UNIVERSITY OF SOUTHERN QUEENSLAND

CHANGING STUDENT PERCEPTIONS OF INFORMATION TECHNOLOGY CAREERS: INVESTIGATING THE USE OF A TECH-SAVVY CAREER-FOCUSSED CURRICULUM FOR IT CAREER DEVELOPMENT WITH REGIONAL JUNIOR HIGH SCHOOL STUDENTS

A Thesis submitted by

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Abstract

The number of students enrolling in secondary Information Technology (IT) subjects within Queensland has shown a significant decline since the year 2000. Tertiary institutions have also experienced a significant decline in domestic enrolments in Australia. The decreases in student participation, as well as students' interest in considering IT careers, have reached a point where serious IT skills shortages have been forecast in Australia. According to Deloitte Access Economics and the Australian Computer Society, demand for IT workers is expected to grow by 100,000 by 2023. This will further strain Australian businesses trying to recruit IT workers to meet this demand.

All schools teaching foundation to year ten follow the Australian Curriculum developed by the Australian Federal Government and endorsed by each State. The Australian Curriculum Digital Technologies learning area focuses on problem-solving, often using coding. There appears to be a perception drawn from the current curriculum that IT equates to coding. The Digital Technologies learning area does not cover any specific content on IT careers. The Australian Curriculum of Mathematics and Science learning areas also demonstrate a lack of specific careers content. Providing students with specific knowledge about careers in these learning areas appears to be a current omission.

This thesis examines the factors influencing student perceptions affecting their choices of studying high school IT subjects and their consideration of an IT career. Factors from the literature align as social or structural. Social factors, especially gender and family, have been the focus of the majority of the research in this field. This research focuses on the structural factors (curriculum and teachers) due to the strong influence of these factors on student decision making about course selection related to IT subjects. Circumscription, Compromise, and Self-creation Theory is used to identify the developmental stage in a student's life, where structural changes may have the most significant impact on perceptions of IT careers. Social Cognitive Career Theory is also used to highlight the importance of a student's self-efficacy on influencing a student's interests and career choice goals.

The study examined the structural factors of curriculum change and teacher preparation for improving student perception about IT subject selection and IT careers. This was tested through the development of an IT curriculum using tech-savvy web-based teaching tools, focussing on developing a student's understanding of the depth and breadth of IT careers. This study involved implementing the IT Careers Curriculum at four schools in the Toowoomba region.

An Information Technology Careers Instrument (ITCI) was developed as part of the study to measure the change in students' perceptions of IT careers. All the IT classes at all four schools were surveyed before and after the implementation of the IT careers curriculum. The impact of the IT Careers Curriculum was also qualitatively measured through student focus groups and teacher interviews. The researcher participated directly by teaching the IT Careers Curriculum at one of the schools, and a self-reflection was undertaken of the IT Careers Curriculum during this time.

The quantitative data collected from the two surveys, before and after the students had undertaken the IT Careers Curriculum used Repeated Measures Analysis of Variance of the Pre and Post Test ITCI Means. The results of this analysis showed no significant improvement in student perceptions towards IT careers as a result of the IT Careers Curriculum. The qualitative data collected through focus groups of students and interviews with the teachers involved in the IT Careers Curriculum indicated a different result. The student focus groups and the teacher interviews indicated that the students' awareness and interest in IT careers had increased after undertaking the IT Careers Curriculum. This strong qualitative finding supported the key research question and provided a counterbalance to the quantitative findings. Reasons for this difference in results are discussed, as are implications for future research in this area.

This research has provided a fresh examination of Circumscription, Compromise and Self-creation Theory, and Social Cognitive Career Theory and the research into structural factors that influence student perceptions towards IT study and career choices. It is believed that this research assists researchers and policymakers to better understand the factors that influence students' IT study and career choices, and informs educational practitioners when developing programs aimed at increasing students' involvement in IT education and vocational pathways, by providing better awareness of the range of IT careers available beyond programming and technical support.

Certification of Thesis

This Thesis is entirely the work of Rohan Lyle Genrich except where otherwise acknowledged. The work is original and has not previously been submitted for any other award, except where acknowledged.

Professor Mark Toleman
Principal Supervisor

Dr David Roberts
Associate Supervisor

Student and supervisors signatures of endorsement are held at the University.

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Finally, thanks must go to my family, firstly to my wonderful wife, Jouwana, who came into my life mid-way through this journey and has provided me with such tremendous support through the good times and difficult times. To Mum, Dad and my brother Peter's family, thank you for your encouragement throughout this journey and understanding when I did not get up to visit as often as we would all have liked because of needing to focus on this study.

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Dedication

To Selwyn Genrich,

Dad, I miss you, and not having you there to see me graduate will be difficult, but I will take solace in the fact that I know you will always be proud of me.

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List of Abbreviations

Abbreviation	Full form
ACIS	Australasian Conference on Information Systems
ACDICT	Australian Council of Deans of ICT
ACPHIS	Australian Council of Professors and Heads of Information Systems
ACS	Australian Computing Society
AiG	Australian Industry Group (AiG)
ALTC	Australian Learning and Teaching Council
ANOVA	Analysis of Variance
AWPA	Australian Workforce and Productivity Agency
CASVE cycle	Communication – Analysis – Synthesis – Valuing – Execution cycle
GUI	Graphic User Interface
ICT	Information and Communications Technology
IPT	Information Processing and Technology
IoT	Internet of Things
IT	Information Technology
ITCI	Information Technology Careers Instrument
ITS	Information Technology Systems
LTCC	Krumboltz's Learning Theory of Career Counselling
MANOVA	Multivariate Analysis of Variance
NGT	Nominal Group Technique
OP	Overall Position (Queensland Tertiary Entrance Ranking)
PwC	Pricewaterhouse Coppers
SES	Socioeconomic Status
SCCT	Social Cognitive Career Theory
SCT	Social Cognitive Theory
SFIA	Skills Framework for the Information Age
STD. DEV.	Standard Deviation
STEM	Science, Technology, Engineering and Mathematics

STEM-CIS	Keir et al (2014) STEM Career Interest Survey
TAFE	Technical and Further Education
TV	Television
USQ	University of Southern Queensland

Chapter 1 Introduction

1.1 Research Problem

Information Technology (IT) education has been part of secondary schooling since the mid-1980s. IT education was initially part of the mathematics curriculum in the form of computer programming. With the increase in the number of computers within schools, more computer-based high school subjects were developed.

In Queensland, subjects in IT have been available for senior students (years eleven and twelve) to select since the early 1990s. These subjects have led to tertiary entry (tertiary eligible subjects), which resulted in schools selecting teachers who are well trained in the senior IT curriculum to teach these subjects.

Schools have also developed junior high school (years seven to ten) IT subjects. There has not been a high level of consistency between schools in the content of the junior high school IT subjects. These junior high school subjects have ranged from lessons focused on word processing, spreadsheeting, presentations, to gaming and animation, depending on the skillset of the school's teachers. The main focus of staffing IT subjects has been on recruiting skilled staff into the senior tertiary eligible subjects. There is an overall impression that the staffing for junior high school IT subjects appears to be on an ad-hoc basis, by staff with time capacity rather than overall skillsets.

The number of students enrolling in senior secondary IT subjects within Queensland has shown a significant decline (Figure 1: Information Technology Enrolment in Year 12 Queensland Schools (2000 – 2018) – Source: Queensland Curriculum & Assessment Authority 2019).

Students undertaking tertiary eligible (OP eligible) IT subjects declined by twenty-four percent from 2004 to 2018. Overall, the number of students undertaking any form of senior IT subjects declined by fifty-one percent from 2002 to 2018.

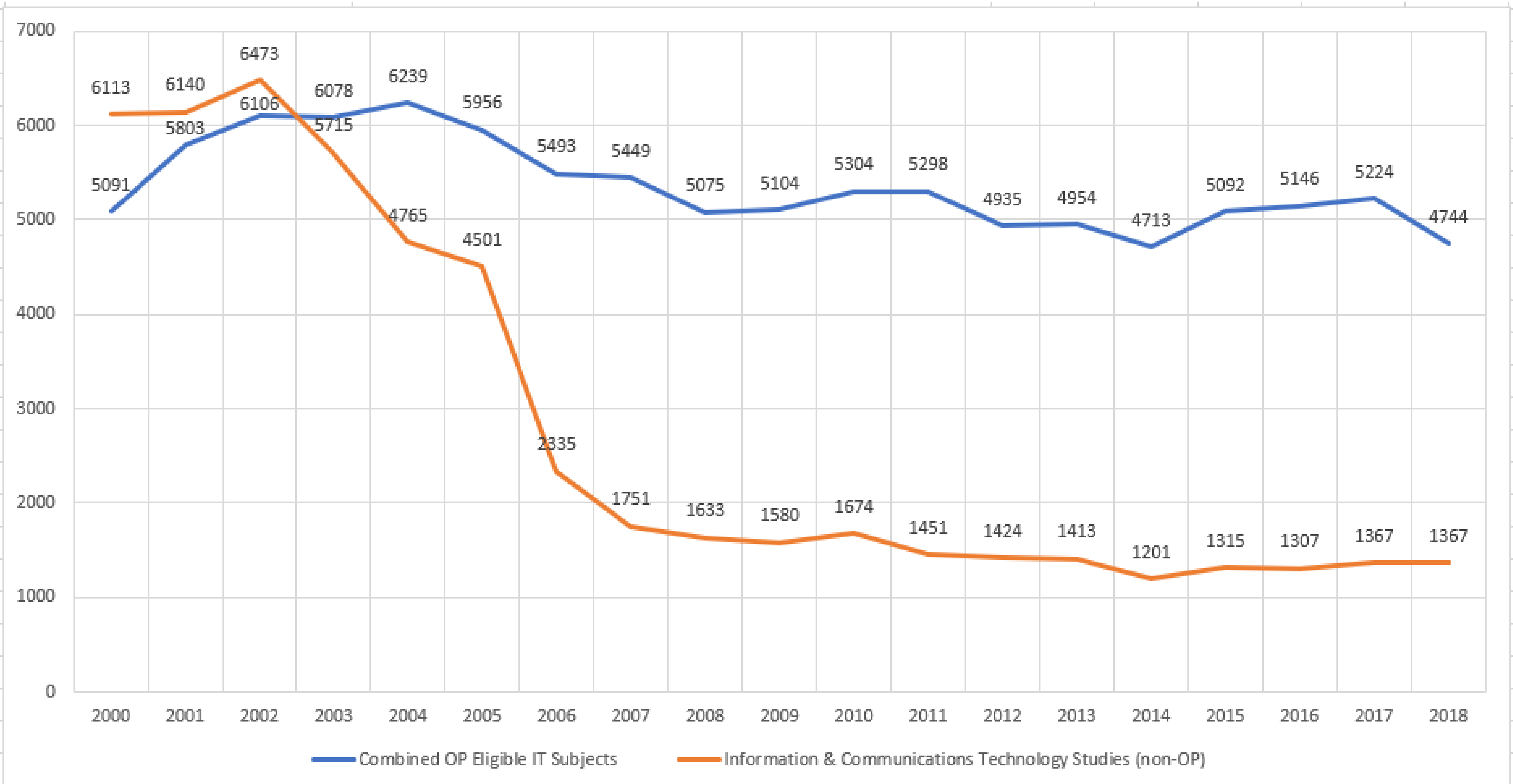


Figure 1: Information Technology Enrolment in Year 12 Queensland Schools (2000 – 2018)

The demand for qualified IT professionals in Australia has consistently been high, yet there has been consistently low numbers of IT university graduates (Downey et al, 2016; McLachlan, Craig and Coldwell-Neilson, 2016; von Hellens, Trauth and Fisher, 2012).

Schools play a critical role in shaping students' aspirations for Science, Technology, Engineering and Mathematics (STEM) careers (Holmes et al. 2018). However, recent studies of national enrolment patterns have indicated that student interest in these fields is in decline (Kennedy et al. 2014). Downs and Kleydish's (2007) study into enrolments for year twelve IT subjects in New South Wales, South Australia, and Victoria also revealed a similar substantial decline in most IT subjects in secondary schooling.

Vocational educational institutions and Universities also saw a significant decline in domestic enrolments between 2001 and 2008 of fifty-six percent across all of Australia (Figure 2: Australian Domestic University Enrolments in Information Technology (2001 – 2018) – Source: Australian Government, Department of Education and Training 2019). Since 2009, there has been a steady increase in domestic IT enrolments. Unfortunately, however, this growth has not been sufficient to reach the enrolment levels from 2000, with a shortfall of 2,538 students Australia-wide.

The decreases in student participation in school IT subjects and university IT courses, along with students' interest in considering IT careers, has reached a point where serious IT skills shortages have been forecast in Australia for roles that require a university degree in IT (Dobson 2007). According to a report by Deloitte Access Economics and The Australian Computer Society on Australia's 'digital pulse' in 2018, "demand for ICT workers is expected to grow by 100,000 between now and 2023, putting further strain on local organisations that have already been struggling to find the correct people with the right skills for several years" (Crofts 2019).

Over the past 20 years, the number of jobs in the Information Technology (IT) field has increased rapidly, increasing demand for qualified IT professionals. According to the European Commission (2017), the gap between supply and demand of IT skilled labour is likely to reach 500,000 by 2020. Catherine Livingstone, then Business Council of Australia President (and now Chair of the Commonwealth Bank of Australia) was quoted in the Sydney Morning Herald (Bagshaw 2015) from an address to the National Press Club as saying "as it stands in Australia, the gap between the digital literacy of our young people and that of our competitor nations is increasing. If we want increased productivity and participation, we need urgently to embark on a 10-year plan to close that gap".

