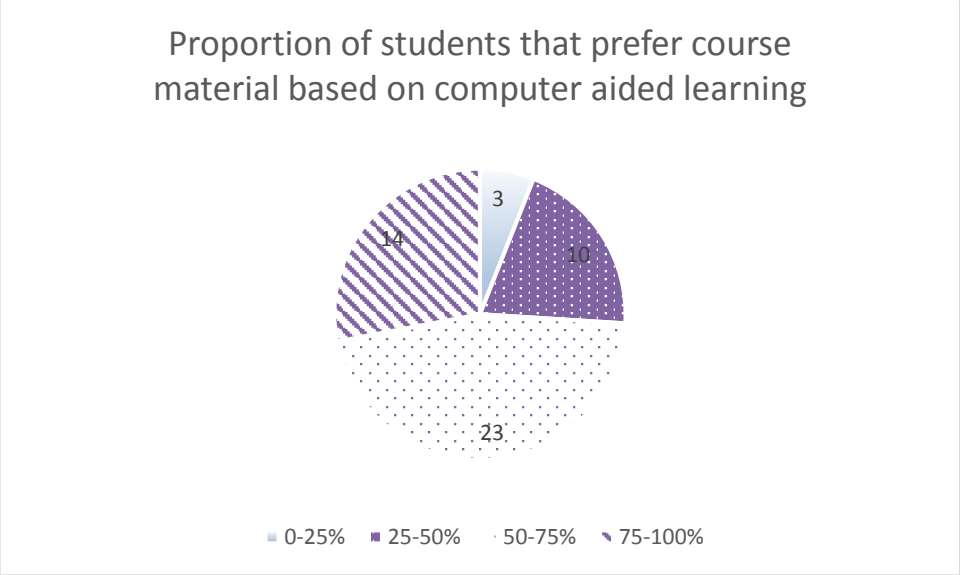

Figure 5 Proportion of students that prefer course material based on computer aided learning

If computer education using computer aided learning will allow students to develop a better understanding of the subject in comparison to traditional teaching?

When asked if computer education using computer aided learning will allow students to develop a better understanding of the subject in comparison to traditional teaching, thirty seven students responded that it would help them in a better manner since they will be able to access the course material all the time and can revise it when needed. Some of them expressed concern over inability of computer aided learning to provide understanding that was comparable to traditional teaching since all things could not be explained via computer aided learning.

If using computer aided learning can lead to distractions?

Twenty eight of the students felt that computer aided learning could lead to distractions which was because of student access to internet with availability of social networking websites at their disposal. Twenty of the students indicated that no such distractions affect them in computer aided learning.

If computer aided learning made the course more exciting and interactive

Forty three of the students felt that computer aided learning made the course more exciting and interactive. The students felt that computer aided learning made it interesting to participate in online discussions, interact with their peers and instructors online and also access the class material at any time.

If learning computer science through computer aided learning would prepare them better for work after graduation

Forty three out of 50 of the students felt that learning computer science through computer aided learning would prepare them better for work after graduation. Some of them felt that it depended on what stream they would take after graduation. Students felt that computer aided learning would provide them with the necessary experience to operate computers since it was used in most organizations.

If student exams should be computer based

When asked if student exams should be computer based, more than 50% of the students felt that exams could be computer based. Nine teen of them suggested that exams should take place in the traditional manner since some students are not habitual with typing and may face technical errors. One of the students suggested that exams should be both traditional as well as computer based.

4.3 Lecturers Profile

What is the institution you are teaching at?

Majority of the lecturers are teaching at AUT (9), followed by Waikato University (4), Wintec Institute (2) and Massey University (1).

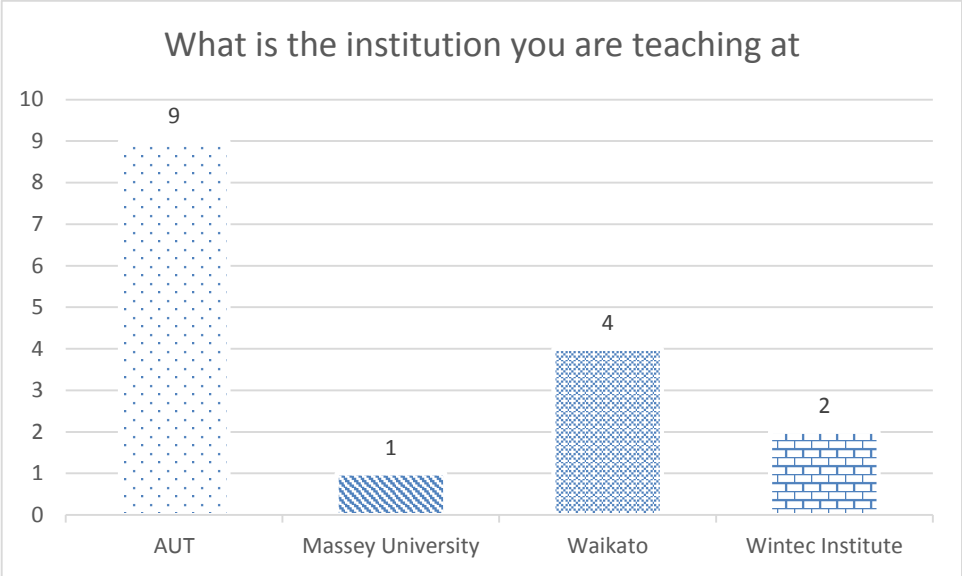

Figure 6 Institution lecturers are teaching at

Gender Diversity

Majority of the lecturers participating in the online survey are males (11), 5 of them are females.

Age Group of Lecturers

Half of the participating lecturers are in the age group of 30-50 years old and half of them are above 50 years old. None of the lecturers are below 30 years old.

Proportion of computer science course currently based on computer aided learning

Seven reported that 25-50% of their computer science course is currently based on computer aided learning, 6 lecturers said that 50-75% of their computer science course is currently based on computer aided learning, 2 lecturers said that 0-25% of their course was based on computer aided learning and only 1 lecturer said that 75-100% of the computer science course was based

on computer aided learning. This shows that computer aided learning is used in some form for every computer science course.

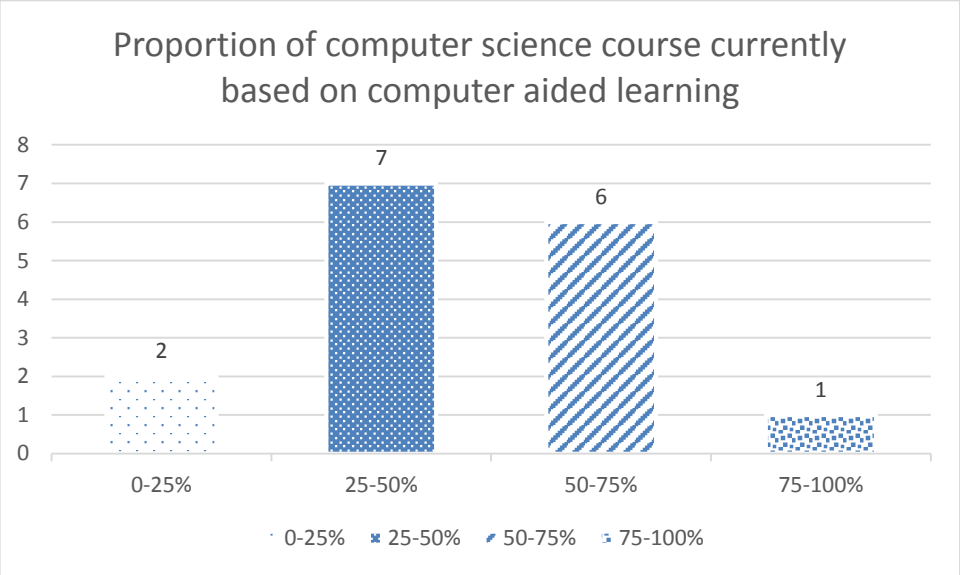

Figure 7 Proportion of computer science course currently based on computer aided learning

4.4 Lecturers Research Data

Do you think learning computer science using computer aided learning will help your students develop a better understanding of the subject as compared to traditional teaching?