Digital literacy is frequently reported as an area of high priority in school education systems internationally. Government authorities use the term digital literacy with little consistency and a lack of understanding of what the term really means. Often Information Technology knowledge and skills (particularly coding skills) are used as a surrogate for digital literacy, but these skills are only one component of digital literacy. This study uses the research of Fraillon et al. (2019) that Digital Literacy relates both to how students learn to use digital technologies and how they can use digital technologies in their learning across other domains. The Australian Federal Government has been proactive in addressing the concerns about Australia's gap in digital literacy through the release of the Australian Curriculum learning area of Technology for students from foundation school enrolment to year ten. Within the technology learning area, they have established a sub-learning area of Digital Technologies, which focuses on giving students knowledge, understanding and skills to "design, create, manage and evaluate sustainable and innovative digital solutions to meet and redefine current and future needs" (Australian Curriculum 2019a).

The Australian Curriculum learning area of Technology was endorsed in 2015, along with seven other learning areas for foundation school enrolment to year ten (Australian Curriculum 2019b). These learning areas have been implemented since their endorsement by each State and territory education authority.

Within primary schools, foundation to year six, each year level is required to provide their students with knowledge and understanding of content about the learning area of digital technologies, including developing an understanding of processes and production skills. By the end of year six, students will have had opportunities to create a range of digital artefacts, such as games or quizzes and interactive stories and animations (Australian Curriculum 2019a).

Most secondary schools offer students in years seven and eight the opportunity to undertake at least a term (one quarter of a year) of IT. The Australian Curriculum requires that by the end of year eight, students will have had the opportunity to work on activities such as "interactive web applications, or programmable multimedia assets, or simulations of relationships between objects in the real world" (Australian Curriculum 2019a).

Schools offer IT as an elective in years nine and ten. Those students who undertake this elective "will have the opportunities to analyse problems and design, implement and evaluate a range of digital solutions, such as database-driven websites, and artificial intelligence engines, and simulations" (Australian Curriculum 2019a).

The Australian Curriculum Digital Technologies learning area focus for foundation to year ten is on various types of problem-solving, often using coding. There appears to be a perception drawn from the current curriculum that IT equates to coding. As part of this research, students' perceptions of Information Technology have been thoroughly investigated.

The Australian Curriculum Digital Technologies learning area does not cover any specific content on IT careers. An analysis of the Australian Curriculum of Mathematics (Australian Curriculum 2019c) and Science (Australian Curriculum 2019d) learning areas' focus also demonstrates a lack of specific careers content. Providing students with specific knowledge about careers in these learning areas appears to be a current omission.

The research undertaken by Niles and Harris-Bowlsbey (2017) into student subject selection and career decisions outlines that both can be affected by experiences in life, deeply held values, self-knowledge, self-efficacy, and knowledge of careers. Adya and Kaiser (2005) also identify social factors (family, peer group, and media) and the structural factors (teachers and curriculum) that influence a student's self-efficacy and their outcome expectations of IT careers. Both studies have been used in this research to determine the factors best suited to influence student career decision making.

This research identified that the current Australian Curriculum provides students with the ability to gain self-knowledge and self-efficacy in digital technologies, but there is limited focus on giving them knowledge of careers in this field.

Professor Iwona Miliszewska, then President of the Australian Council of Deans of Information and Communications Technology, stated in her submission to the Australian Government Information and Communications Technology (ICT) Statistics Review (2015), the importance of providing accurate information about the various IT disciplines to students, parents and careers advisors for informed career decisions to be made. She attributed at least a partial lack of IT enrolments in higher education to poor and inaccurate IT career information. The Australian Government Department of Education, Skills and Employment (2019) list IT as essential to Australia's economy as part of their Delivering Skills for Today and Tomorrow report. The demand for IT professionals is projected to increase by 71,000 workers by 2024.

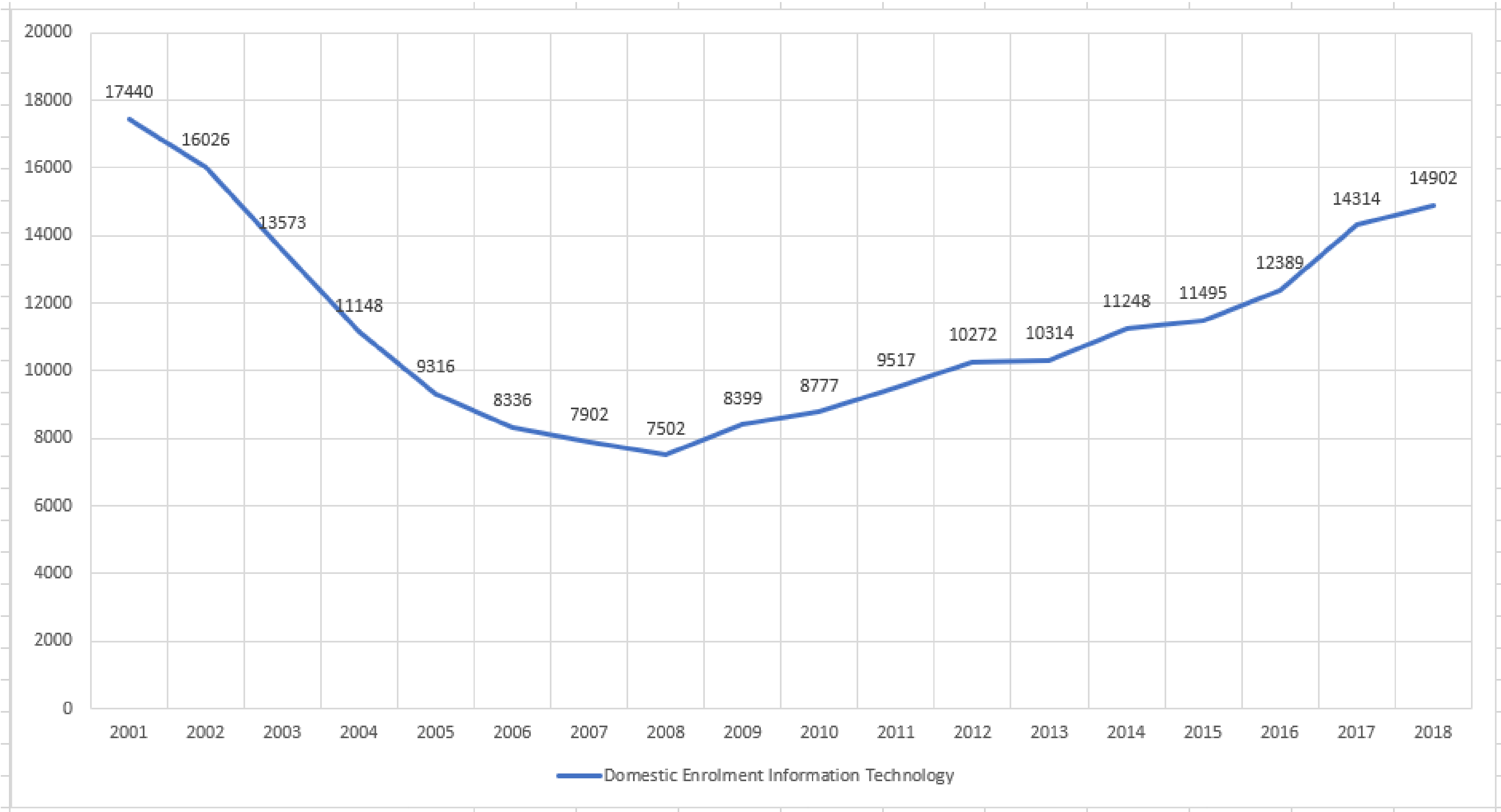


Figure 2: Australian Domestic University Enrolments in Information Technology (2001 – 2016)

1.2 Research Questions

The aim of this research was to investigate whether providing students with IT careers knowledge had an impact in their subject selection and career decisions, which in turn may have had an impact on IT enrolments for tertiary education.

The overarching research question that has been developed to address the aim of this research is:

> **How does an information technology career focused curriculum, using tech-savvy teaching tools, impact on year nine students' perceptions toward information technology careers?**

This research question will be further refined in the Literature Review chapter into a series of sub-questions, which will form the mixed methods research design, using both quantitative and qualitative research methods to address the question.

The investigation involved:

- the development of a tech-savvy curriculum unit with a focus on IT careers content that was tested in both private and public, suburban and rural junior high schools,
- the development of a survey instrument to measure the change in student perceptions towards IT careers upon completion of the IT careers curriculum,
- the quantitative analysis of the change in student perceptions to IT careers from before the IT Curriculum (Pre-Test) to after the IT Curriculum (Post-Test),
- the qualitative analysis of student perceptions of IT careers after the IT Curriculum, through focus group discussion, and
- the qualitative analysis of the IT class teacher's views of IT careers after the IT Curriculum, through interview discussion.

The term Tech-savvy has been defined in the Cambridge University Press (2015) dictionary as "Well informed about or proficient in the use of modern technology, especially computers". Numerous authors have used this term (Hechter and Vermette 2014; Walling 2012; Hockly 2012; Hicks 2011; Hwang and Jackson 2011). For this research, the term tech-savvy has been used to refer to the technology focus that has been given to the curriculum intervention developed for the research.

For the purpose of this research, the term junior high school refers to the phase of education in secondary schools for years seven to ten, which helps to ensure the bridge between primary and secondary school is safe, strong and consistent for all students (Queensland Government, Department of Education and Training 2015).

1.3 Background to the Research

Most of the academic research into student IT tertiary enrolments and career selection has focused on the gender imbalance between males and females in university enrolments and more broadly within the IT sector (Lynch 2009, Craig and Coldwell 2010 and Trauth et al. 2012). There has been little focus on the non-gender related issues of IT enrolments and career selection in senior secondary schools. Downes and Looker (2011) found that self-efficacy of computer use, both at school and at home, were key factors that influence students' (particularly females) plans to undertake computing and IT subjects in senior secondary school. Babin et al. (2010) found that parents were the strongest influences on a student's IT career decisions. Reid (2009) examined the gender gap in high school computing studies in Australia. Her findings were that while males appear to dominate the senior secondary school subjects, there was also a general decline in participation at all levels.

Koppi, et al (2013) focused their research on university students, examining the reasons for students' poor perceptions of IT, and gender imbalances leading to high levels of attrition in IT courses.

The key findings from all of these studies have been that student perceptions play a significant role in students' subject selection, and their experiences in junior high school and senior high school IT subjects. Typically these subjects are delivered by teachers who have limited expertise or experience of IT and consisted of mundane, repetitive tasks which play a major role in the development of poor perceptions of students going forward into senior secondary education and tertiary education (Genrich, Toleman and Roberts 2014).

Gottfredson's (2002, 2005) theory of circumscription, compromise, and self-creation identifies four career developmental stages in a student's life where they progressively discount career alternatives that do not meet their image of self (circumscription) and amend their self-image to accommodate real-world constraints in favour of other career alternatives (compromise). The third stage focuses on students in junior high school. Students start to become acutely aware of differences in social status: which occupations have higher status, what personal attributes are needed to get high-paying jobs. They also start to consider factors that drive perceptions of success, that is, what are the characteristics of success. During this stage, students eliminate from further consideration any career path that they see as too low in prestige, irrelevant, mundane or that seems to be out of reach in terms of ability or effort required (Gottfredson 2006). The final stage focuses on students in senior secondary school, tertiary education, and early in their careers. By this final stage, students are only considering those careers that have not been rejected in the third stage.

The challenge that this places on IT education and the IT industry is that students may perceive IT as mundane and repetitive therefore eliminating it from consideration as a career during the junior high school years through circumscription. Once this occurs it is very challenging to reverse their mindset.

Brown and Lent's (2012) Social Cognitive Career Theory (SCCT) highlights the importance that self-efficacy, as well as outcomes, expectations and other personal and environmental factors (e.g. gender, culture, barriers, and supports), play in shaping a student's self-image. SCCT examines the conditions that can limit or strengthen the ability to influence student's self-image. Personal, environmental and learning experience variables are seen to influence a student's interests and career choice goals.

Adya and Kaiser (2005) discuss how these variables can be examined as the social factors (e.g. family, peer group, and media), and the structural factors (e.g. teachers and curriculum). Each of these factors can play a role in either strengthening or limiting a student's self-efficacy and also their outcome expectations of IT careers, leading to career choices.

Thomas and Allen (2006) investigated why Australian undergraduates decided not to pursue IT careers even with the amount of exposure to technology that they have in pre-tertiary schooling. Their research found that students believe professionals in these careers do technical work on a computer all day and have few opportunities to work with others. Johnson and Miller (2002) contend that these careers are not attractive to students, particularly females, because of the manner in which they are advertised (i.e., a men-only environment, long hours that would not be conducive to a family). They believe that jobs in the IT field need to be more clearly articulated to attract more diverse individuals.

Learning experiences through teachers and the curriculum can have an important effect on both the student's self-efficacy and their outcome expectations (Brown and Lent 2012). This research investigates whether a more appropriate IT curriculum for junior high school students combined with suitable teaching methods has the potential to raise the perceptions of the IT discipline and IT careers in secondary education students.

1.4 Significance of the Research

Dobson (2007) and Bagshaw (2015) have identified that decreases in student participation in IT subjects have reached a point where serious IT skills shortages have been forecast in Australia. They also identified that these decreases are affecting student interest in pursuing IT careers. The result is causing a gap between the IT skill levels of our young people and that of our competitor nations.

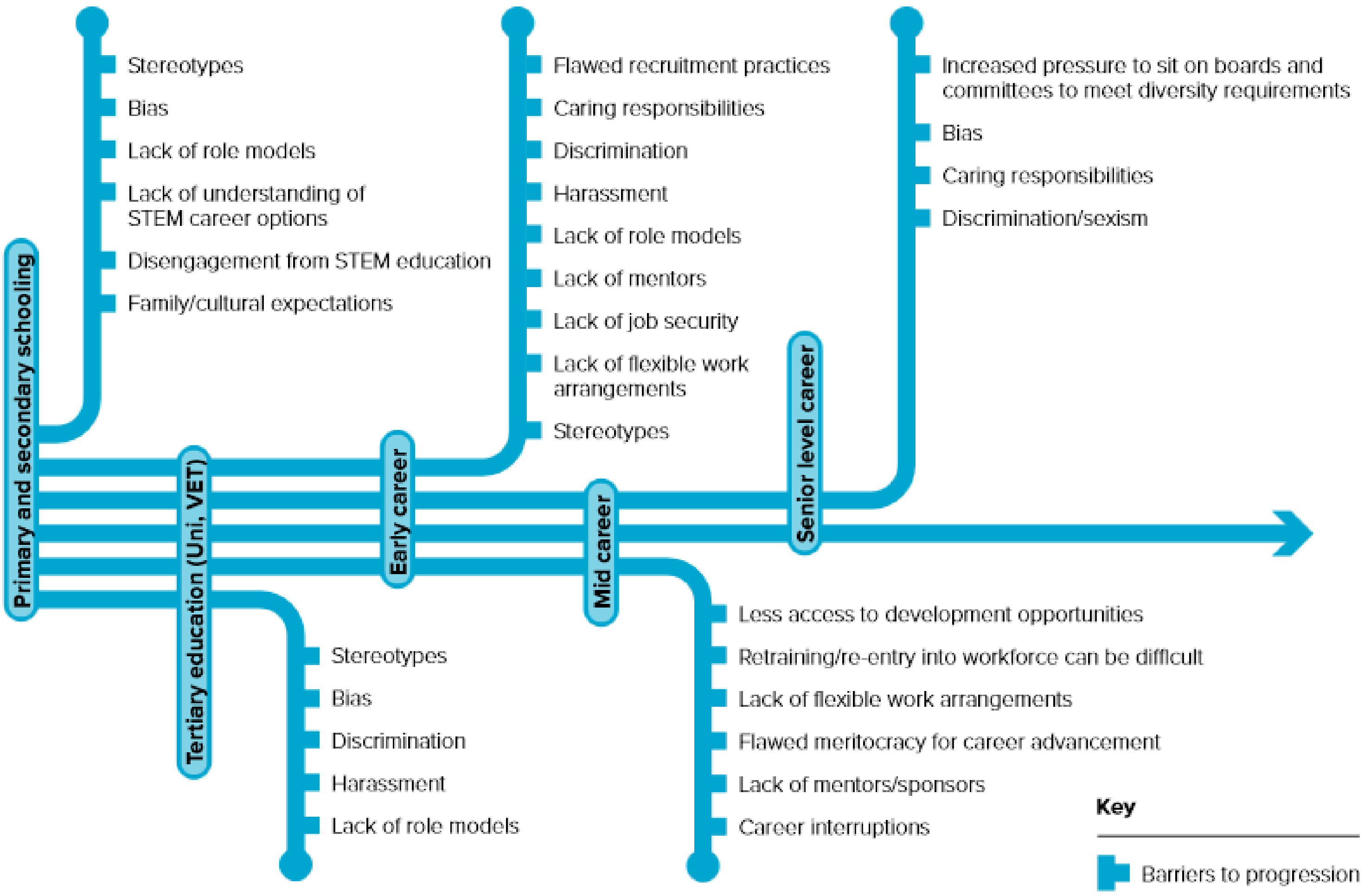
The Australian Academy of Science (2019) acknowledges the "critically important role of the education system in starting a healthy pipeline of STEM (Science, Technology, Engineering and Mathematics) students" and a lack of understanding of STEM career options as key barriers for female participation in STEM careers (Figure 3). This research postulated that these same barriers are also apparent for male participation as well, especially in the IT component of STEM.

This research examined the career-focused barriers to career progression in IT within secondary schooling. Currently, there has been limited research that targets secondary schooling with a view of improving awareness of career opportunities that arise from studying STEM (Australian Academy of Science 2019), and even less that specifically focuses on the subset of STEM, information technology.

The significance of the research is that it provides governments and education agencies with a better understanding of the importance of teaching about careers in IT in secondary schooling. This will also provide further evidence for its use in higher-level STEM careers research.

This research provides a four-week Information Technology (IT) Careers Curriculum, which is currently not present in the Australian Curriculum of Digital Technologies, to teachers in junior high school IT classes. This four-week curriculum has been developed to assist teachers to start breaking down the career progression barriers that are currently leading to limited numbers of students considering IT careers.

An expected outcome of this research, and the four-week curriculum that will be developed, is the possibility of increased enrolments in senior secondary school IT classes, due to better career understanding, prior to transitioning from junior high to senior high school.



Career progression pipeline for women in STEM, showing barriers to progression at each stage. Barriers were identified during consultation and research.

Figure 3: Career Progression Pipeline for Women in STEM (Australian Academy of Science (2019))

Further, possible increased enrolments in the vocational education and university sectors IT courses may result from the research as students are provided with better awareness of the range of IT careers available beyond programming and technical support.

1.5 Methodology

This research explored whether providing students with detailed information in the form of a four-week careers-focused IT curriculum within their year nine IT subject had an impact on student interest in such careers. Students in different schools in the Toowoomba region were involved in undertaking a four-week IT Careers Curriculum during their year nine IT subjects.

The data collection involved both quantitative and qualitative phases. The quantitative phase explored changes in student interest by collecting data from each of the year nine IT subject student groups involved prior to the start of the four-week curriculum and immediately after the conclusion of the four-week curriculum. This was achieved through an online survey instrument. The qualitative phase expanded on the findings of the quantitative phase, through the use of student focus groups and teacher interviews.

The survey was developed by combining questions from three existing career test instruments, including a Social Cognitive Career Theory Instruments (SCCT), and two Science, Technology, Engineering and Mathematics Instruments (STEM). The three instruments used all had high levels of reliability and were grounded in SCCT. The focus groups were conducted with a local convenience sample of students from the schools participating in the research. The teacher interviews were conducted with a local convenience sample of teachers from the participating schools in the research. The survey was pilot tested with knowledge experts and adjusted as was required.

The research sample for this study consisted of state and private schools. Within each school, there was at least one IT teacher of junior high school students and their year nine IT subject students.

The online questionnaire consists of a single section with thirteen items. The questionnaire contains instructions for completing the survey and the purpose of the survey. Student’s school name and initials and day/month of birth were collected for coding to allow for matching between the first and second iteration of the survey.

1.6 Data Analysis

The quantitative data was examined as to whether the IT Careers Curriculum resulted in a statistically significant improvement between the two surveys in terms of students' perceptions of IT careers.

Congruence method (pattern matching) analysis is a desirable technique for case study analysis (Yin 2014). This method was used to analyse the transcript data from student focus groups and the transcripts of teacher interviews.

1.7 Contribution of the Research

The existing knowledge of student perceptions towards IT careers, especially during junior high school is limited. Most of the research to date on the decline in IT enrolments has focused on gender differences in IT courses in senior secondary schooling, vocational education institutions and universities. (Lynch 2009, Craig and Coldwell 2010, and Trauth et al 2012)

Little previous research has been located that deals specifically with junior high school students and IT careers. The focus in Science, Technology, Engineering and Mathematics (STEM) with this age group is on student enrolments within Mathematics and the Sciences. This research will benefit both the academic and educational community.

1.7.1 Contribution to Academic Research

This research provides a current and comprehensive review of the literature on the development of a student's career choices. It reviews Gottfredson's (1981) Circumscription and Compromise Theory to identify the critical age in the developmental stages in a student's life where a careers curriculum intervention will have the most impact. It examines Brown and Lent's (2012) Social Cognitive Career Theory (SCCT), and how self-efficacy towards IT, affects student's career perceptions.

1.7.2 Contribution to Educational Practice

Gottfredson's (1981) Circumscription and Compromise Theory and Brown and Lent's (2012) Social Cognitive Career Theory (SCCT), is used as the theoretical underpinning of this study and the basis for the focus on the IT Careers Curriculum that has been developed in the research. The research reviews the most appropriate method of teaching and curriculum content for the IT Careers Curriculum and incorporates these findings into an IT Careers Curriculum within the current Australian Curriculum.

1.8 Scope of the Research

When researching in state schools, approvals need to be obtained at the Department of Education level, including whether a working with children check (in Queensland this is called a Blue Card) was needed for the researcher. Once this high-level approval was received, each school must be contacted individually through the school's principal, who will pass the information down to the relevant head of department, and then to the actual teachers. There are many opportunities for research projects to be challenged in this process, resulting in limited opportunities to research within schools.

The research was also confined to schools in the Toowoomba region, a regional city in Queensland, and therefore may not apply to other schools in different states and territories. While the Australian Curriculum is being implemented across Australia, different schools have implemented it in different ways, and this too may have an impact on the research.

1.9 Outline of the Thesis

This thesis is organised into nine chapters. The structure is based on the recommendations of Perry (1998) and the University of Southern Queensland PhD Guidelines (USQ 2019).

Chapter 1 provides background information on the study, the research problem, the overarching research question, the significance of the research, the research contribution, and the scope of the research.

Chapter 2 systematically reviews the literature on the factors that affect student career choice and reveals the gap that exists in the current literature on changing student perceptions towards IT careers, revealing the scarcity of research conducted in the area of student perceptions towards IT careers beyond gender concerns. The current lack of IT Careers Curriculum within the Australian National Curriculum is examined, and tech-savvy teaching tools are identified from the literature to inform the development of the IT Careers Curriculum in Chapter 4.

Chapter 3 presents the details and justifies use of the proposed research methodologies employed in this research. The chapter begins with a description of the research philosophical paradigm used. It presents comparisons of quantitative and qualitative research strategies. The chapter also outlines the process for the development of the IT Careers Curriculum, the IT Careers Interest instruments, the student focus groups and teacher interviews. A description of the research orientation, ethical considerations, and validity are also provided.

Chapter 4 presents the Curriculum Design and Development for the IT Careers Curriculum, using tech-savvy teaching tools, that will be implemented and tested with year nine students to ascertain if it can influence students' perceptions towards IT careers.

Chapter 5 presents the implementation of the IT Careers Curriculum, using tech-savvy teaching tools, with year nine students to ascertain if it can influence students' perceptions towards IT careers. It includes the primary researcher's reflection on their involvement as an active participant, teaching the IT Careers Curriculum at one of the four schools.

Chapter 6 discusses the quantitative analysis and findings of the data collected from two stages in the research plan. Firstly, a discussion is undertaken of the analysis and findings from the factor analysis that was used to reduce the number of items in the ITCI instrument to a small sub-set of the original set of identified instruments obtained from literature sources. Secondly, the implementation and subsequent analysis and findings of the data collected from the ITCI instrument with the year nine IT classes, testing them prior to and immediately after they have undertaken the IT Careers Curriculum, to ascertain their change in perceptions towards IT careers is discussed.

Chapter 7 discusses the qualitative analysis and findings of the data collected from the final two stages of the research plan, after the implementation of the IT Careers Curriculum to the year nine IT classes. Congruence method (pattern matching) analysis was used for both qualitative data sets – the data from the year nine IT class student focus groups, and finally, the year nine IT class teachers' interviews.

Chapter 8 presents a discussion of the research findings. The chapter provide a critical examination of the research results with discussions based on the context of the research method and reviewed literature. Discussions are structured around the overarching research question and seven sub-questions with a reflection on research work conducted and the presentation of the key themes emerging from this research.

Chapter 9 concludes the research by summarizing the findings which include the development of the IT Careers Curriculum. The contribution of research to the body of knowledge is discussed and implications of the research to theory and practice are presented. The chapter also discusses the limitations of the research, and recommendations for further research.

1.10 Summary of Chapter 1

This chapter introduced the research study, and provided the basis upon which the rest of the thesis is constructed. The research background and motivation were presented for an overall understanding of the research context. The research problem and overarching research question were identified. Justification of the research and the research methodology was then briefly introduced. The scope of the research was provided before an outline of the thesis chapters. The next chapter is the literature review on the topics relevant to the research.

Chapter 2 Literature Review

2.1 Chapter Introduction

Chapter 1 provided a background to the study, including a brief overview of the problem of dwindling enrolments in Information Technology classes, as well as the motivation for the study. In this Chapter, the issues outlined in Chapter 1 are expanded upon in order to provide a more detailed context for the study. The aim of this Chapter is to provide a critical review of the literature, focusing on cultural, social and structural factors, and the individual attributes of people that influence decisions to follow an IT educational or vocational pathway.

The emphasis of this literature review is on students in secondary and tertiary education, and the factors that influence their decisions to participate in IT courses and ultimately IT careers. Where possible, the focus of this literature was towards secondary school-aged students and researched in an Australian context, but a large portion of research in this field has been undertaken outside of Australia. This required the literature review to be expanded to include countries facing similar problems with recruitment into the IT field. This Chapter explores literature in a diverse range of research disciplines including information systems and computer science, education and educational psychology, careers psychology and sociology.

In order to organise this review of literature, the chapter is structured into three main areas including information technology enrolments and career selection, the current career development strategies used in career development interventions, and the literature used to inform the creation of the IT Careers Curriculum used in Chapter 3.

Section 2.2 provides information about the IT enrolments and career selection in the Queensland context. It reviews the research undertaken into the limited numbers of students selecting IT courses in senior secondary schooling and at tertiary institutions. Gender differences in IT course selection are investigated as it is the most prevalent research that has been conducted. Finally, the non-gender factors to which researchers have attributed low enrolments in IT programs are investigated.

Section 2.3 reviews the current career development theories used to investigate the careers choice development of school-age students. Gottfredson's (2005) theory of Circumscription, Compromise, and Self-creation is first investigated to determine the key student age groups where a student's self-career development occurs, and especially where careers are removed from further career exploration. Lent, Brown, and Hackett's Social Cognitive Career Theory (SCCT) (2002, 2006) is then explored to identify the factors that influence student careers decision making, including Bandura's (1986) Social Cognitive Theory (SCT) on self-efficacy, and Lent et al. (2002) personal and environment factors (gender, culture, barriers, and supports) that affect student career exploration and career selection. Finally, Adya and Kaiser's (2005) social factors (family, peer group, and media), and structural factors (e.g. teachers and curriculum) are examined.