Eleven of the participants did agree that learning computer science through computer aided learning will help their students in developing a better understanding of the subject in comparison to traditional teaching methods. Rest of the lecturers reported that efficacy of computer aided learning depends on the learning style of students and that there should be healthy mixture of traditional learning and computer aided learning methods. One of the lecturers also said that it depends on the subject and computer aided learning may depend on whether the subject is theoretical or practical in nature. This data is consistent with the paradox that most of the lecturers are unwilling to use computer aided learning for their courses since they feel that it will not help students in learning.

Do you think using computer aided learning can lead your students to distractions?

Eleven of the lecturers agreed that using computer aided learning may lead students into distractions, rest of them said that it depended on the materials and methodologies used by lecturers. Some of the advantages of computer aided learning as pointed out by lecturers include easy to access study material any time, creative discussions by students and interest generated about the study topics.

Do you think learning computer science though computer aided learning will help prepare your students better for work after graduation?

According to the survey, 13 out of 16 lecturers agreed that computer aided learning could help their students prepare themselves for work after graduation. Some of the lecturers said that it is never their aim during teaching computer science through computer aided learning. Computer science is a very broad area and it is not certain which part of the course will be useful for the students in the future. Since computers are used everywhere, the lecturers did agree that computer based learning is likely to benefit the students.

Do you think the exams should be computer based?

In response to the question if student exams should be computer based, more than 8 lecturers disagreed with the idea. They felt that certain areas in computer programming require coding or theory, and therefore cannot be computer based. The lecturers did not see any specific advantage in seeing the exams as computer based. The lecturers suggested that exams could be a combination of theoretical and online computer based exams.

Do you think that computer aided learning could prevent students attending classes?

Fourteen lecturers agreed that computer aided learning could prevent the students from attending classes and they tend to not spend time in classrooms and rely only on computer aided learning which may affect their academic performance.

4.5 Lecturer Interviews

Eight computer science lecturers have been interviewed from different tertiary institutions in New Zealand in order to collect valuable information about the views of educators about impact of e-learning on the learning and development of computer science students in New Zealand. The indicative questions for interviews were as follows:

1. What obstacles do you have in adopting computer aided learning?

In response to this question, the first participant said that he had not used computer aided learning in AUT and preferred blackboard for teaching purpose. He did not see any obstacles in using computer aided learning, and uses a balance of traditional and e-learning for students. The second participant cited that using technology in the most effective manner was an obstacle for lecturers since there was insufficient training provided to them to use new devices such as tablets for teaching purpose. His response: "Well, I would say that the main obstacle is understanding the strength of the technology I'm using. If I understand it well and know the features of what I'm using then it makes it easier, but sometimes it is really hard to know everything something new so sometimes it is really hard. For example, the surface pro tablet and whole lot of other features. So there is a lack of training I guess is an obstacle."

The third participant did not face any obstacles in adopting computer aided learning and found it very helpful. The fourth participant also did not face any hurdles with computer aided learning. The fifth participant did not see any obstacles in computer aided learning. The sixth participant did see some obstacles in adopting computer aided learning as he was not much accustomed to using computers for teaching purpose. The seventh participant mentioned budgetary constraint as a main obstacle in adopting computer aided learning. The eighth participant faced minimum obstacles in computer aided learning since he used it occasionally for assessment.

Summary:

The key obstacles faced include using technology for computer aided learning since many lecturers are not accustomed the use of technology for e-learning. Other obstacles for e-learning methodologies include a budgetary constraint.

2. If you had some obstacles how did you overcome them?

The first participant did not have any obstacles related to e-learning. The second participant resolved obstacles related to technology and device use by referring to search engines like Google or asking others for help. The third participant used Google to find out solutions to errors or difficulties faced during computer aided learning. An excerpt from the interview – "Tool for learning I depended on Google, like read some manuals about them and Googled the results." The fifth and sixth participant did not use computers for teaching. The seventh participant mentioned that it was beyond the budget of students to purchase computer devices which is the main obstacle. This was resolved by using mobile for learning purpose. The eighth participant mentioned using podcasts for computer aided learning and faced issues with finding the codes for the same. The issue was resolved by using a program called Studio.

Summary:

The methods used to resolve obstacles related to technology and device included referring to search engines like Google or asking others for help. Mobile phones were used for teaching to overcome the budgetary constraints. Podcasts were also used for low budget learning initiatives.

3. Do you refer your students to online courses or materials of other institutions? If yes, what institutions? If not, why not?

In response to this question, the first participant lecturer responded that he preferred uploading his prepared notes for students and did not explicitly upload notes from other universities. He did accept referring materials from other universities in preparing his notes. Excerpt: "Well, as

in when necessary I put up notes and those notes are prepared by myself sometimes with materials from other universities. So I don't explicitly put a set of notes from other universities, but I use materials from other universities in my own notes."

The second participant did refer his students to study materials from other universities such as Stanford and MIT that were free to access online. The third participant did not refer his students for materials for other universities, but did mention that it was worth referring to other study material than relying only on Google. The fourth participant told that he did ask his students to refer material online to enhance their learning. The fifth participant also did not refer his students for other courses since he made the course contents himself and saw no need to do so. The sixth and eighth participants did provide referral links to students for materials from other universities. The seventh participant did refer students for study materials from other universities.

Summary:

The lecturers did prefer upload their prepared notes for students and did not explicitly upload notes from other universities. They provided referral links to students for materials from other universities. They did opine that students could refer material online to enhance their learning.

4. Do you think that massive online courses is a threat to the existence of traditional tertiary institutions?

The first participant did not see massive online courses as a threat to traditional teaching as he said that these cannot replace lecture insights and interaction with students in a classroom set-up. The second participant also did not see online learning as a threat to traditional classroom teaching. The third and fifth participant agreed that online courses could be seen as a threat to the existing tertiary institutions. The fourth participant did not see online courses as a threat to existing tertiary colleges. Here is an excerpt: "I don't think so. That's extra. You still need to teach to enhance their understanding they can follow any online resource e-learning whatever."

The sixth participant did not see online courses as a threat to traditional teaching and said that both methods are necessary for student learning. The seventh participant did not see online courses as a threat for teaching. The eighth participant said that it was student's choice to choose the teaching method. However, he did mention that student grades suffered as they did not take traditional classroom teaching.

Summary:

Some lecturers did see online learning as a threat to traditional teaching, but they also felt that traditional teaching would have to continue along with e-learning and it was student choice to choose between the two methods.

5. Does computer aided learning help you to manage your time more efficiently?

The first participant did accept that computer aided learning helped him to manage his time more efficiently. The second participant said that it may help one to manage time more effectively once one is accustomed to the technology, but in the initial stages it is more time consuming. The third participant agreed that computer aided learning did help him to manage his time more efficiently. The fourth participant agreed that computer aided helped him to save time and better manage it in comparison to traditional teaching. The fifth and sixth participants mentioned that they did not save any time with computer aided learning. The sixth participant was more used to traditional teaching and mentioned that it would be challenging for him to adopt computer aided learning as it needs practice. He said: "Probably not because I already got used to the old way of this sort of face to face teaching and sometimes I think it is taking extra time to prepare computer things so until some people give me a good example can convince me. " The seventh participant also mentioned that computer aided teaching in fact consumed more time as course material needs to be designed carefully. The eighth participant agreed that online teaching helped him to save time.

Summary:

The lecturers who find it challenging to adopt computer aided teaching do not find any time savings as a result of the method, however some do feel that if they are learned with the computer technology, it may become efficient. Some lecturers who do use computers often find the method time saving.

6. Do you use computer aided learning tools in assessments such as blackboard?

To this the first participant responded that he did not use computer aided tools for doing assessments, but he did use them to upload assessment results for students. The second participant used blackboard technology for submission of assignments, but not for assessment purpose. The third participants did use computer aided tools in assessments. The fourth participant used the computer aided tools in non-controlled assessments that were not marked in the final grade of students. The fifth and sixth participants did not use computer aided tools for assessment. The seventh participant did not use blackboard, but used online tests for assessments. He said:" I haven't used blackboard in assessment. I have used I have certainly had students work on develop software during a test in a live environment." The eighth participant also used computer aided learning for uploading marks and not for assessment purpose.

Summary:

None of the lecturers used technology such as blackboards for assessment purpose, however some used blackboard to upload the assignments. Some lecturers use technology for online tests that are not part of the final grade.