Section 2.4 reviews the current foundation to year ten national curriculum, and investigates its impact on the curriculum being used in Australian schools, especially junior high school. It outlines the current gap about IT careers in the national curriculum and how this may impact on senior school subject selection and IT career choice.

Section 2.5 focuses on the literature used to inform the creation of the IT Careers Curriculum that will be implemented in Chapter 3, and the results analysed in Chapters 4 and 5. The current research into digital media practices in education (wikis, blogs and podcasting) will be examined to inform the IT Careers Curriculum within the structure of the current Australian National Curriculum.

Section 2.6 discusses the mixed-methods research approach that have been used in this thesis. The research sub-questions informed from the literature related to the quantitative and qualitative research methods are articulated in sections 2.6.1 and 2.6.2.

2.2 Information Technology Enrolments and Career Selection

Schools play a critical role in shaping students' aspirations for STEM careers (Holmes et al. 2018). There is strong evidence that there is currently insufficient students participating in Science, Technology, Engineering and Mathematics (STEM) in upper high-school and tertiary studies to meet societal needs (Craig and Horton, 2009; Rodriguez et al. 2014; Kennedy, Lyons and Quinn, 2014; Kennedy, Quinn and Lyons, 2018; Prieto-Rodriguez et al. 2020). These negative trends have generated a great deal of discussion in the media (Smith, 2011; Tisdell, 2014) and in political and economic publications (Deloitte Access Economics, 2017; Deloitte Access Economics, 2014; Education Council, 2015; Lowe, 2014; Prinsley and Baranyai, 2015) in Australia.

Research into a direct causal link between attitudes and intention to participate in STEM courses from a systematic perspective (Appianing and Van Eck 2015; Potvin and Hasni, 2014) and in large scale international comparisons studies (Kjærnsli and Lie, 2011) both concur that attitudes have a substantial influence on young peoples' future study or career orientation.

Over the past 20 years, the demand for qualified IT professionals has been high, yet there has been consistently low numbers of IT graduates in Australia (Downey et al, 2016; McLachlan, Craig and Coldwell-Neilson, 2016; von Hellens, Trauth and Fisher, 2012). IT as a discipline is in a state of constant change due to the pace of technological development, resulting in no clear picture of possible professional career opportunities (Koppi and Naghdy, 2009; Byars-Winston, 2014; Hajkowicz et al. 2016). There is a need for outreach programs to attract a diverse range of students to the computing discipline. The lack of qualified computing graduates to fill the growing number of computing vacancies is of concern to government and industry and there are few female students entering the computing pipeline at high school level (Lang et al. 2016). The 'pipeline' metaphor uses an 'ever-narrowing' pipeline to indicate the trajectory towards STEM careers, with individuals lost at junctions along the pipeline, and very few emerging at the end to be retained in STEM careers (Cannady et al. 2014, p. 444).

Due to concerns in the gender equality seen in these enrolments and career selection, there has been much research focused on the gender imbalance in university enrolments and within the IT sector. To avoid the shortfall of scientists and engineers there is a need 'to shore up [a country's] native talents by increasing the recruitment and retention of those who continue to be underrepresented in science, technology, engineering and mathematics – women, as well as, underrepresented minorities' (Tsui, 2007, p. 555). Women are underrepresented in most STEM fields (Liben and Coyle, 2014; Wang and Degol, 2017), and 'females continue to be less likely to pursue science, technology, engineering, and mathematics (STEM) careers than their male counterparts' (Wang et al. 2013, p. 770).

Numerous reasons have been suggested for the underrepresentation of women in STEM, and a range of initiatives have been put in place to increase female participation, many in the form of targeted interventions (Craig 2015; Blickenstaff, 2005; Wang and Degol, 2017). These interventions take different forms and follow diverse approaches, and often look to reverse the female 'pipeline leakage' by addressing environmental factors and issues at the school and student level (van den Hurk et al. 2019; Main and Schimpf 2017).

Researchers have shown that girls generally use technology outside of school in similar numbers to boys (Mims-Word, 2012; Underwood, 2016). In a report from the International Computer and Information Literacy study (ICILS) (De Bortoli et al. 2014) it was noted that Australian girls' computer information literacy was significantly higher than boys. Despite this, girls generally had a lower interest in studying IT (Craig 2015; Gorbacheva and Coldwell-Neilson 2016).

Some of the findings from the gender research and subsequent research has also investigated the non-gender issues of the current curriculum and teaching as factors contributing to the decline. Most of the research investigated the perceptions of either senior high school or university students.

Lasen (2010) conducted focus groups with Queensland senior high school students to investigate their perceptions of Information Technology subjects. The research identified several factors that deter females from IT education and career pathways. One major barrier was girls' experience in junior high school IT subjects "which had been typically delivered by teachers with limited expertise and constituted by mundane, repetitive tasks" (Lasen 2010).

Students in the study acknowledged the pervasiveness of IT in the workplace but perceived that they could continue to hone their skills on a needs basis and, indeed, were routinely and purposefully using computers on a daily basis at home.

A lack of understanding of the different foci of the senior IT curriculum was evident among the students in the research, with many associating senior IT subjects with programming and other highly technical skills. It was also discovered that many of these students expressed an aversion to programming (Lasen 2010).

First year university students' perceptions of IT as a career was investigated by Thomas and Allen (2006). They identified that there were numerous stereotypes, often depicted in the media that affect students' perceptions of the selecting IT studies and careers. The students surveyed did not know any females in the IT industry and could not name any female role models from real life or from TV or film. They recommended that the way in which computer personnel are depicted in the media, such as girls' magazines that target the early teen market, could be used by Computer Societies to raise the profile of girls seeing technology as fun, worthwhile and a job they might consider.

Thomas and Allen (2006) also found that students had chosen to withdraw from IT as a subject at school and a possible career path by year ten of their schooling. They identified gender differences in their reasons for giving up IT, "with females listing computer illiteracy and dislike of being called a nerd as their main reasons and males listing boredom, teachers not being encouraging and little creativity as their main reasons for stopping" (Thomas and Allen 2006). The students in the research were surveyed about their perceptions of the IT industry. The analysis of the survey found that female students were significantly more negative about the IT industry than male students. The survey investigated the technical versus non-technical issue in perceptions of an IT career. The majority of the participants believed that an IT job consists mainly of technical work and working at a computer (Thomas and Allen 2006).

Rosenbloom et al. (2007) investigated how the differences between the perceptions of each gender towards a career have an impact on career choice. Thomas and Allen (2006) determined that students felt that their perceptions of an IT career came from schooling, friends and the media as their main sources of knowledge of the area. Annabi and McGann (2019) found that misperceptions about the nature of IT university programs, careers, and job prospects were all factors in the limited number of students enrolling in IT. Their study provided a longitudinal account of the changes in student perceptions of IT in college students.

The ongoing challenges of gender and the study of IT in New South Wales, South Australia and Victorian secondary schools was investigated by Lynch (2009) as the focus of an Australian Learning and Teaching Council (ALTC) project in 2005-2007 into Gender and IT. The research found that students held several misconceptions about the focus of IT curriculum taught in high schools and career opportunities in the IT sector. The research recommends strategies to counter these misconceptions through curriculum change. Craig and Coldwell (2010) undertook a gender-based careers initiative with secondary school girls aged 14 to 18. These students were shown a range of IT career opportunities available in information technology over a two-day showcase event involving industry speakers from a wide variety of areas within the sector. The initiative resulted in over two-thirds of the students indicating that they would consider a career in IT. Trauth et al. (2012) explored the gender issue in more depth, by also examining gender within ethnic group, approaching the topic of gender and the IT profession from the perspective of intersectionality of gender and ethnicity.

Lewis, McKay and Lang (2006, 2007) investigated the gender differences in students choosing to study IT courses at universities. They found that while there had been many strategies implemented in the 1990s, which were primarily focused on increasing numbers, these strategies had not addressed the issues of reviewing and reforming curriculum, teaching and assessment practices. Margolis and Fisher (2003) examined the same concerns in the USA context where they identified student experience and curriculum as affecting IT career selection.

Globally, there are several other non-gender factors that researchers have attributed to low enrolments in IT programs over the last fifteen years, including abysmal economic conditions and decreasing demand for IT jobs after the dot-com bust in the early 2000s (Dick et al. 2007; George et al. 2005).

Curriculum quality and relevance to industry have also been identified as reasons students stopped choosing IT programs and careers (Firth, Lawrence, and Looney 2008; Firth et al. 2011; Scott et al. 2009).

Individual factors, such as students' self-efficacy, attitudes, outcome expectations, social support, and social norms, have also been identified by researchers as reasons students did or did not choose IT programs and careers (Benamati and Rajkumar 2013; Koch and Trower 2011).

Akbulut-Bailey (2012) found that social support, self-efficacy, outcome expectations, and interests independently and cumulatively affect students' choice to study IT. Joshi and Kuhn's (2011) research identified that student's attitudinal beliefs towards IT, such as software/programming skill self-efficacy and technical, income, leadership, and job-variety-related work values have significant influence on students' attitudes. They found that these beliefs are derived from a student's interaction with others (family members, friends, teachers, and partners), and have a significant impact on IT attitudes. Babin et al. (2010) examined the role of influencers on student decisions to pursue IT careers. Their findings indicate that parents are the strongest influencers and guidance counsellors are the weakest influencers.

However, how students perceive IT represents perhaps the most often investigated and cited non-gender factor that influences IT enrolment (Benamati and Rajkumar 2013; Akbulut-Bailey 2012; Walstrom and Schambach 2012). Since the mid 2000's, prospective students held highly negative misperceptions about IT studies, related professions, and job availability (Granger et al. 2007; Benamati and Rajkumar 2013).

The type of work associated with a job was rated as an important issue in their deciding on a career or future studies (Scott et al. 2009). They found that students had little knowledge of IT and perceived it to be narrowly focused to work that was either sitting at a computer or coding.

Thomas and Allen (2006) recommend that the problem needs to be tackled in the early years – primary and lower secondary school. As students say that much of their knowledge of IT as a career comes from school, the school curriculum should be examined to determine if it is suitable for both genders. This could include the curriculum itself or the way in which it is taught and assessed.

The factors that contribute to low participation rates in senior secondary school IT courses was explored by Downes and Looker (2011). They found that in addition to gender and the student's beliefs about the value of the course, students' decision to study IT courses are also affected by the amount of use of IT a student has at school and at home.

The key findings from all these studies have been that student perceptions play a significant role in student's subject selection, and the experiences of junior high school IT subjects. Schools are one place where all students should be encouraged to think and work positively with technology (De Bortoli et al. 2014; Barrett, 2018). How schools react to, support, and equip classrooms and teachers obviously influences IT learning outcomes. The Australian Council for Educational Research (ACER) report that current traditional classroom settings and curricula tend not to accommodate different forms of learning (Masters, 2016). The physical environment of a computing classroom is also often not encouraging and does not engender a feeling of belonging, conveying the wrong message to students.

Typically, these subjects are delivered by teachers with limited expertise or experience of IT and are constituted of mundane, repetitive tasks which plays a major role in the development of poor perceptions of students going forward into senior secondary education and tertiary education (Genrich, Toleman and Roberts 2014).

The following section of the literature review investigates the current career development and intervention theories. It examines how students develop their career related perception, at what stage in a student's educational journey changing their career-related perceptions would have the highest impact, and how these theories can be used to improve student perceptions of IT careers. The literature identified in this section will form the basis for the methodologies used in this research.

2.3 Career Development Theories

Student career paths are affected by many variables, including their personal attributes (interests, abilities, values), learning and socialisation experiences, and the resources, opportunities, and barriers afforded by their environments. Career paths are created not by any one of these forces, but rather by the complex interactions among them (Brown and Lent 2012).

Career development is the search for a life career that fits our own concept of who we are, both socially and psychologically (Gottfredson 2006). The process of career development plays out over multiple stages of a person's career, such as education (early schooling through to tertiary studies), gaining employment, mid-career changes, and retirement. Career development theories provide methods for explaining how different factors operate together to determine career choices over a person's life.

Significant career development takes place during adolescence, usually while students are in junior high school and senior high school. Students begin to clarify their career identity (Erikson 1963), develop an awareness of career interests, and undertake career-related tasks, such as career planning and career exploration, as they increasingly think about their future career (Super 1990). Good career development is therefore essential as part of junior high school to senior school curriculum, "it is crucial to consider career education as a key curriculum addition to adolescents' schooling" (Creed et al. 2007).

The Ithaca Group (2019) was commissioned by the Australian Government Department of Education and Training to explore career education within the Australian Curriculum. They define career education as:

> *The development of knowledge, skills and attitudes through a planned program of learning experiences in education and training settings which will assist students to make informed decisions about their study and/or work options and enable effective participation in working life* (p. 6).

Careers development theory underpins the theoretical methods used to establish career education practices, both nationally and in schools.

Niles and Harris-Bowlsbey (2017, pp. 35-6) have summarised the key career development theories (Table 1) that are currently used by career development researchers.