7. Do you think your students benefit from computer aided learning? If so, in which way?

In response to this question, the first participant agreed that students will benefit from computer aided learning since they will have an access to additional resources. He quotes, "Well they

have access to more resources, yes they do benefit and they have access to more resources that way. Yeah" The second participant also agreed that students will benefit from online learning since it helps them to revise the taught concepts and also provides them access to many resources. The third participant did not answer this question. The fourth participant agreed that students could benefit from computer aided learning since it would help them to supplement lecture teaching with more learning materials. The fifth participant said that he did not see any specific benefit for students from online learning. The sixth participant mentioned that it may benefit the students as students find it very useful for them. The seventh and eighth participants mentioned that students may benefit from online learning.

Summary:

Six out of 8 lecturers feel that students do benefit from online learning since they are exposed to additional learning material that helps them in learning. They also get access to learning material that can be revised multiple times to enhance their learning.

4.6 Discussion

As reported earlier, 27 student participants studied computer or IT courses at school for more than 2 years, 9 for less than 1 year, 7 for 1-2 years and 7 did not study IT or computer courses at school. The proficiency level of students in computers and IT is an important factor that can affect their performance outcome for e-learning courses as use of e-learning technology requires some level of expertise in accessing and interpreting computer systems and therefore this factor will play an important role in finding out the comfort level of students with e-learning technologies and their performance. It may happen that 7 of the students who did not study computer courses at the school may face some kinds of problems in e-learning activities that may have affected their performance, but such an analysis is beyond the scope of this study.

Twenty of the student participants said that 50-75% of their computer science course is based on computer aided learning such as online tutorials, quizzes, lecture notes, instructional materials, and other techniques, 14 of the participants said that 75-100% of their computer course was based on computer aided learning aids, while 10 of them said that 25-50% of their computer course was based on computer aided learning aids, 8 of the participants said that 0-25% of their computer course was based on computer aided learning aids. The performance of students on e-learning courses may also depend on the percentage of course that is depending on e-learning in comparison to traditional learning. For students who have 75-100% of their course through online learning, the teaching methodology and learning techniques will vary from those who have 25-50% of their courses through e-learning and those with 0-25% of courses delivered through e-learning.

As mentioned in the literature review, one of the concerns is that e-learning as a method is lacking direct face-to-face interaction, and that this face-to-face interaction between students and teachers is key to better education. This was one of the main problems in acceptance and promoting e-learning method of teaching in mainstream classroom. Some of the students may favour traditional teaching methods in comparison to modern e-learning methodologies and therefore course content with a balanced or higher percentage of traditional technologies may help them. However, they may be deprived of the benefits of using e-learning technologies that allows them to access course material when needed and also repeatedly listen to lectures. Seven lecturers reported that 25-50% of the computer science course is currently based on computer aided learning, 6 lecturers said that 50-75% of the computer science course is currently based on computer aided learning, 2 lecturers said that 0-25% of the course was based on computer aided learning and only 1 of them said that 75-100% of the computer science course was based on computer aided learning. It is clear that some proportion of the computer science courses are currently including computer aided learning which makes it clear that both lecturers as well

as the students consider the benefits of computer aided learning as advantageous for student learning.

Majority of the student participants (23) said that they would prefer 50-75% of their course material based on computer aided learning techniques such as online tutorials, quizzes, lecture notes and instructional materials, 14 of the students suggested that 75-100% of their course material should be based on computer aided learning, 10 of them suggested that 25-50% of their course should be based on computer aided learning and 3 of them preferred 0-25% of their course based on computer aided learning. Majority of the students are in favour of computer aided learning as they do wish to have some part of their course in the form of e-learning which indicates a high level of acceptance of e-learning technologies and their benefits among the computer science students and their inclination towards using these technologies for educational purpose.

When asked if computer education using computer aided learning will allow students to develop a better understanding of the subject in comparison to traditional teaching, the students responded that it would help them in a better manner since they will be able to access the course material all the time and can revise it when needed. Some of them expressed concern over inability of computer aided learning to provide understanding that was comparable to traditional teaching since all things could not be explained via computer aided learning. Eleven of the lecturer participants did agree that learning computer science through computer aided learning will help their students in developing a better understanding of the subject in comparison to traditional teaching methods. Rest of the lecturers reported that efficacy of computer aided learning depends on the learning style of students and that there should be healthy mixture of traditional learning and computer aided learning methods. One of the lecturers also said that it depends on the subject and computer aided learning may depend on whether the subject is theoretical or practical in nature. The results of inputs provided by the

lecturers are similar to those of the students. The efficiency of computer aided learning will therefore depend on the learning style of students and their comfort level with computers. It is true that computer aided learning has its advantages for students such as accessing course material all the time and ease of learning, however such methods may not be favourable for all the students. Therefore some proportion of online learning or computer aided learning needs to include theoretical or traditional teaching methods to help students in better understanding of concepts that cannot be explained through computer aided learning.

Most of the students felt that computer aided learning could lead to distractions which was because of student access to internet with availability of social networking websites at their disposal. Some students indicated that no such distractions affected them in computer aided learning. The students have a mixed thinking about the advantages of using e-learning technologies for educational purpose. The most common advantages of e-learning technologies such as ready accessibility of course material, repetitive lectures to enhance learning and facility to solve computer problems on digital devices is considered positive by many students since they feel that these could help them in improving their academic performance. However, e-learning technologies do have some disadvantages as well since students tend to be distracted through the use of social media networks, online media and instant messaging systems that have been known to have a detrimental impact on student academic performance. Some of the previous research studies such as those by (Fox, Rosen, & Crawford, 2009) have recorded the negative impact of instant messaging applications on the academic performance of students. Another research study by (Jacobsen & Forste, 2011) has indicated a negative relationship between the use of various types of electronic media by first year university students and their academic performance. Therefore, the students are justified in their concerns for the negative impact of e-learning methodology on their academic performance since it increases the risk for higher social media and instant messaging applications. Majority of the lecturers agreed that

using computer aided learning may lead students into distractions, rest of them said that it depended on the materials and methodologies used by lecturers. Some of the advantages of computer aided learning as pointed out by lecturers include easy to access study material any time, creative discussions by students and interest generated about the study topics. These observations are consistent with the past research literature.

Almost all the lecturers agreed that computer aided learning could prevent the students from attending classes and they tend to not spend time in classrooms and rely only on computer aided learning which may affect their academic performance. This indicates that computer aided learning may have a negative impact on the student academic performance as indicated in the earlier research studies as well. Since lecturers were more concerned about the negative impact of computer aided learning, they preferred traditional teaching methods.

Forty three of the students felt that computer aided learning made the course more exciting and interactive. The students felt that computer aided learning made it interesting to participate in online discussions, interact with their peers and instructors online and also access the class material at any time. This indicates the positive impacts of e-learning advantages for university students and the benefits of using these technologies to enhance participation among the university students. These results are consistent with the previous research study by (Liaw, 2008) on e-learning that has proved usefulness and satisfaction with e-learning technologies tend to motivate the university students to use the technology for learning purpose.

Forty three of the students felt that learning computer science through computer aided learning would prepare them better for work after graduation. Some of them felt that it depended on what stream they would take after graduation. Students felt that computer aided learning would provide them with the necessary experience to operate computers since it was used in most organizations. According to the survey, 13 out of 16 lecturers agreed that computer aided learning could help their students prepare themselves for work after graduation. Some of the

lecturers said that it is never their aim during teaching computer science through computer aided learning. Computer science is a very broad area and it is not certain which part of the course will be useful for the students in the future. Since computers are used everywhere, the lecturers did agree that computer based learning is likely to benefit the students. The inputs provided by lecturers as well as the students are similar in the fact that both agree that computer aided learning can train the students better for work conditions in the future as computers are commonly used in organizations and a proficient use of computers can be therefore advantageous for the students. A research article by (Hrastinski, 2008) has provided great detail about the perceived benefits of e-learning technologies for students. The results of the current study are thus consistent with the research literature in the sense that e-learning technologies are highly recommended for professional growth and development in organizations.

When asked if student exams should be computer based, more than 50% students felt that exams could be computer based. Nineteen of them suggested that exams should take place in the traditional manner since some students are not habitual with typing and may face technical errors. One of the students suggested that exams should be both traditional as well as computer based. These observations are related to an earlier research study by (Zhang, Zhao, Zhou, & Nunamaker Jr, 2004) which states the advantages and capabilities of e-learning technologies in comparison to traditional classroom teaching methods, but writes clearly that e-learning technologies are not in a position to completely replace traditional classroom technologies. Some of the students may still face technical issues for e-learning technologies including some of them that may not be able to adjust with e-learning technologies due to their learning style.