Theory	Theorists	Orientation	Key Constructs
Work Adjustment	Rene Dawis Lloyd Lofquist	• Trait-factor • Career choice / adjustment	• Satisfaction • Satisfactoriness • Person-in-an environment • Correspondence
Life-space, Life-Space	Donald Super	• Developmental	• Life span • Career stages • Career development tasks • Life space • Self-concept • Career maturity • Career adaptability
Personality Theory of Career Choice	Anne Roe	• Personality Theory / Psychodynamic	• Early childhood experiences • Needs hierarchies • Field / Level
Circumscription, Compromise and Self-Creation	**Linda Gottfredson**	• **Developmental/ sociological** • **Career choice development**	• **Circumscription** • **Compromise**

Vocational Personalities and Work Environments	John Holland	• Person-Environment • Career choice	• Congruence • Consistency • Differentiation • Vocational identity
Learning Theory of Career Counselling	John Krumboltz	• Social learning • Career choice development	• Learning experience • Self-observation generalisations • World view generalisations • Task-approach skills, actions • Planned happenstance
Social Cognitive Career Theory	**Robert Lent, Steven Brown, Gail Hackett**	• **Social cognitive** • **Career choice development**	• **Self-efficacy** • **Outcome expectorations** • **Personal goals** • **Triadic reciprocal model**
Cognitive Information Processing Approach	Gary Peterson, James Sampson Jr., Robert Reardon, Janet Lentz	• Cognitive career choice	• Pyramid of information processing CASVE cycle • Executive processing domain • Career thoughts inventory
Career Construction Theory	Mark Savickas	• Differential, developmental, and dynamic perspective of careers	• Vocational personality • Life themes • Career Adaptability • Career Style interview
Integrative Life Planning	L. Sunny Hansen	• Contextual career choice / adjustment	• Social justice • Social change • Connectedness • Diversity • Spirituality • Integrative life planning inventory
Postmodern	Vance Peavey	• Constructivist	• Meaning-making
	Larry Cochran	• Narrative	• Career problem • Life history • Future narrative
Chaos Theory of Careers	Robert Pryor, Jim Bright	• Self-organisation and change; phenomenalist	• Attractors • Patterns • Patterns and Fractals

Table 1: Key careers development theories

This research focuses on the two key theories that investigate the career choice development of school age students (Gottfredson's Theory of Circumscription, Compromise, and Self-Creation and Lent, Brown and Hackett's Social Cognitive Career Theory). While Krumboltz's Learning Theory of Career Counselling also focused on career choice development, it was not selected due to its focus within the workplace of individuals currently employed, which is beyond this research. The other career development theories listed in Table 1 were not selected as their focus was not on career choice development of school age students.

2.3.1 Gottfredson's Theory of Circumscription, Compromise, and Self-Creation

Gottfredson's (2002, 2005) theory of Circumscription, Compromise, and Self-creation describes the process of formulating career aspirations in childhood and adolescence. Gottfredson's theory was developed to address the question "why do children seem to re-create the social inequalities of their elders long before they themselves experience any barriers to pursuing their dreams?" (2002, p. 85). The theory examines the compromises people make in their career aspiration, particularly as they relate to gender-typed learning and experiences. Compromise involves the process of limiting career choices due to prestige, gender-type, and field of interest (Gottfredson 1981). Gottfredson's theory emphasizes the view that "career choice is an attempt to place oneself in the broader social order" (Gottfredson 1996, p. 181). Thus, she offers a developmental and sociological perspective of career development.

People distinguish occupations according to the dimensions of "masculinity-femininity, occupational prestige, and field of work" (Gottfredson 2002, p. 88). Gottfredson (2005) asserts that "occupational prestige is positively correlated with the degree of intellectual capacity required for job performance". A person's self-concept interacts with their occupational stereotypes. When people make career decisions, they determine the suitability of an occupation by considering perceived gender appropriateness (most important), prestige (second in importance), and the degree to which the occupation will fulfil their preferences and personality needs (least important). The "zone of acceptable occupational alternatives" or "social space" (2002, p. 91) represents a person's perception of their fit in society. Gottfredson contends that people compromise because they typically search for a good enough occupation, rather than for a great one. This is because a great choice requires more intensive values clarification and determination of alternative rather than a good enough one. People become indecisive when they perceive the options within their social space as undesirable. Occupational satisfaction hinges on the degree to which "the compromise allows one to implement a desired social self, either through the work itself or the lifestyle it allows self and family" (2002, p. 107).

Circumscription involves the process of eliminating unacceptable occupational alternatives based primarily on gender and prestige; and highlights the fact that young people begin eliminating occupational options "as soon as they are able to perceive essential distinctions among people and lives" (Gottfredson 2002, p. 131). The circumscription process is guided by five principles (2002, pp. 94-95).

The first principle notes that circumscription is guided by the growing capacity of students to understand and organise complex information about themselves and the world as they progress from magical to abstract thinking.

The second principle reflects the belief that because occupational aspirations are inextricably linked with one's self-concept, occupational preferences reflect attempts to both implement and enhance it.

The third principle is that students begin to grapple with more complex distinctions among people (for instance, perceptions related to prestige) while they are still in the process of integrating more concrete phenomena, such as gender-roles, into their self-conceptions.

The fourth principle emphasizes the belief that students progressively eliminate occupational options as their self-concepts become clearer and more complex. At the same time, Gottfredson notes that "people reconsider options they have ruled out as unacceptable in gender-type … and prestige only when they are prompted to do so by some formative new experience or some notable change in their social environment" (2002, p.95).

Finally, the circumscription process is gradual and not immediately obvious despite its strong effect on the person undergoing it. The theory provides concepts describing boundaries and motivational dimensions related to the formation of career aspirations (Herr, Cramer, and Niles 2004). Gottfredson's (1981, 2002, 2005) theory of career development, identifies the importance of self-concept and how work can provide meaning and purpose in an individual's life (Jena and Nayak 2020).

Hu et al. (2020) and Cochran et al. (2011) investigated the relationship between adolescent occupational aspirations and midlife career success in mental health. The model for adolescent occupational aspirations was derived from Gottfredson's (1981) theory of Circumscription and Compromise. These two research papers examined whether parental socioeconomic status (SES), ability and gender predict adolescent occupational aspirations and influence career achievement in later life.

Miyamoto and Wicht (2020) utilised Gottfredson's (1981, 2002, 2005) theory of career development in their investigation of age-related changes in adolescents' occupational aspirations. Their research examined the effects of socioeconomic status (SES) of aspired occupations on a longitudinal basis across 30 years, finding the developmental trajectories of the SES of occupational aspirations seem to be similar across age-cohorts. These principles operate throughout the stages of cognitive development (Table 2) that Gottfredson (1996) delineated to describe the circumscription process.

Gottfredson's Stages	Description of Circumscription Process
Stage One: Orientation to Size and Power	The first stage occurs between ages three and five (kindergarten and early schooling); and reflects the onset of object constancy in cognitive development. At this stage, students classify people in simple terms such as big and little, strong vs. weak, orienting themselves to the size difference between themselves and adults. During this stage, students also start to recognise occupations. It is during this time that they start to move away from reporting that they would like to be animals and fantasy characters when they grow up (Gottfredson 2006). There is little discounting of actual careers happening this early in their development.
Stage Two: Orientation to Gender Roles	This stage occurs between ages six and eight (primary school). Here, students become aware of the different gender roles of men and women. They think dichotomously – good / bad, rich / poor – and attempt gender role stereotypes as behavioural imperatives. Their occupational aspirations reflect a desire to behave in ways that are appropriate to their gender, manifesting in their belief that certain jobs are for men and certain jobs are for women. It is during this stage that students develop their "tolerable-gender-type … boundary" Gottfredson 2005). It is during this time that work specific to female careers in Science, Technology, Engineering and Mathematics (STEM) should start to be applied before the female students have discounted these types of careers (Gottfredson 2006).
Stage Three: Orientation to Social Valuation	During this stage, which occurs between ages nine and thirteen (late primary and junior high school), students think more abstractly and become aware of social class and prestige, they are acutely aware of differences in social status: which occupations have higher status, what personal attributes are needed to get high-paying jobs. Students start to consider factors such as what makes someone be considered successful. They reject occupations not in line with their perceived ability levels nor approved of by their social reference group, social class and ability determine the tolerable-level boundary which represents the lower limit of occupations they are willing to consider (which occupations are beneath them and, therefore, not worthy of their consideration). Students also establish a tolerable-effort level based on the upper limit of effort they are willing to exert and the risks they are willing to take (occupational goals that are not beyond their ability to achieve). Together, these levels determine the zone of occupations students consider acceptable (Gottfredson 1996). They eliminate from further consideration any career path that they see as too low in prestige, irrelevant, mundane or that seem to be out of reach in terms of ability or effort required (Gottfredson 2006).
Stage Four: Orientation to the Internal, Unique Self	During this stage, which starts at age fourteen (senior schooling and tertiary education), adolescents become more introspective and self-aware. Engaging in more abstract thinking than before, adolescents begin identifying internally generated goals and self-concepts and explore occupational options congruent with these. As Gottfredson note, "vocational development erupts into conscious awareness during Stage four" (2005, p. 81). This stage features a shift as emphasis turns from eliminating unacceptable options to identifying those that are preferred and acceptable. It is now that the process of compromise appears. Compromise involves eliminating options because of factors such as their perceived inaccessibility. Compromise may be anticipatory (prior to actual encounters with external barriers) or experiential (after actual encounters with external barriers).

Table 2: Four stages of Gottfredson's circumscription process

Gottfredson (1996) notes that, traditional, career development interventions occur during stage four, when people are attempting to crystallize and clarify their self-concepts. However, Gottfredson's theory highlights the importance of interventions to young people in earlier stages of development, often in the form of career education programs. Such programs should focus on helping young people explore a full range of occupational options to promote systematic exploration in career choice (Gottfredson 2005). Interventions that address gender-role stereotypes and expose students to options across occupational levels should be cornerstones of such programs. Gottfredson posited that career education programs must be sensitive to students' level of cognitive development, expose students to a wide range of career options, and foster awareness of the circumscription and compromise process.

The challenge that this has on IT education and the IT industry is that students' perceptions of IT is that it is seen as mundane and repetitive. This has resulted in many students eliminating it from consideration as a career during these junior high school years through circumscription, and once this occurs, it is very difficult to reverse.

2.3.2 Lent, Brown, and Hackett's Social Cognitive Career Theory (SCCT)

Social cognitive career theory (SCCT) (Brown and Lent 1996; Lent 2005, 2013; Lent and Brown 2002, 2006; Lent et al. 1996; Lent, Brown and Hackett 2002) provides a conceptual framework for understanding how people develop career-related interests, make career choices, and achieve career success and stability. SCCT builds upon the assumption that cognitive factors play an important role in career development and career decision making. SCCT has some linkages to Krumboltz's learning theory of career counselling (LTCC) (Mitchell and Krumboltz 1996). Lent et al. (1996) noted, however, that SCCT differs from Krumboltz's theory in several ways. "SCCT is more concerned with the specific cognitive mediators through which learning experiences guide career behaviour; with the manner in which variables such as interests, abilities, and values interrelate; and with the specific paths by which person and contextual factors influence career outcomes. It also emphasizes the means by which individuals emphasize personal agency" (p. 377). Lent (2013) views SCCT as a model that is complementary to trait-factor and developmental models of career behaviour.

Social Cognitive Theory (SCT)

SCCT draws heavily from Bandura's (1986) Social Cognitive Theory (SCT). Specifically, SCCT incorporates Bandura's triadic reciprocal model of causality, which assumes that personal attributes, the environment, and overt behaviours "operate as interlocking mechanisms that affect one another bi-directionally" (Lent et al. 1996, p. 379). Within this triadic reciprocal model, SCCT highlights self-efficacy beliefs, outcome expectations, and personal goals. Thus, SCCT also incorporates research, applying self-efficacy theory to the career domain (Hackett and Betz 1981; Lent and Brown 2002; Lent and Hackett 1987).

Bandura (1986) defines self-efficacy beliefs as "people's judgements of their capabilities to organise and execute courses of action required to attain designated types of performances" (p. 391). Self-efficacy beliefs are dynamic self-beliefs and are domain specific. Self-efficacy beliefs provide answers to questions pertaining to whether we can perform specific tasks. Our beliefs about our abilities play a central role in the career decision-making process. We move towards those occupations requiring capabilities we think we either have or can develop. We move away from those occupations requiring capabilities we think we do not possess or that we cannot develop.

Bandura (1986) posits four sources that shape self-efficacy beliefs:

1) personal performance accomplishments,
2) vicarious learning,
3) social persuasion, and
4) physiological states and reactions.

The most influential of these sources is the first (personal performance accomplishments). Successful accomplishments result in more positive or stronger domain-specific, self-efficacy beliefs, and failures lead to more negative or weaker domain-specific beliefs.

Outcome expectations are beliefs about the outcomes of performing specific behaviours. Outcome expectations include our beliefs about "extrinsic reinforcement (receiving tangible reward for successful performance), self-directed consequences (such as pride in oneself for mastering a challenging task), and outcomes derived from the process of performing a given activity" (Lent et al. 1986, p. 381). Outcome expectations influence job behaviour to a lesser degree than self-efficacy beliefs. Thus, outcome expectations are what we imagine will happen if we perform specific behaviours.

Personal goals also influence career behaviours in important ways. Personal goals relate to our determination to engage in certain activities to produce a particular outcome (Bandura 1986). Goals help organise and guide our behaviour over long periods of time.

The relationship among goals, self-efficacy, and outcome expectations is complex and occurs within the framework of Bandura's (1986) triadic reciprocal model of causality (personal attributes, external environmental factors, and overt behaviour). This model describes how personal inputs (predisposition, gender, and race) interact with contextual factors (culture, geography, family, gender-role socialisation) and learning experiences to influence our self-efficacy beliefs and outcome expectations. Self-efficacy beliefs and outcome expectations, in turn, shape our interests, goals, actions, and eventually, our attainments (Lent 2013). However, they are also influenced by contextual factors (job opportunities, access to training opportunities, financial resources).

Self-efficacy perceptions have been found to influence decisions about what behaviours to undertake (Bandura, et al. 1977; Betz and Hackett 1981), the effort exerted and persistence in attempting those behaviours (Barling and Beattie 1983; Brown and Inouye 1978), the emotional responses (including stress and anxiety) of the individual performing the behaviours (Bandura et al. 1977; Stumpf et al. 1987), and the actual performance attainments of the individual with respect to the behaviour (Barling and Beattie 1983; Locke et al. 1984; Schunk 1981; Wood and Bandura 1989). Self-efficacy has been identified to be a strong predictor of academic achievement, course selection, and career decisions across domains and age levels.