In response to the question if student exams should be computer based, more than 8 of the lecturers disagreed with the idea. They felt that certain areas in computer programming require coding or theory, and therefore cannot be computer based. The lecturers did not see any specific advantage in seeing the exams as computer based. The lecturers suggested that exams could be

a combination of theoretical and online computer based exams. In comparison to the students, majority of the lecturers do not see any advantage in making exams computer based. It is clear that lecturers do not consider the advantage of e-learning over traditional teaching and evaluation methods.

Some of the obstacles that prevent lecturers from adopting e-learning for teaching purpose include lack of adequate training for lecturers for using latest technology for e-learning purpose. Another obstacle in adopting computer aided learning is that some of the lecturers may not be well accustomed to using computers for teaching purpose. Budgetary constraint is another obstacle in adopting computer aided learning. Necessary grants and budgets need to be allocated in order to make technical devices available for e-learning in university set-ups.

The lecturer participant's resolved obstacles related to technology and device use by referring to search engines like google or asking others for help. The participants used Google to find out solutions to errors or difficulties faced during computer aided learning. This throws light on the necessity of lecturer training for using technical devices.

The way e-learning helped lecturers to manage their time effectively was closely related to their comfort level with the new technology. For lecturers that did not know how to use computers and other devices, e-learning consumed comparatively more time than traditional teaching methods. Lecturers showed lesser enthusiasm towards e-learning since they felt that it would be more time consuming and less helpful for the students.

When asked if lecturers used e-learning for assessment purpose, most of them preferred to use blackboard technology for uploading assignments and results, rather than assessment purpose. Most of the participants did agree that e-learning was beneficial for students in some ways such as referring many resources and expanding their knowledge. It is clear that both lecturers and students perceive the benefits derived from e-learning in a positive manner. Both students and lecturers recommend the use of traditional as well as e-learning methods for course curriculum

rather than solely traditional teaching or solely e-learning since each methodology has its own benefits for student learning. The outlook of lecturers towards e-learning is based on the fact that e-learning alone cannot substitute traditional teaching and that lack of contact is a major limitation of e-learning.

Chapter 5: Conclusion

The involvement of new technology in education is getting more adoption and acceptance, with this in mind and all factors that are stated the e-learning should be part of global education system. As mentioned by various studies the application of IT and other modern technology in the classrooms of New Zealand are presented as a method that offers a feasible learning environment for students. Interactions with students and modern technology have positively endorsed students' knowledge of science and for science. On contrary, lecturers didn't adopt e-learning and e-learning technologies as much as students. The understanding of modern technologies and IT used in e-learning and incorporating them in the teaching process in an efficient manner was not easy.

The challenges in creating best education environment using e-learning methodology are complex. The method and strategy of adopting e-learning should be debated and all current experiences involving e-learning and implementing in to education system should be considered. This past experience should help improve current state and improve future integration and adoption thereby increasing the process of acceptance. Process of integrating should be evaluated and limitations noted by lecturers should be considered and resolved, process should be more transparent and allow lecturers, students and industry to engage in this process. This collaboration and co-creating between lecturers, students and industry will create scientific data for improving and adopting of e-learning (Luehmann & Frink, 2009).

The modern technologies hold huge potential for the education system. These technologies have the potential to facilitate industry, lecturers, and students to create scientific knowledge in an innovative way.

As discussed in the literature review section, there are many differences between online learning and traditional classroom teaching. Online education allows better quality of education since majority of the interactions between the teachers and the students are recorded and can be audited later. Online education can be especially useful for computer science education since there is dearth of quality lecturers in technical education therefore making traditional teaching limited in its reach. While in traditional classroom teaching environment, it is the lecturer who is primarily responsible for preparation of the course curriculum and student assessment activities, in the online education settings, the technical department also plays an important role.

Online education saves a lot of time for teachers and makes them highly efficient for teaching. However in traditional teaching settings, time management may be an issue. In the current study, some of the lecturers who knew how to use online learning tools did agree that online teaching was time saving for them. In the research literature it is evident that online teaching helps in a better assessment of students. However from the current research it is found that most lecturers do not use online assessment tools for students and solely use online learning tools to upload assessment results.

The process of adapting e-learning is explained as the link among individual and new technology and his response regarding new technology used in learning process (Marton, 1986, in Stein et al., 2011). The same applies to students as well as lecturers using e-learning for educational purpose. Collaboration among students and teachers has been mentioned by Wenger et al. (2009) where he suggested that the collaboration should be made when creating the learning base for students. This aspect needs to be further developed in the context of online learning for computer science education in New Zealand. The learning base should be based in the context of the community. To ensure that the learning base performs as expected, it needs

to adapt to students' habits and actions (Anderson, 2008). Adequate measures are needed for implementation of online learning on a larger scale while addressing student needs.

Past research has been done by Moreno et al. (2007) on topic of acceptance of e-learning method in Australia. Where the results revealed that the lecturers had concern that e-learning over the web will induce lack of communication with other students and about the lack of creativity and that e-learning will affect the way knowledge is shared among students. Similar concerns were raised by computer science lecturers over the use of e-learning over traditional classroom education.

Another research done in China (McConnell & Zhao, 2007, in Stein et al., 2011) regarding the use of IT technologies in teaching methods and cooperative teaching, it was established that the learning had significant value to the lecture and way the students accepted the knowledge. Similar observations were made in the current study as well since students did prefer traditional classroom teaching along with online learning.

A study carried out in Bahrain (Jamlan, 2004) has found that developing infrastructure for e-learning requires large investment not only for technology and mainframe infrastructure. This was also indicated by lecturers in the current study when they mentioned that online education demanded significant investment which was a challenge for its implementation. The same was addressed by using mobiles for e-learning purpose.

According to research conducted by Marshall (2010), in order to apply e-learning methods in the tertiary education in New Zealand, organizational and practical issues need to be resolved, factors such as Time of exposure; Lack of expert leadership; Planned strategy and operation outcomes; Lack of motivation and support; and Risk acceptance affected e-learning implementation. Lack of lecturer training did emerge as a challenge for adoption of e-learning in the current research study. *The effectiveness of the ICTs the teachers used to support learning about landforms and erosion of rocks depended on more than teachers knowing how to use*

technology. It also required of them how to use it to support the specific learning needed for the earth science" (Otrel-Cass, Cowie, & & Khoo, 2010, p. 21).

5.1 Limitations of Study

One of the limitations of the current research study is that it is restricted to the computer science students in New Zealand tertiary institutions. Therefore, it does not cover the perception of students from other courses such as biology, business studies etc. in relation to e-learning. An important factor for computer science students is that a substantial amount of their course curriculum is related to e-learning. This may not be true for students of other courses and therefore results may vary for the same study being conducted for students of other courses enrolled in New Zealand tertiary institutions. Additionally, the perception of tertiary institution students towards e-learning will also depend heavily on the quality of e-learning initiatives provided to the students. The quality of e-learning initiatives has not been assessed as a factor in the current research study. Also, substantial difference may exist for factors affecting e-learning in New Zealand and countries, depending on the facilities for e-learning. Such an assessment is beyond the scope of this study.

The sample size of 50 used for tertiary students in New Zealand may not represent the behaviour and perception of all computer science students towards e-learning and therefore the results of this study cannot be generalized for the entire population. The research study does not take into account the impact of cognitive factors on e-learning initiatives. Student learning styles that also may have a direct impact on the efficacy of e-learning have not been considered in the current case study. The sample size of 24 lecturers is also very small to make any generalized viewpoint for lecturer's opinion about e-learning and its impact on student academic performance.

The current case study does not draw a comparison about the utility of various devices used in e-learning with no study conducted on the use of various digital devices used by students for e-learning purpose.

5.2 Future Work

In the current study the impact of e-learning on computer science students have been considered. Future studies on e-learning can assess the impact of e-learning on students from various academic courses and assess if course curriculum has any relation with the efficacy of e-learning activities for students. The current research study does survey university students asking them if they would prefer e-learning over traditional forms of learning, but does not separate student groups into separate groups for e-learning and traditional learning.