Lent et al. (1996) explored the relation of self-efficacy to educational choice and performance, by assessing the extent to which self-efficacy, in conjunction with other relevant variables, predicted academic grades, persistence, and perceived career options within science and engineering fields. They found that self-efficacy contributed to the prediction of grades, persistence, and range of perceived career options in technical and scientific fields.

Within the school environment, mastery experience in a study area was the most important source of self-efficacy (Usher and Pajares 2009). Contextual factors such as gender, ethnicity, academic ability, and career areas also influence a student's self-efficacy.

The relationship between the social cognitive variables of career decision-making self-efficacy and perceptions of barriers in career exploration was investigated by Gushue et al. (2006). Their research identified that career decision-making, self-efficacy influenced students' career development and career exploration behaviours.

Pinquart et al. (2002) investigated whether academic self-efficacy and grades in school at the ages of twelve to fifteen would be associated with job satisfaction at the age of twenty-one. The research found that individuals with high self-efficacy and better grades were more likely to be satisfied with their jobs. The researchers propose that "career success may profit from school-based interventions that focus on the increase of academic self-efficacy and academic capabilities" (p. 344).

Self-efficacy in the sciences of junior high school students was investigated by Britner and Pajares (2005). The confidence with which students approach science has been acknowledged as a potentially powerful influence (Whigham et al. 1999; Britner and Pajares 2001; Kupermintz 2002; Lau and Roeser 2002). A student's belief in their ability to succeed in science tasks, courses, or activities, or their science self-efficacy, influences their choices of science-related activities, the effort they expend on those activities, the determination they show when encountering difficulties, and the ultimate success they experience in science (Bandura 1997; Britner and Pajares 2001; Zeldin and Pajares 2000). Students were found to shape their choices for science in a variety of ways across time. There is an interplay of self-efficacy with respect to science, occupational images of working scientists, relationship with significant adults and perceptions of school science (Cleaves 2005). This makes self-efficacy a prime focus for science educators who want to increase student accomplishment and engagement in science.

The heuristics students use as they form their mathematics self-efficacy was examined by Usher (2009). Students with high mathematics self-efficacy reported having high levels of achievement in mathematics. Bandura (1997) identified that the interpretations students make of their past successes and failures serve as an important source of information about their self-efficacy. Mastery experience was also found to be a powerful source of self-efficacy. When students feel they have mastered requisite subskills, when they have accomplished difficult tasks, when they interpret performances as successful, they develop a robust belief in their personal efficacy (Bandura et al. 1977).

Compeau and Higgins (2015) discuss the role of individuals' beliefs about their Information Technology (IT) self-efficacy in the determination of IT use. IT self-efficacy was found to exert a significant influence on individuals' expectations of the outcomes of using IT, their emotional reactions to IT (affect and anxiety), as well as their actual IT use. An individual's self-efficacy and outcome expectations were found to be positively influenced by two factors, the encouragement of others and others' use of IT in their work group. The research found that self-efficacy represents an important individual trait, which moderates organizational influences (such as encouragement and support) on an individual's decision to use IT.

The relationship gender plays in students' self-efficacy towards Information Technology has been identified by numerous researchers as a factor in the limited number of females studying and choosing IT careers. Parental support, teacher expectation and social support for using IT have been identified as factors that influence a students' self-efficacy towards IT.

The relationships between genders towards IT self-efficacy, perceived parental support, perceived teacher expectations, and perceptions of the nature of IT instruction were explored by Verkiri (2009). Perceived teacher expectations and parental support were positively associated with students' self-efficacy. Perceptions that IT learning activities were creative and personally meaningful was a significant predictor of students' interest in IT. The findings of this study indicated that men and women's self-efficacy are differentially affected by parents, teachers, and IT instruction.

Vekiri and Chronaki (2008) examined the relationship between home IT experiences, perceived social support for using IT, and self-efficacy about IT learning with primary school students. The research found that all students used IT at home but identified that there were gender differences in the amount and type of IT use. Perceived support from parents and peers to use IT were identified as factors that contributed to positive IT self-efficacy and value beliefs.

The effects of self-efficacy on the academic and career choices of females who selected a career in mathematics, science, and technology was investigated by Zedlin and Pajares (2000). The research found that women had to have a higher level of perseverance and resiliency than men to overcome academic and career obstacles in male-dominated career domains than for females operating in more traditional fields.

2.3.2 Lent, Brown and Hackett's Social Cognitive Career Theory (SCCT)

Social cognitive career theory (SCCT) (Brown and Lent 1996; Lent 2005, 2013; Lent and Brown 2002, 2006; Lent et al. 1996; Lent, Brown and Hackett 2002; Brown and Lent 2019; Lent and Brown 2019; Lent and Brown 2020) is particularly useful in addressing the two areas of career concern: performance attainment and persistence at overcoming obstacles. Performance is influenced by ability, self-efficacy, outcome expectations, and goals. Ability affects performance both directly and indirectly through influencing self-efficacy and outcome expectations. According to Lent and Brown (1996), "Higher self-efficacy and anticipated positive outcomes promote higher goals, which help to mobilize and sustain performance behaviour" (p. 318). Problems in career development emerge when individuals prematurely foreclose on occupational options due to inaccurate self-efficacy, outcome expectations, or both, and when individuals forego further consideration of occupational options due to barriers they perceive as insurmountable (Lent 2013). Career development interventions in SCCT are often directed towards self-efficacy and outcome expectations.

"The basic process for facilitating interest exploration … include assessing discrepancies between self-efficacy and demonstrated skill and between outcome expectations and occupational information" (Brown and Lent 1996, p. 357). Students can be helped to modify their self-efficacy beliefs in several ways. When ability is sufficient but self-efficacy is low due to factors such as racism and gender-role stereotyping, students can be exposed to personally relevant, vicarious learning opportunities. Students with sufficient ability but low self-efficacy can also be encouraged to gather ability-related data from friends, teachers, and others to counteract faulty self-efficacy. Educators can also work collaboratively with these students to construct success experiences to strengthen weak self-efficacy. In processing these success experiences, educators can challenge students when they identify external attributions for their successes and disregard internal, stable causes for their successes. Thus, the four sources of self-efficacy can be used as organising structures for career interventions (Lent 2005).

Rogers and Creed (2011) used social cognitive career theory to investigate career choice, such as career planning and career exploration with senior secondary school students in an Australian context. They investigated the three main social-cognitive variables of self-efficacy, outcome expectations and career goals, on students' career planning and career exploration. Career exploration was found to be associated with career goals, and career planning was associated with self-efficacy.

The role of personality, social supports, and the SCCT variables of self-efficacy, outcome expectations and goals in explaining the career readiness of students' in their career planning and exploration was tested by Rogers et al. (2007). Career exploration was found to be associated with goals and social supports; career planning was associated with self-efficacy.

Rogers and Creed (2011); Rogers et al. (2007) both indicate that student's career planning results from having high self-efficacy in their chosen career area and a student's career exploration results from having clear goals and good social support.

Social Cognitive Career Theory (SCCT) highlights the importance that self-efficacy, as well as outcomes expectations and other personal and environment factors (gender, culture, barriers, and supports) play in shaping a student's self-image. SCCT examines the conditions that can limit or strengthen the ability to influence student's self-image. Personal, environmental and learning experience variables are seen to influence a student's interests and career choice goals.

2.3.3 Adya and Kaiser (2005) Social and Structural Factors

Ashcraft et al. (2012) report that both student genders have either little knowledge, or an incorrect perception, of what an IT career involves. Girls typically see an IT career as for men not women and think that it is ‘nerdy’ and involves sitting at a computer for most of the day with little interaction with other people (Ashcraft et al. 2012). In promoting IT, many programs aim to counter the stereotypical images that girls have of IT (Craig, Lang and Fisher 2008).

There are many factors which are known to influence girls’ disinclination to pursue IT studies further, including the influence of parents, family and peers; the availability and use of technology at home; early exposure to IT; informal education outside the school; and the stereotypical image of IT careers promoted in the media and popular culture (Hunter and Boersen 2017; Hunter and Boersen 2016; Gorbacheva et al. 2014; Craig, Fisher and Lang, 2007; Lang, 2010; Bain and Rice, 2006; Ashcraft et al. 2012; Clayton, Beekhuyzen and Nielsen, 2012).

Although there have been many intervention programmes implemented to improve the gender imbalance in the IT profession, gender diversity in practice has not improved significantly (Gorbacheva 2019; Craig, 2015; Loiacono et al, 2016; Trauth, 2017). Gorbacheva, Craig, Beekhuyzen, and Coldwell-Neilson state that ‘more empirical evidence is required to confirm [the] assumption that career intentions lead to career choice’ (2014, p. 298).

Adya and Kaiser’s (2005) model focused primarily on girls’ career choices investigating how social factors (family, peer group, and media), and the structural factors (teachers and curriculum) can play a role in either strengthening or limiting a student’s self-efficacy and their outcome expectations of IT careers, leading to career choices. These social and structural factors have been applied more generally to both genders in the following research.

Social Factor: Family

According to Dryler (1998), during childhood and adolescence, one of the most influential contexts of socialisation is the family. Barker and Aspray (2006, p. 25) supports Dryler (1998) and state that “school policies and teachers can have a significant influence on students, but no influence is greater than that of family”. Family expectations, influenced by the cultural setting of the family, have been found to contribute towards the decisions of students to enter IT education and careers (Lang and McKay 2006). Quite possibly, the economic situation of the family also plays a role in students’ technical career choices, with a large number of families having both parents in the paid workforce (Lang and McKay 2006). In their study of Australian

IT enrolment factors and trends, Lang and McKay (2006) found that "the emergent trend is of high family expectations influencing career choices of students, and supports the earlier findings that technically educated parents strongly influenced career path of their daughters" (Lang and McKay 2006, p. 54). Dryler (1998) found that the influence of families, especially parents, on a student's career choice was mostly through choosing IT as a career themselves or actively engaging in the use of technology. Still, while many students gather career knowledge from family members, who act as role models for a variety of professions, due to low numbers currently in the IT profession, few would have had personal exposure to IT professionals apart from their school teachers.

Relationships with parents and siblings are usually the strongest early relationship and involve exposure to the possible and appropriate roles for both genders (Barker and Aspray 2006). Students may also be exposed to unintentional and subtle gender bias in the home by parents (Gürer and Camp 2002). Parents are often unaware that they are teaching their children gender roles through nonverbal cues as their own gender orientations are firmly established (Henslin 1999). "These lessons continue throughout childhood" (Henslin 1999, p. 73). Students are keen observers and notice the role their parents take in everyday life (Margolis and Fisher 2002, p. 21), and students frequently model their behaviour on their same-sex parent (Moorman and Johnson 2003). Margolis and Fisher (2002) also found that parents, particularly fathers, were more actively engaged in IT activities with their sons than with their daughters. The IT attitude of their parent potentially provides inspiration for some, or despair for others, especially females, as there is an absence of strong tech-savvy female IT role models in the home (Moorman and Johnson 2003).

Paa and McWhirter (2000, p. 41) found that "both girls and boys identified their parents as important influences on their career explorations". Early parental involvement in a child's career planning has been clearly found to have a positive bearing on the choice of IT as a career (Adya and Kasier 2006). Additionally, parents' support for a child's career exploration was found to have a direct effect on the likelihood of seeking and listening to parental advice about career options (Meszaros et al. 2006). "The trust placed on parents to know what is best may override the authority of others, like advisors and/or faculty members, who are better acquainted with a wide range of career options, especially in highly technical fields, but are less trusted because they do not know a student personally" (Meszaros et al. 2006, p. 966). Dryler (1998) also found that students often make career choices in the same area as their parents' expertise because of the belief that there was more possibility of obtaining their assistance in this particular area. Moreover, Dryler (1998) established that service-class and highly educated parents promoted gender atypical occupations more than less educated, or working-class parents.

"As fathers continue to influence girls' career choices and mothers get involved in the workforce, educating parents about IT career options is important" (Adya and Kaiser 2006, p. 286). The importance of educating parents about IT careers is strengthened by the research of Hinds and Croft (2006), who found that parent perceptions about IT careers were mostly negative. These perceptions were that: IT careers could pay well, but there are few job opportunities; there is a high turnover rate; it is solitary work; it follows a boom/bust cycle; and that it is a hard and competitive field to enter. Furthermore, "mothers could benefit from additional resources about IT and other non-traditional careers so that the guidance they provide to their daughters supports the consideration of a wide range of career options" (Meszaros et al. 2006, p. 965).

Social Factor: Peers

In the absence of mentors, peers may possibly influence careers (Kram and Isabella 1985). Peer groups in the teenage years have limited impact on career, rather they influence social responsiveness, behaviours, fashion styles, and attitudes (Adya and Kaiser 2005). Peers can exert a powerful influence on a child's beliefs and behavioural choices. (Barker and Aspray 2006; Henslin 1999). "Peers influence children's beliefs about the value of education, appropriate and possible gender performance, and academic choices" (Barker and Aspray 2006, p. 34). In addition, males and females are likely to engage in different activities and acquire different competencies, patterns of expectation, values and long-term goals if their peers reinforce traditional gender role behaviours and values (Eccles et al. 1999). Moreover, "during adolescence, peer influence, particularly of boys on girls, impacts on female self-concept, self-efficacy, classroom experiences and external goal orientation" (Adya and Kaiser 2006, p. 283).