As per research study conducted by (Hairston & Nafukho, 2015), a statistically significant difference existed between the students subjected to e-learning versus traditional learning methods. The traditional group according to the study was more satisfied in comparison to the e-learning group for aspects such as general course program schedule and overall course satisfaction rate. The results of this research study established the preference of e-learning group as well as traditional learning group towards computers. Future research studies on e-learning can be conducted with a larger sample size with more than 100 students and a control group of traditional learning can be compared with e-learning activities so that more details about the advantages and the impact of e-learning methods on student learning can be known.

According to another research by (Hamid, Waycott, Kurnia, & Chang, 2015), social networking technology can be used for student teaching by integrating social technologies in course curriculum thus allowing teachers to use for educational activities. It concluded that students using online social networking websites for educational purpose had a positive learning outcome. Social networking technologies have the power to enhance student learning and experience (Hamid, Waycott, Kurnia, & Chang, 2015). However, only limited number of

studies have investigated the use of social media technologies for student learning and assess their impact on the efficacy of student learning and their academic performance in comparison to the traditional teaching methodologies. Therefore further research is needed to assess the use of social networking technologies with e-learning methods in order to assess their utility for computer science students and students enrolled in other academic courses.

The present research study does not consider the impact and utility of mobile devices for e-learning activities. A research study by (Atallah, Tamim, Colburn, & Saadi, 2015) investigates the student perceptions of advantages obtained by using iPad for learning activities, the challenges faced by them while using the device for educational activities and their preferences for using the device in order to enhance their learning activities. In the future studies, the impact and utility of mobile devices such as iPad and iPhone can be considered in relation to e-learning efficiency for university students.

The current study does take into account the student knowledge of information technology and computers, but does not estimate their level of expertise in using digital devices. Research conducted by (Mohammadyari & Singh, 2015) has studied the impact of digital literacy on the performance of individuals and efforts required for e-learning activities. The study has been conducted on accountants in New Zealand that are involved in e-learning activities. Further research studies can therefore assess the expertise level of computer science students in using computers for e-learning purpose and investigate if variation in the level of knowledge and expertise interferes with their e-learning activities. Therefore future research studies need to consider the expertise of students using computers for e-learning activities.

The current research study does not consider the impact of using online educational games for e-learning purpose, on the academic performance of students. A research study by (Hung, Young, & Lin, 2015) conducted in Taiwan has attempted to create a game based learning

environment for English speaking classes and reduce the achievement gap for poor performing students. The research study was conducted on school students and concluded that interactive online games had the potential to enhance the academic performance of students. Future research studies on e-learning for computer science students can therefore analyse the impact of online interactive games in order to enhance the academic performance of computer science students.

It is important to study the factors that affect the student use or avoidance of e-learning technology. A research study by (Tosuntaş, Karadağ, & Orhanb, 2015) has explained the factors that affect the acceptance and use of online teaching technology such as whiteboard by high school teachers. The results of the study indicate that performance expectations, effort expectations and social influence positively affect their acceptance and use of technology. Future research studies can investigate the impact of various factors affecting the use of specific e-learning technologies by high school as well as tertiary lecturers.

The current research study does not consider the role of personalized or customized e-learning in improving the academic performance of computer science students. Research studies such as (Chang, Kurcz, El-Bishouty, Kinshuk, & Sabine, 2014) have identified the role of working memory capacity (WMC) as a cognitive aspect that affects the attitude of students to perform cognitive tasks. WMC is often over-loaded in traditional learning activities and therefore integrating WMC in online learning activities can balance the overload and thus positively affect student learning. Further research studies can investigate the factors that contribute to higher WMC load for tertiary students and then suggest measures in order to optimize this load and improve student performance. Another research study conducted by (Bernard & Bachu, 2014) has studied the impact computer aided collaborative learning on the academic performance and engagement of students in academic activities. The study claims that computer aided collaborative learning improves the metacognitive skills of students. Further

research studies on e-learning can therefore assess the impact of e-learning activities on the cognitive abilities of the computer science students in comparison to the traditional teaching methods.

The current research study does not take into account the quality of e-learning initiatives offered by the university. A study by (Martı´nez-Caro, Cegarra-Navarro, & Cepeda-Carrio´n, 2014) aims to identify an effective model of e-learning while taking into account quality management initiatives that are essential to ensure superior quality of e-learning initiatives by universities. Future research studies on e-learning for computer science students can therefore survey student rating of the quality of the e-learning methods and applications and their role in student learning.

The current research study does not take into account the impact of learning styles on the efficiency of e-learning activities and their academic performance. Research studies such as (Seyal & Rahman, 2015) have found the impact of student learning style, their attitude towards e-learning technologies and their behavioural intention to use such technologies for academic purpose. Future research studies should therefore assess the student learning styles and correlate them with their use of e-learning activities and their academic performance. Such studies will contribute a great deal in enhancing the design of e-learning course material for students with different learning styles and will thus help educators in addressing gaps in academic performance.

The current research study is focused on assessment of impact of e-learning initiatives on tertiary students in New Zealand region only. Further research studies can assess and compare the efficacy and use of various e-learning technologies for computer science students in other countries. Comparison between the e-learning facilities may also be made between developed countries and developing nations.

The current research study does not assess the role of mobile based learning in e-learning activities for students. Further research studies on the subject can consider the role and efficiency of mobile phones in e-learning activities in New Zealand taking into consideration the fact that a large proportion of students in New Zealand have access to internet enables smartphones that can support e-learning applications.

Future research studies may also investigate the impact of student creativity on their performance using e-learning applications. Creativity is considered as an important aspect for success in a highly competitive human society. Research studies have suggested that with the use of blended techniques in e-learning, student creativity can be enhanced (Wegerif, Li, & Kaufman, 2015). Such study will help lecturers in designing e-learning curriculum that fosters student creativity and positively affect their academic performance.

The current research study does study the motivations that make students adopt e-learning technologies to some extent. However, a detailed analysis in future studies is needed to investigate the relative impact of various motivation factors in order to segregate the important and non-important factors that motivate students for e-learning.

The current research study does not take into account the strategies used by students to enhance their academic performance through e-learning. Further research studies can therefore record the experiences of students with e-learning while focusing on those students who initially faced challenges with e-learning and later were able to address these challenges. The future research study can then assess the role of various factors in helping them overcome the challenges faced by them during e-learning.

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Appendixes

Appendix A: Ethical Approval

AUT UNIVERSITY
TE WĀNANGA ARONUI O TAMAKI MAKAU RAU

A U T E C
S E C R E T A R I A T

18 November 2014

Sergiy Klymchuk
Faculty of Design and Creative Technologies

Dear Sergiy
Re Ethics Application: **14/347 Investigating the ways of how e-learning enhances teaching and learning of computer science in New Zealand.**

Thank you for providing evidence as requested, which satisfies the points raised by the Auckland University of Technology Ethics Committee (AUTEC).
Your ethics application has been approved for three years until 17 November 2017.
As part of the ethics approval process, you are required to submit the following to AUTEC:

- A brief annual progress report using form EA2, which is available online through http://www.aut.ac.nz/researchethics. When necessary this form may also be used to request an extension of the approval at least one month prior to its expiry on 17 November 2017;
- A brief report on the status of the project using form EA3, which is available online through http://www.aut.ac.nz/researchethics. This report is to be submitted either when the approval expires on 17 November 2017 or on completion of the project.

It is a condition of approval that AUTEC is notified of any adverse events or if the research does not commence. AUTEC approval needs to be sought for any alteration to the research, including any alteration of or addition to any documents that are provided to participants. You are responsible for ensuring that research undertaken under this approval occurs within the parameters outlined in the approved application.
AUTEC grants ethical approval only. If you require management approval from an institution or organisation for your research, then you will need to obtain this.
To enable us to provide you with efficient service, please use the application number and study title in all correspondence with us. If you have any enquiries about this application, or anything else, please do contact us at ethics@aut.ac.nz.
All the very best with your research,

Kate O'Connor
Executive Secretary
Auckland University of Technology Ethics Committee
Cc: Naif Aldhahri tvs0449@aut.ac.nz; Krassie Petrova

Appendix B: Participant information sheet (survey)

Participant Information Sheet

Date Information Sheet Produced: 10 November 2014

Project Title

Investigating the ways of how e-learning enhances teaching and learning of computer science in New Zealand.

An Invitation

My name is Naif Aldhahri. I am a Masters student of Computer and Information Systems at AUT University. Currently I am doing my Master's thesis.

This is an invitation to join in a research project to investigate the ways of how e-learning enhances teaching and learning of computer science in New Zealand. The project is being led by Sergiy Klymchuk, Associate Professor, School of Computer and Mathematical Sciences. The findings will be disseminated among all participants; the wider community will have access to my master thesis published online.

What is the purpose of this research?

This research focuses on using computer based instruction for introductory computer science practical courses at tertiary level. By doing this research the researcher will enhance his understanding of the e-learning and participants will reflect on their own practice of teaching/learning of computer science.

How was I identified and why am I being invited to participate in this research?

You have been identified as a potential participant due to the nature of your work/study.
As university computer science lecturer/student you possess the knowledge and experience required to undertake this research.

What will happen in this research?

Questionnaires – The participants will be handed a short questionnaire related to the nature of this research. Participation is voluntary and anonymity of the participants will be maintained.

What are the discomforts and risks?

Care will be taken to ensure that discomforts and risks are minimum. Participants will merely have to share their opinions and views of e-learning by being surveyed.

How will these discomforts and risks be alleviated?

Anonymity of the participants will be maintained.

What are the benefits?

The results of the study might be applied to the e-learning activities and might prompt towards the needs of more research in this area. The participants will reflect on their own practice of teaching/learning of computer science and develop a better understanding of e-learning and its advantages. This research will also allow me to complete my Masters' degree.

How will my privacy be protected?

Anonymity and confidentiality will be maintained for questionnaires. Data collected will be kept secure by the researcher.

What are the costs of participating in this research?

There are no costs involved in participating in this research.

What opportunity do I have to consider this invitation?

The details of the research will be e-mailed to the lecturers for questionnaires. The students will be invited to fill student questionnaire online by their lecturers

How do I agree to participate in this research?

By filling the questionnaire you give us your consent to participate in this project

Will I receive feedback on the results of this research?

Feedback will be ongoing throughout the project, and is an essential component of the collaborative approach.

What do I do if I have concerns about this research?

Any concerns regarding the nature of this project should be notified in the first instance to the Project Supervisor, Sergiy Klymchuk, Associate Professor, School of Computer and Mathematical Sciences. Email address: sergiy.klymchuk@aut.ac.nz Phone: (09) 921 9999 ext. 8431

Concerns regarding the conduct of the research should be notified to the Executive Secretary of AUTEC, Kate O'Connor, ethics@aut.ac.nz , 921 9999 ext 6038.

Whom do I contact for further information about this research?

Researcher Contact Details:
Naif Aldhahri
Email Address: tvs0449@aut.ac.nz
Mobile: 022-2444402

Project Supervisor Contact Details:

Sergiy Klymchuk, sergiy.klymchuk@aut.ac.nz, phone (09) 9219999 ext. 8431.

Approved by the Auckland University of Technology Ethics Committee on 18 November 2014,
AUTEC Reference number **14/347**

Appendix C: Participant information sheet (interview)

Participant Information Sheet

Date Information Sheet Produced: 10 November 2014

Project Title

Investigating the ways of how e-learning enhances teaching and learning of computer science in New Zealand.

An Invitation

My name is Naif Aldhahri. I am a Masters student of Computer and Information Systems at AUT University. Currently I am doing my Master's thesis.

This is an invitation to join in a research project to investigate the ways of how e-learning enhances teaching and learning of computer science in New Zealand. The project is being led by Sergiy Klymchuk, Associate Professor, School of Computer and Mathematical Sciences. The findings will be disseminated among all participants; the wider community will have access to my master thesis published online.

What is the purpose of this research?

This research focuses on using computer based instruction for introductory computer science practical courses at tertiary level. By doing this research the researcher will enhance his understanding of the e-learning and participants will reflect on their own practice of teaching of computer science.

How was I identified and why am I being invited to participate in this research?

You have been identified as a potential participant due to the nature of your work/study.
As university computer science lecturer you possess the knowledge and experience required to undertake this research.

What will happen in this research?

The interviews will be held face to face and/or via Skype and the participants will be selected lecturers from tertiary institutions in New Zealand. The interview is voluntary and will be held at a time suitable for the participant. The participant has the option of exiting the interview at any time. The interviews will be voice-recorded and transcribed by the researcher. The participants will have an opportunity to view and correct the transcriptions by receiving an email from the researcher attaching the transcript file.

What are the discomforts and risks?

Care will be taken to ensure that discomforts and risks are minimum. Participants will merely have to share their opinions and views of e-learning by being interviewed.

How will these discomforts and risks be alleviated?

Anonymity of the participants will be maintained. Skype interviews will be held as per the convenience of the participants.

What are the benefits?

The results of the study might be applied to the e-learning activities and might prompt towards the needs of more research in this area. The participants will reflect on their own practice of teaching of computer science and develop a better understanding of e-learning and its advantages. This research will also allow me to complete my Masters' degree.

How will my privacy be protected?

Anonymity and confidentiality will be maintained for interviews. Data collected will be kept secure by the researcher.

What are the costs of participating in this research?

There are no costs involved in participating in this research.

What opportunity do I have to consider this invitation?

The details of the research will be e-mailed to the lecturers for both questionnaires and interviews. Interview dates will be set as per the convenience of the participants. Participation is voluntary.

How do I agree to participate in this research?

By filling the questionnaire you give us your consent to participate in this project

Will I receive feedback on the results of this research?

Feedback will be ongoing throughout the project, and is an essential component of the collaborative approach.

What do I do if I have concerns about this research?

Any concerns regarding the nature of this project should be notified in the first instance to the Project Supervisor, Sergiy Klymchuk, Associate Professor, School of Computer and

Mathematical Sciences. Email address: sergiy.klymchuk@aut.ac.nz Phone: (09) 921 9999 ext. 8431

Concerns regarding the conduct of the research should be notified to the Executive Secretary of AUTEC, Kate O'Connor, ethics@aut.ac.nz, 921 9999 ext 6038.

Whom do I contact for further information about this research?

Researcher Contact Details:
Naif Aldhahri
Email Address: tvs0449@aut.ac.nz
Mobile: 022-2444402

Project Supervisor Contact Details:

Sergiy Klymchuk, sergiy.klymchuk@aut.ac.nz, phone (09) 9219999 ext. 8431.

Approved by the Auckland University of Technology Ethics Committee on 18 November 2014,
AUTEC Reference number **14/347**

Appendix D: Participant Consent form.

1 Consent Form

For use when interviews are involved.

Project title: ***Investigating the ways of how e-learning enhances teaching and learning of computer science in New Zealand***

Project Supervisor: ***Associate Professor Sergiy Klymchuk***

Researcher: ***Naif Aldhahri***

- ○ I have read and understood the information provided about this research project in the Information Sheet dated 10 November 2014.
- ○ I have had an opportunity to ask questions and to have them answered.
- ○ I understand that notes will be taken during the interviews and that they will also be audio-taped and transcribed.
- ○ I understand that I may withdraw myself or any information that I have provided for this project at any time prior to completion of data collection, without being disadvantaged in any way.
- ○ If I withdraw, I understand that all relevant information including tapes and transcripts, or parts thereof, will be destroyed.
- ○ I agree to take part in this research.
- ○ I wish to receive a copy of the report from the research (please tick one): Yes○ No○

Participant's signature:
.....
…
Participant's name:
.....
…
Participant's Contact Details (if appropriate):
……..
……..
……..
……..

Date:
Approved by the Auckland University of Technology Ethics Committee on 18 November 2014,
AUTEC Reference number **14/347**
Note: The Participant should retain a copy of this form.

Appendix E: Questionnaire for students

1. What is the institution you are studying at (please type):
2. Are you a domestic or international student (please tick one):

   Domestic International
3. What is your gender (please tick one): Male Female
4. What is your age group (please tick one): < 20 y.o. 20-25 y.o. > 25 y.o.
5. For how many years did you study computer/IT courses at school (please tick one):

   None < 1 year 1-2 years > 2 years
6. What proportion of your computer science course is approximately based on computer aided learning (online tutorials, quizzes, lecture notes, instructional materials, etc.)?
   A. 0-25%
   B. 25%-50%
   C. 50%-75%
   D. 75%-100%
7. What proportion of your computer science course would you prefer to be based on computer aided learning (online tutorials, quizzes, lecture notes, instructional materials, etc.)?
   A. 0-25%
   B. 25%-50%
   C. 50%-75%
   D. 75%-100%
8. Do you think learning computer science using computer aided learning will help you develop a better understanding of the subject as compared to traditional teaching? Please comment.
9. Do you think using computer aided learning can lead to distractions? Please comment.
10. Do you think computer aided learning makes the course more exciting and interactive? Please comment.
11. Do you think learning computer science though computer aided learning will help prepare you better for work after graduation? Please comment.
12. Do you think your exams should be computer based? Please comment.