Student perceptions and attitudes towards IT are affected by the views of friends or peers, and friends play a role in student course selection decisions (Margolis and Fisher 2002). Throughout the teenage years, individuals feel an increased need to conform to the qualities that their peers feel are acceptable (Barker and Aspray 2006). Students are also generally concerned about being teased or bullied about being different and avoid subjects or activities that make them appear that way. In order to avoid negative attention from their peers, students are more likely to choose subjects that are locally considered to be appropriate for their gender role (Barker and Aspray 2006). IT classes in secondary school are predominantly filled with male students; consequently, the female students have few female colleagues to share ideas and stories with. They are also more likely to stand out in the class and feel more uncomfortable.

Peer networks can influence students' academic motivation by being a source of social interaction, by allowing them to observe the interactions of others and providing access to activities (Pintrich and Schunk 2002). It may be useful to use students who have been educated about careers in school-based interventions to facilitate career awareness and the information-gathering process amongst their peers (Paa and McWhirter 2000). Likewise, according to Margolis and Fisher (2002, p. 115), "some of the best recruiters of girls [in IT] are other girls". Gürer and Camp (2002) also recommend that in classrooms girls be paired with other girls to encourage equal access. This would also provide girls with a support system.

Social Factor: Media

The media has played an important role in providing hours of entertainment to individuals. The millennial generation are spending up to nine hours a day engaging in media consumption (Goldsborough 2016). While the amount of consumption of media is high, the media has little influence on motivating career choice, rather their focus is on enhancing gender stereotypes that focus on physical image (Adya and Kaiser 2005). "We live in a culture which specializes in manipulating our thoughts and attitudes through image" (Frieze 2005, p. 400).

Social media has become the millennial generation's primary source of information and entertainment. Eighty-five percent of millennials utilizing social media in some form and three percent viewing their news on social media sites (American Press Institute 2015, Johansson 2016). Gruman 2016 and Nhan et al. 2015 found that career portrayals on social media platforms do not accurately reflect reality. With the high consumption of social media by millennials, these unrealistic social media portrayals can have a negative impact of their career decision making when their social media developed expectations meet with reality.

Other forms of mass media, such as television, movies and magazines, also play a large role in influencing peoples' impressions of IT (Gürer and Camp 2002) and "enhance gender stereotypes that emphasise physical image" (Adya and Kaiser 2006, p. 283). Mass media images of IT carry implicit and significant messages about gender roles; computer programmers and developers are often depicted as men, while the users are frequently female (Barker and Aspray 2006, Aral and Walker 2012, Henderson and Franklin 2007).

Students who have not had actual exposure to tertiary-level IT students or professionals in the IT industry rely on images in popular culture (Goode et al. 2006). "For students living in a media-saturated society who have no access to people in the field, the Hollywood image translates into a perceived reality" (Goode et al. 2006, p. 99). Television, advertising and computer games also reinforce cultural expectations of gender and gender stereotypes (Henslin 1999). For instance, inaccurate media sources report that women cannot genetically compete with men in technical fields, which encourages females to avoid these areas (Gürer and Camp 2002).

The things that students learn at school are reinforced at home through family and entertainment, with television, music and movies reiterating gender stereotypes (Kimmel 2004). It is problematic that there is a distinct lack of both fictional and real-world role models within mass media and, where they do exist, they reinforce unflattering and negative stereotypes and spread misinformation about the use of IT in real-world situations (Multimedia Victoria 2001, Aral and Walker 2012, Henderson and Franklin 2007, Huey and Broll 2015). Often, archaic stereotypes are produced and reproduced by the media. In recent television dramas such as NCIS and Criminal Minds, both male and female IT experts are often portrayed as anti-social, powerful and intense or geeky (McLeod et al. 2013). Few students would identify with these role models.

Most advertisements in computer magazines also only show male users, or women being assisted by a male co-worker. Women will not find role models in these magazines (Carey 2001). There has been some improvement over the years with trade journals showing women in professional roles, but the problem is that teenagers do not usually access this form of media (Adya and Kaiser 2006). One of the recommendations that both Beekhuyzen et al. (2014) and Jepson and Peri (2002) make to encourage women into IT education is to create biographies and successful stories of women in IT that women can read. Several researchers are now pointing to the Internet as a means to provide role models and overcome negative stereotypes (Carey 2001; Jepson and Peri 2002). The Australian Computer Society Career Foundation Interactive ICT Career Wheel has been developed to include video biographies for each IT career path, with a good representational mix of genders in all professional aspects of the IT profession.

Structural Factor: Teachers

Teachers are expected to be highly competent, deliver a quality curriculum and prepare their students for future careers, but many teachers are under-prepared to deliver the IT curriculum in the classroom (Goldman 2003). Students are being taught by teachers with a disparate range of IT skills (Barker and Aspray 2006), partially due to the level of exposure and training the teachers have received in their pre-service and in-service education, and their access to software and hardware (Goldman 2003). While teachers are expected, through cultural or organisational pressure, to undertake training to improve their IT skills (Goldman 2003), many of them struggle to keep pace with changes in technology (Multimedia Victoria 2001).

To prepare students in IT, teachers must have the knowledge and ability to teach relevant content (Margolis et al. 2012). However, perceptions among teachers and administrators is that teaching and learning IT is daunting and technically challenging (Yadav et al. 2017). Specifically, schools have a lack of teachers with the knowledge and ability to provide computer science instruction (Ozturk, Dooley and Welch, 2018). IT curriculum may not be enough to guide teachers who decide to teach the concepts without having a clear understanding of the content (Ozturk et al., 2018).

Barker and Aspray (2006) reiterate the need for these teachers to undertake training in IT areas, as well as the need to provide teachers with the time to be able to implement IT effectively in the classroom. For example, Lai and Pratt (2004) found that, on average, IT coordinators (a teacher whose supports the IT professional development of teachers and coordinates IT implementation in their school) spent the equivalent of one month's full-time work doing IT-related professional development, primarily in their own time. While these IT coordinators are respected by their colleagues as leaders, this role is often seen as an additional function on top of their normal teaching responsibilities (Lau and Pratt 2004). Barker and Aspray (2006, p. 43) believe that "policy has not enabled teachers the time, training, or reward structure to incorporate newfound access into effective learning strategies".

Technology is evolving at an exponential rate and, over the years, teaching has also changed by reflecting new technological developments (Goldman 2003). IT is now considered an integral part of the curriculum and pedagogy, (the Australian National Curriculum: Digital Technologies and the Queensland Studies Authority Technology curriculum are discussed in section 2.4), but this complicates the demands and issues around effective teaching practices. Teachers who did not grow up with IT frequently assume that the teaching methods used when they were students will work just as well for their current students, but Prensky (2001a, p. 3) states "that assumption is no longer valid". There is also an expectation that the number of teachers who have all the required skills to integrate IT into their pedagogy is increasing at the same rate as the technology, but this does not match reality (Goldman 2003). Teachers also need to consider the tools that they use in their IT pedagogy. According to Huff (2002), there is often a male bias in educational software used within the classroom, with programs designed for students generally looking like software designed for boys. Most teachers also see computers as tools (King and Bond 2001), and they may unwittingly be weaving gender stereotypes into IT due to the software being used within the classroom (Huff 2002). Correspondingly, Dorman (1998) states that it is the way that we use computers that reinforces gender bias, not the computer itself.

"Teachers are generally perceived by their students as having legitimacy, authority, and expertise; they thereby influence the opinions and behaviours of their students, both in short and long terms" (Barker and Aspray 2006, p. 20). Teachers are particularly important role models for students (Downes 2004); they need to inspire and engage students, who look up to them, by showing that they enjoy and are comfortable and capable with IT. Furthermore, additional research evidence shows that teachers who role-model the use of IT in their teaching practices help their students to build confidence and competence as IT users – self-efficacy (Matthew et al. 2002). Having good role models in the IT classroom is also important for the recruitment of students. The career decisions of students, especially high achievers, are influenced by, amongst other factors, the kind of role-modelling and attention that they receive from their teachers (Watson et al. 2002). Correspondingly, Cuny and Aspray (2000) also report that several students confirm that having a teacher working with them and encouraging them influences their decision to enter the IT domain.

Structural Factor: Curriculum

"Inevitably, the use of [IT] in education shapes the teaching and learning activities" (Lim 2002, P. 412). Teaching information literacy or fluency is not enough to prepare students for IT careers, as it does not teach them the fundamentals of IT which are crucial for these jobs (Barker and Aspray 2006). Moreover, the degree to which students are exposed to computer applications, programming and games varies between schools (Barker and Aspray 2006). For example, "even at schools that are 'heavily wired', computer science is too often interpreted as 'computer literacy' and only low-level user skills are taught" (Goode et al. 2006, p. 91). Research is now analysing the variety of IT use, rather than placing the problem with females, "which implies the acknowledgement that technology is not necessarily beneficial and that non-users may be so by choice" (Gansmo 2006, p. 724).

Considerable evidence points to the content and delivery of the secondary IT curriculum being an important factor in interesting students to continue in IT pathways (Newmarch et al. 2000).

Technology impacts every aspect of daily life, and software and hardware interactions continue to increase exponentially in school, work, and recreation (Teo and Zhou, 2017). Even though computer use in classrooms is common for everyday teaching and learning, students often take passive roles as users of hardware and software (Carter, 2014; Peters and Araya, 2011). The way that computers are introduced into the curriculum lacks the relevance and interest needed to attract students into IT study or career paths (Scott 1996). Scott (1996) also believes that students “must be encouraged to use computers for completing projects in a range of subjects across the curriculum and given the opportunity to develop an appreciation of the diverse uses of computers”. McLachlan, Craig, and Coldwell-Neilson (2016) suggest that while students’ overall technology interest is positive, “the disheartening result is that students are still not interested in undertaking further computing study”. Fisher et al. (2016) and Craig and Horton (2009) reported that classroom lessons need to include activities that are creative, challenge the stereotypical image of IT being boring and are not just about programming.

The curriculum and teachers may also overly or subtly reinforce gender differences and inequalities (Kimmel 2004). IT course selection can be influenced by parents, teachers and guidance counsellors steering the students away from these courses (Barker and Aspray 2006). Ashcraft, Eger, and Friend (2012) stated that the curriculum should also demonstrate how technology can improve peoples’ lives. They found that girls are more positive towards IT when the curriculum incorporates group work or cooperative assignments rather than individual projects. The preference for girls is for topics that tap into their interests and prior knowledge (NCWIT 2015).

Primary and early secondary school students are first exposed to IT education through the integration of IT in the general school curriculum. It is usually only when students leave the junior high school years of schooling that they have the opportunity to choose elective IT-specific subjects. Without learning experiences in primary and early secondary school, students are not prepared to enrol and succeed in IT classes in later years. This omission leads to a decline in enrolment at secondary school levels (Krauss and Prottsman, 2017).However, many of the names given to, and images associated with, school IT subjects frequently do not reflect the true nature or creativity of the subjects (Courtney et al. 2006). Furthermore, “the choice of courses is based not solely on what they enjoy but the type of person they hope to be and the type of person they hope their peers will believe they are” (Barker and Asprey 2006, p. 34). They also choose elective subjects based on their personal experiences and abilities (Young 2002). Another problem with the secondary IT curriculum is its lack of relevance for further study programs. Currently, senior IT subjects are not a prerequisite for tertiary IT programs. Universities have also found that the composition and content of IT subjects frequently do not reflect the typical tertiary IT curriculum (Sheard et al. 2001). By year eleven, students are competing in the competitive tertiary entrance system, and it is often too late for them to explore alternative subjects and career pathways, so previous experiences in junior high school IT subjects are used in their decision process (Courtney et al. 2006).

Schools have both a manifest function (the formal education and transmission of skills) and a latent function, which includes universality and hidden curriculum (Henslin 1999). The hidden curriculum involves "understandings, values and attitudes that are implicit in school structures and the way material is taught" (Krause et al. 2003, p. 267). Barker and Aspray (2006, p. 16) state that "what is taught at school and what students are required to learn influences students' (and parents') beliefs about what knowledge is important and what is interesting". Consequently, the naming and content of subjects, along with the elective nature of IT classes, can cause the student to forego enrolling in elective IT classes because of misleading information and student perceptions. Gürer and Camp (2002) recommend that, in order to prepare students for tertiary IT study paths, IT classes should be implemented into the basic school curriculum. These classes should provide students with appropriate IT skills, and interesting and challenging projects.

Niles and Harris-Bowlsbey (2015) found that subject selection and career decisions can be affected by life experiences, personal values, self-knowledge, self-efficacy, and knowledge about careers. Bandura et al. (2001) indicate that a student's self-efficacy is the effect that their own beliefs about their ability to perform tasks successfully influence their actual task performance. Increasing a student's self-efficacy of IT, the belief that they have the capability to perform IT tasks, is an important construct in a students' self-image (Bandura 1997). McInerney et al. (2006) found that while there were several factors that were significant to students' career choices, it is their self-efficacy towards Information Technology that is the primary influence.

Thomas and Allen (2006) investigated the perceptions that students in tertiary education have towards IT as a career. It was found that Australian undergraduates are deciding not to pursue IT careers, despite the amount of exposure to IT content they receive in pre-tertiary schooling. Negative stereotypes, such as that professionals in these careers do technical work on a computer all day and have few opportunities to work with others, were found to detract students away from studying IT. The research found that "changing these perceptions requires the computer profession to become more aggressive in public relations and showcasing its stars" (Thomas and Allen 2006, p. 177). Negative stereotypes towards IT cause students to struggle to identify IT as a future career (Cussó-Calabuig et al. 2018; Michell et al. 2017; Cussó-Calabuig et al. 2017; Masters et al. 2016). Education providers need to reshape their curriculum to make it more appealing to potential students.

Previous research has been undertaken (Appendix 2.1: Genrich, Toleman and Roberts 2014) into understanding the Social and Structural factors influencing student perceptions affecting their decision to study information technology in later years of high School and at university. This research was undertaken using focus groups and a survey involving recent high school graduates, to seek corroboration as to the impact these factors have on student perceptions of Information Technology. The key findings of this initial research were that the Curriculum and Teachers are two factors that could be manipulated through an intervention career focused IT curriculum at junior high school level to improve student perceptions of the IT discipline and to improve the number of students considering further IT studies and careers.