Thank you very much for answering the questionnaire

Appendix F: Questionnaire for lecturers

1. What is the institution you are teaching at (please type):
2. What is your gender (please tick one): Male Female
3. What is your age group (please tick one): < 30 y.o. 30-50 y.o. > 50 y.o.
4. What proportion of your computer science course is currently based on computer aided learning (online tutorials, quizzes, lecture notes, instructional materials, etc.)?
    A. 0-25%
    B. 25%-50%
    C. 50%-75%
    D. 75%-100%
5. Do you think learning computer science using computer aided learning will help your students develop a better understanding of the subject as compared to traditional teaching? Please comment.
6. Do you think using computer aided learning can lead your students to distractions? Please comment.
7. Do you think computer aided learning makes the course for your students more exciting and interactive? Please comment.
8. Do you think learning computer science though computer aided learning will help prepare your students better for work after graduation? Please comment.
9. Do you think your exams should be computer based? Please comment.
10. Do you think that computer aided learning could prevent students attending classes? Please comment.

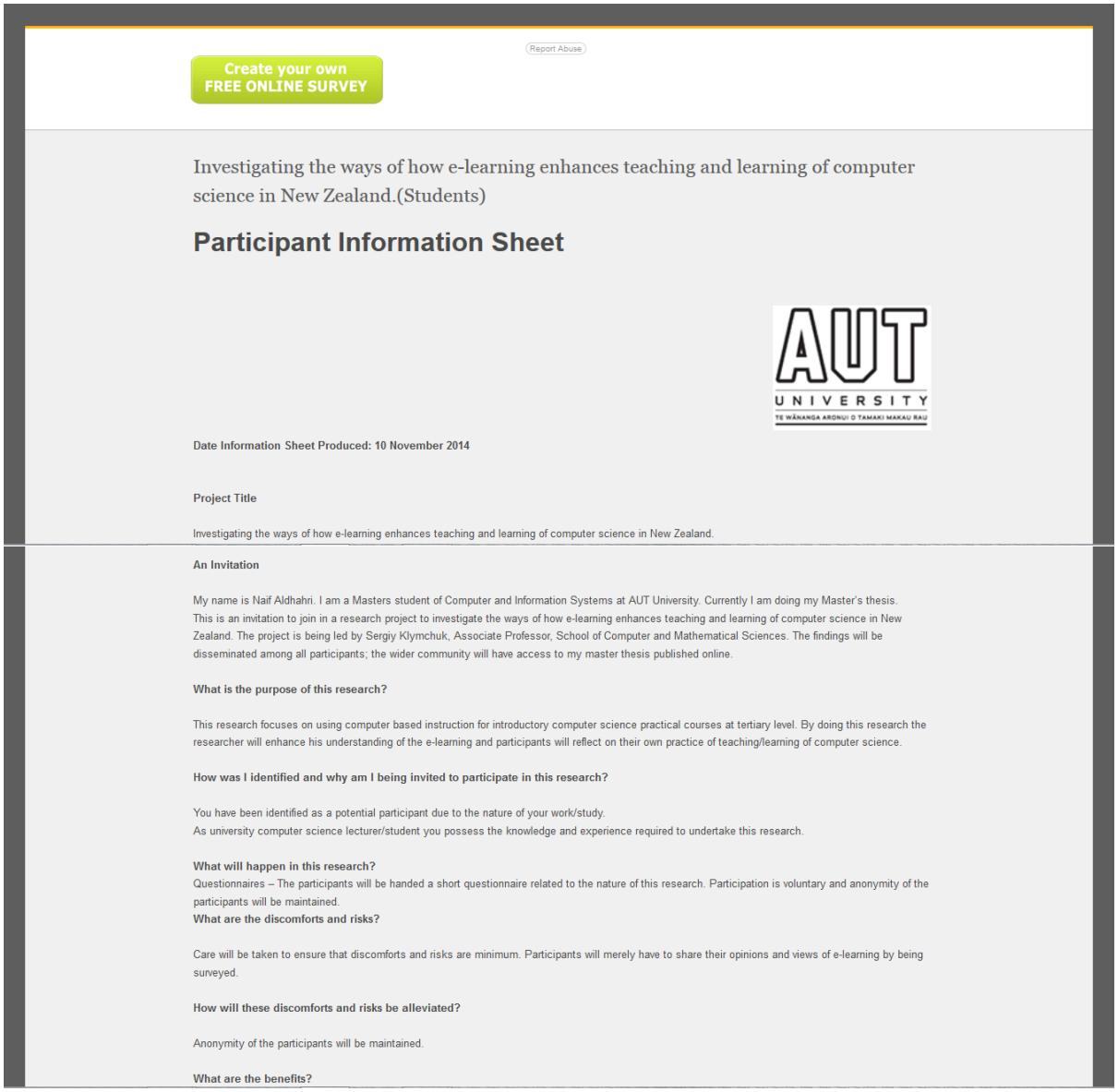
Thank you very much for answering the questionnaire

(After completing the questionnaire the lecturers will be asked on the Thank You page as below.

If you are willing to be interviewed either on Skype or face-to-face please type your name and e-mail address. Those details will not be connected with your answers to the questionnaire. Alternatively please e-mail the researcher that you are willing to be interviewed: tvs0449@autuni.ac.nz

Appendix G: Format of students questionnaire

Link: http://freeonlinesurveys.com/app/rendersurvey.asp?sid=yef6oe9hjlhkanq551996&refer=



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Investigating the ways of how e-learning enhances teaching and learning of computer science in New Zealand.(Students)

Participant Information Sheet

AUT UNIVERSITY
TE WĀNANGA ARONUI O TAMAKI MAKAU RAU

Date Information Sheet Produced: 10 November 2014

Project Title

Investigating the ways of how e-learning enhances teaching and learning of computer science in New Zealand.

An Invitation

My name is Naif Aldhahri. I am a Masters student of Computer and Information Systems at AUT University. Currently I am doing my Master's thesis. This is an invitation to join in a research project to investigate the ways of how e-learning enhances teaching and learning of computer science in New Zealand. The project is being led by Sergiy Klymchuk, Associate Professor, School of Computer and Mathematical Sciences. The findings will be disseminated among all participants; the wider community will have access to my master thesis published online.

What is the purpose of this research?

This research focuses on using computer based instruction for introductory computer science practical courses at tertiary level. By doing this research the researcher will enhance his understanding of the e-learning and participants will reflect on their own practice of teaching/learning of computer science.

How was I identified and why am I being invited to participate in this research?

You have been identified as a potential participant due to the nature of your work/study.
As university computer science lecturer/student you possess the knowledge and experience required to undertake this research.

What will happen in this research?
Questionnaires – The participants will be handed a short questionnaire related to the nature of this research. Participation is voluntary and anonymity of the participants will be maintained.
What are the discomforts and risks?

Care will be taken to ensure that discomforts and risks are minimum. Participants will merely have to share their opinions and views of e-learning by being surveyed.

How will these discomforts and risks be alleviated?

Anonymity of the participants will be maintained.

What are the benefits?

The results of the study might be applied to the e-learning activities and might prompt towards the needs of more research in this area. The participants will reflect on their own practice of teaching/learning of computer science and develop a better understanding of e-learning and its advantages. This research will also allow me to complete my Masters' degree.

How will my privacy be protected?

Anonymity and confidentiality will be maintained for questionnaires. Data collected will be kept secure by the researcher.

What are the costs of participating in this research?

There are no costs involved in participating in this research.

What opportunity do I have to consider this invitation?

The details of the research will be e-mailed to the lecturers for questionnaires. The students will be invited to fill student questionnaire online by their lecturers

How do I agree to participate in this research?

By filling the questionnaire you give us your consent to participate in this project

Will I receive feedback on the results of this research?

Feedback will be ongoing throughout the project, and is an essential component of the collaborative approach.

What do I do if I have concerns about this research?

Any concerns regarding the nature of this project should be notified in the first instance to the Project Supervisor, Sergiy Klymchuk, Associate Professor, School of Computer and Mathematical Sciences. Email address: sergiy.klymchuk@aut.ac.nz Phone: (09) 921 9999 ext. 8431

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Approved by the Auckland University of Technology Ethics Committee on 18 November 2014
, AUTEC Reference number 14/347

Survey

1 What is the institution you are studying at (please type):

2 Are you a domestic or international student (please tick one):

- ○ Domestic
- ○ International

3 What is your gender (please tick one):

- ○ Male
- ○ Female

4 What is your age group (please tick one):

- ○ < 20 y.o.
- ○ 20-25 y.o.
- ○ > 25 y.o.

5 5. For how many years did you study computer/IT courses at school (please tick one):

- ○ None
- ○ < 1 year
- ○ 1-2 years
- ○ > 2 years

6 What proportion of your computer science course is approximately based on computer aided learning (online tutorials, quizzes, lecture notes, instructional materials, etc.)?

- ○ 0-25%
- ○ 25%-50%
- ○ 50%-75%
- ○ 75%-100%

7 What proportion of your computer science course would you prefer to be based on computer aided learning (online tutorials, quizzes, lecture notes, instructional materials, etc.)?

- ○ 0-25%
- ○ 25%-50%
- ○ 50%-75%
- ○ 75%-100%

8 Do you think learning computer science using computer aided learning will help you develop a better understanding of the subject as compared to traditional teaching? Please comment.

9 Do you think using computer aided learning can lead to distractions? Please comment.

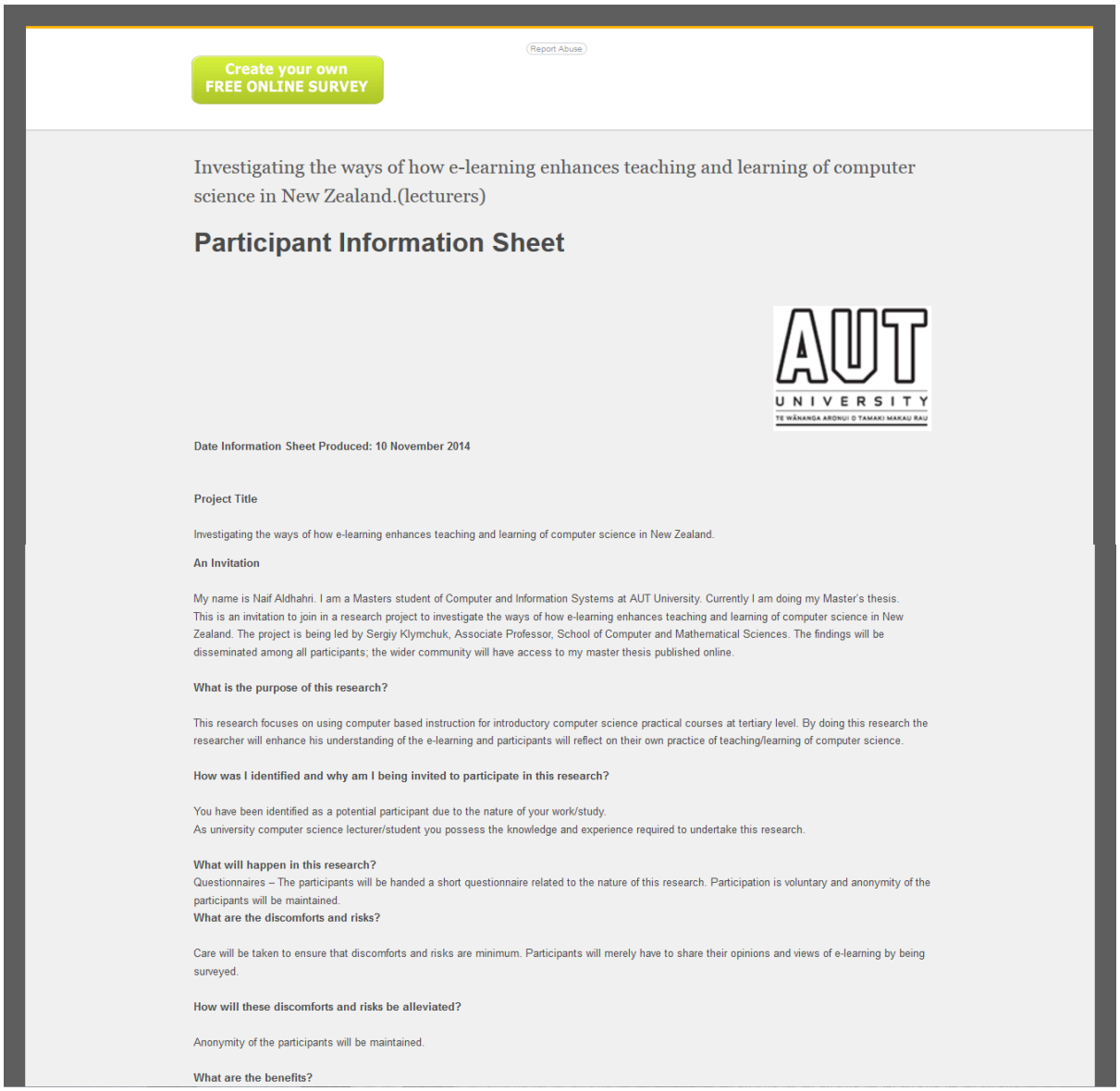
10 Do you think computer aided learning makes the course more exciting and interactive? Please comment.

11 Do you think learning computer science though computer aided learning will help prepare you better for work after graduation? Please comment.

12 Do you think your exams should be computer based? Please comment.

Appendix H: Format for lecturers questionnaire

Link: http://freeonlinesurveys.com/app/rendersurvey.asp?sid=l3npfx748kcpsh9547692&refer=



Create your own
FREE ONLINE SURVEY

Report Abuse

Investigating the ways of how e-learning enhances teaching and learning of computer science in New Zealand.(lecturers)

Participant Information Sheet

AUT UNIVERSITY
TE WĀNANGA ARONUI O TAMAKI MAKAU RAU

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How will these discomforts and risks be alleviated?

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The results of the study might be applied to the e-learning activities and might prompt towards the needs of more research in this area. The participants will reflect on their own practice of teaching/learning of computer science and develop a better understanding of e-learning and its advantages. This research will also allow me to complete my Masters' degree.

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What opportunity do I have to consider this invitation?

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How do I agree to participate in this research?

By filling the questionnaire you give us your consent to participate in this project

Will I receive feedback on the results of this research?

Feedback will be ongoing throughout the project, and is an essential component of the collaborative approach.

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Approved by the Auckland University of Technology Ethics Committee on 18 November 2014
, AUTEC Reference number 14/347

Survey

1 1. What is the institution you are teaching at (please type):

2 What is your gender (please tick one):

- ○ Male
- ○ Female

3 What is your age group (please tick one):

- ○ < 30 y.o.
- ○ 30-50 y.o.
- ○ > 50 y.o.

4 What proportion of your computer science course is currently based on computer aided learning (online tutorials, quizzes, lecture notes, instructional materials, etc.)?

- ○ 0-25%
- ○ 25-50%
- ○ 50-75%
- ○ 75-100%

5 Do you think learning computer science using computer aided learning will help your students develop a better understanding of the subject as compared to traditional teaching? Please comment.

6 Do you think using computer aided learning can lead your students to distractions? Please comment.

7 Do you think computer aided learning makes the course for your students more exciting and interactive? Please comment.

8 Do you think learning computer science though computer aided learning will help prepare your students better for work after graduation? Please comment.

9 Do you think your exams should be computer based? Please comment.

8 Do you think learning computer science though computer aided learning will help prepare your students better for work after graduation? Please comment.

9 Do you think your exams should be computer based? Please comment.

10 Do you think that computer aided learning could prevent students attending classes? Please comment.

Next Page

Appendix I: Indicative questions for interview

1. What obstacles do you have in adopting computer aided learning?
2. If you had some obstacles how did you overcome them?
3. Do you refer your students to online courses or materials of other institutions? If yes, what institutions? If not, why not?
4. Do you think that massive online courses is a threat to the existence of traditional tertiary institutions?
5. Does computer aided learning helps you to manage your time more efficiently?
6. Do you use computer aided learning tools in assessment?
7. Do you think your students benefit from computer aided learning? If so, in which way?