The literature on career development theories identifies that learning experiences through teachers and the curriculum can have an important effect on both the student's self-efficacy and their outcome expectations (Brown and Lent 2012; Adya and Kaiser 2005).

This literature has been used to review the initial overarching Research Question as outlined in chapter 1. From the literature, it was found that increasing student self-efficacy and outcomes expectations towards IT will impact students' perceptions of IT careers. The literature has indicated a need that a research sub-question is required to further investigate this finding. These findings are used in the development of an IT Careers Interest (ITCI) instrument to measure the change in student perceptions towards IT careers. The research sub-question has been identified as:

> **Research Question 1a: What factors contribute to an information technology career survey instrument to test changes in student perceptions towards information technology careers?**

The literature in section 2.5 investigated more appropriate Information Technology curriculum for junior high school students and teaching methods that have the highest potential to impact the perceptions of the IT discipline and IT careers in secondary education students. The IT Careers Interest (ITCI) instrument was used to measure this impact.

The following section of the literature review outlines the current national curriculum requirements for foundation to year ten schooling in Australia. These guidelines play a significant role in what IT curriculum is currently taught. It examines the current level of IT careers curriculum that is required to be taught.

2.4 Australian IT Curriculum

The Skills Framework for the Information Age (SFIA) is a practical resource for people who manage or work in information systems-related roles of any type (SFIA Foundation 2015). It is one of the underpinning frameworks for many professional accreditation bodies around the world including institutional curriculum accreditation of Australian universities by the Australian Computer Society.

The Australian National Curriculum is a set of consistent national standards for education in Australia across eight learning areas: English, Mathematics, Science, Humanities and Social Sciences, the Arts, Technologies, Health and Physical Education, Languages, and Work Studies (Australian Curriculum 2019e). The Technologies area is divided into two subjects: Design and Technologies, and Digital Technologies. The Design and Technologies subject focuses on students using design thinking and technologies to generate and produce designed solutions for authentic needs and opportunities (Australian Curriculum 2019f). The Digital Technologies subject focuses on students using computational thinking and information systems to define, design and implement digital solutions (Australian Curriculum 2019a). These two Technology curriculums are being implemented in foundation school enrolment to year ten. Appendix 2.2 contains the full sequence of content from foundation school enrolment to year ten of the Australian Curriculum, Assessment and Reporting Authority Digital Technologies Curriculum.

Outside of the Technology learning area and the two subject areas, under the National Curriculum, all other learning areas are also engaged in the use of Information Communications and Technology (ICT) through the ICT General Capability whereby students learn to use IT effectively and appropriately to access, create and communicate information and ideas, solve problems and work collaboratively in all learning areas at school. The capability involves teaching students to learn to make the most of the digital technologies available to them, adapt to new ways of doing things as technologies evolve and limit the risks to themselves and others in a digital environment (Australian Curriculum 2019a). There are seven General Capabilities under the Australian Curriculum: Literacy, Numeracy, Information communications and technology (ICT), Critical and creative thinking, personal and social capability, ethical understanding, and Intercultural understanding.

The Queensland Studies Authority (2015) also has a foundation school enrolment to year nine Technology curriculum which is in use within Queensland Schools. This curriculum's focus is broader than Information Technology, focusing on the following two areas of knowledge and understanding:

- Technology as a human endeavour – focusing on technology influences and the impacts on people, their communities and environments in local and global contexts, and
- Information, materials and systems (resources) – focusing on resources originating from different sources, existing in various forms and manipulated to meet specifications and standards to make products.

Any intervention career-focused IT curriculum at junior high school level would need to be designed to incorporate the National Curriculum Technology - Digital Technologies stand learning objectives and the Australian Curriculum ICT capabilities, as well as the current Queensland Prep – 9 Technology curricula.

The following section of the literature review investigates the type of tech-savvy teaching tools that can have an impact for teachers in engage their students within an intervention career-focused IT curriculum at junior high school level. It examines how the current generation learn and the technologies that will improve student self-efficacy towards IT.

2.5 Teaching Tools for the "Millennial" Generation

The current generation is often referred to as the "Millennial" generation – also known as "Generation Y" or the 'Net Generation' (Dimock 2018; Burke and Ng 2006; Oblinger and Oblinger 2005; Zemke et al. 2000; Barnard et al. 1998). They have and "are being socialized in a way that is vastly different from their parents" (Prensky 2001a, p. 1). Many of them were introduced to IT as toddlers, or during early childhood education, and have been "socialized to use computers and the Internet from an early age" (Durndell and Miller 2006, p. 696). Consequently, they are confident and competent users of computers, mobile phones, the Internet, email, and instant messaging. Moreover, they have become accustomed to the connected, graphics-oriented, random-access, quick payoff, twitch-speed world of computer games, the Internet and music videos (Prensky 2001b). They are also anecdotally just-in-time consumers of information, who find theoretical knowledge irrelevant (Langridge 2003) and are often bored by traditional educational methods (Prensky 2001b).

Students come to the classroom with a social media presence, podcasts of their favourite comedian or area of interest on their smartphone, and experience in virtual reality through the games they are playing. Students use digital media frequently and ubiquitously in their everyday lives (Calvani et al. 2012).and they express a great deal of confidence in their own technology ability, even when such confidence may be unfounded (Katz and Macklin 2007; Ng, 2012; Prior et al. 2016; Wilkinson 2006). In some respects, they are more tech-savvy than their teachers (Harris and Rea 2009). The benefits of youth participation and learning potential in digital media environments have been increasingly documented in recent years (Cohen and Kahne 2011; Klopfer et al. 2009; Lemke et al. 2009; Palfrey and Gasser 2008). “Good learning requires that learners feel like active agents (producers) not just passive recipients (consumers)” Gee (2005). Computer literacy skills enable “students to exploit new simulation tools, information appliances, and social networks; they facilitate the exchange of information between diverse communities and the ability to move easily across different media platforms and social networks” (Jenkins et al. 2006).

Youth participation and learning potential in digital media environments has been the focus of several studies across different disciplines (Cohen and Kahne 2011; Gee 2005; Jenkins et al. 2006; Lemke et al. 2009; Palfrey and Gasser 2008). Tezci and Içen (2017) observed that YouTube was the most frequently used social media by students, second Facebook and third Twitter. Another digital media environment for students is the use of computer-based games. When they are used as a source of information and for enhancing children’s learning they have resulted in positive educational outcomes (Mitchell and Saville-Smith, 2004; Chen et al. 2011; Baghaei et al. 2016; Yusoff et al. 2018).

An earlier study by Klopfer et al. (2009) examined the educational use of popular social media that students are already familiar with, such as Facebook, Twitter, and games like Sim City. Their findings identified the positive implications of these technologies in enhancing students’ social network and data management skills, but also acknowledges the unique challenges that accompany the use of these tools in the classroom. Many of the digital media skills students identified were surface-rather than deep-level in nature. Dinsmore and Alexander (2012, 2016) identify the difference between surface versus deep-level strategies as between strategies aimed only at the superficial processing or encoding of information (e.g., navigation, digital reading). Much of the research towards educational use of digital media has been conducted in after-school or outside-of-school groups where Internet filters do not restrict access to information. In these settings students regularly participate in rich online media spaces downloading and producing content (Lenhart et al. 2010; Oblinger 2008; Rideout et al. 2010).

While students are immersing themselves in digital media at home, it was found that teachers still persist in only using technology for preparing and demonstrating instruction or for administrative tasks rather than integrating it with students' course work (Gray et al. 2010; Rakes et al. 2006). There needs to be a shift in teachers' usage of these technologies to engage their students to use these tools that they are already using at home, in the classroom context.

Chittleborough et al. (2008) demonstrated that teacher attitudes, student engagement, and learning increased in science classrooms when using digital media within scaffolded instruction. The use of digital learning technologies themselves were not thought to produce higher order thinking or learning; scaffolds, collaborative environments, and teacher attitudes were key in their success.

While it is important for teachers to focus on good teaching, they also need to evaluate the student's perception of the subject in relation to whether it is intellectually challenging, interesting and useful (Mitchell et al. 2000). Many students report negative opinions of IT-specific subjects and general dissatisfaction with IT curriculum (Carey 2001; Multimedia Victoria 2001). Both genders found secondary school IT classes boring (Pau et al. 2005; Teague 1998) because they had lost the element of fun and creativity, and there was little difference between what is taught at the primary and secondary school levels (Pau et al. 2005). Hinds and Croft (2006) also found that most students are open to less classical and more creative ways of solving problems and they find that teaching IT in a step-by-step manner dampens their interest. Furthermore, students are obtaining a skewed view of the IT field because of the IT curriculum focus on mastering software packages and the perception that IT is simply word processing (Downs 2004; Newmarch et al. 2000).

Media applications such as tagging, social networks, virtual worlds, data mashups, gaming, and blogging offer rich learning opportunities shaped by participation (Jenkins et al. 2006; Oblinger 2008; Thomas and Seely-Brown 2011) and adolescents are increasingly involved in these new, alternative complex spaces for communication, collaboration, and production (Barab et al. 2005; Jenkins et al. 2006; Steinkuehler 2010).

Advanced IT classes often lack a context that captures the interest of students (Goode et al. 2006). A student's interest in a class is determined by having a broad awareness of the domain, specific past experiences in previous classes on the subject, and their self-efficacy of the subject matter (Kahu et al. 2017). Considerable evidence points to the content and delivery of the secondary ICT curriculum being an important factor in interesting students, especially girls, to continue in ICT pathways (Newmarch et al. 2000). Educational programs geared toward attracting student to IT seek to provide positive experiences with technology and education in order to negate the perception that IT is boring (Outlay et al. 2017) One solution to raise students' interest in IT classes is to introduce tech-savvy web-based learning experiences, such as wikis, blogging or multimedia podcasting development, into the secondary school curriculum to provide an engaging and interesting experience for the students (Chawinga 2017; Jones 2015; Downs 2004). Before engaging with tech-savvy web-based learning tools, students should be introduced to the breadth of IT careers. Reception and/or elevator pitches allow students to investigate a new concept and communicate their findings in a scaffolded manner (McCollough et al. 2016).

Career choice intervention methods (e.g., counseling, career classes, workshops) are, on the whole, reasonably efficient and demonstrably effective (e.g., Brown and Ryan Krane 2000; Whiston et al., 2017), offering valuable help to many people who seek assistance with career decision-making.

2.5.1 Tech-Savvy Web-based Learning Tools

Today's students are creative, interactive, and media-oriented; they use Web 2.0 technologies in their everyday lives; and believe that more use of such technologies in school would lead to their increased preparation and engagement (DeGennaro 2008; Solomon and Schrum 2007; Spires et al. 2008).

Borsheim et al. (2008) suggested blog and wiki use honed necessary multiliteracy practices in English classrooms. Another review of research on podcasting to teach English Language learners revealed student's attitudes and learning greatly increased when compared to traditional methods. In most cases, students improved skills related to speaking, listening, grammar, and pronunciation (Hasan and Hoon 2013). Harris and Rae (2009) identified wikis, blogs and podcasts as three technology media tools that can facilitate learning in Information Systems education. They state the advantages of using these technology media tools are that the student becomes part of the lesson, and the world becomes the classroom. Galagan (2009) and Harris and Rae (2009) also acknowledge that collaboration and competition by using these technology media tools also increase learning.

The following literature identifies where education practice of digital media has been undertaken in the classroom.

Reception / Elevator Pitches

Elevator pitches are a successful strategy used in the classroom as a method of student exploration on a given topic and peer learning through effective and succinct presentation of ideas back to the class. “Elevator pitches are so named because the proposition is that one is sharing an elevator with a potential investor and has only the time of the ride to make a pitch and secure a follow-up appointment” (McCollough et al. 2016). Elevator pitch teach students the ability to distil their idea into a short statement that summarises all key points effectively, and quickly communicate this to various stakeholders (Clark 2008; Hoehn-Weiss et al. 2004; Mason and Harrison 2003; Davidsson and Honig 2003; Baron and Markman 2003). In the most typical pitch format, students stand in front of judges and deliver a memorized one- to two-minute proposal. McCollough et al. (2016) examines the strength of a new format for the elevator pitch: the reception format, where students work in teams to develop their pitches, and present their pitch in teams, allowing for more time of questions and answer at the end of the team’s pitch.

Wikis

Parker (2007) observed that “course content is no longer static; with a wiki it is ever-changing and can evolve through a course and beyond” (p. 290). A wiki is essentially a collection of interlinked Web pages that allows users to create, edit, and link web pages easily in a collaborative effort. Cronin (2009) examined the use of wikis in tertiary marketing classes. The research concluded that that the wiki work improved the collaboration skills of students.

Blogs

Unlike using a wiki, teaching practices using blogs focus on students working individually with feedback and comments from peers or instructors. Students then individually reflected on the feedback and produced a final version of their work (Hew and Cheung (2012). The use of blog appears to have a positive impact on student writing and critical thinking ability (Arslan and Sahin-Kizil 2010; Salam and Hew 2010; Wong and Hew 2010).

Podcasting

Students should develop their own podcasts that contain either original material or that analyse and deepen the understanding of existing material (Jonassen et al. 2008; Putman and Kingsley 2009). Jonassen et al. (2008) identified that the technical aspects as well as the decision-making processes involved in producing a podcast offer students a unique learning opportunity and would provide them with a greater sense of ownership.

From the literature, it was found that the development of the IT Careers Curriculum, using tech-savvy teaching tools, that will assist students in increasing their self-efficacy and outcomes expectations towards IT, will impact students' perceptions of IT careers. The literature indicated a need that a research sub-question is required to further investigate this finding. The research sub-question has been identified as:

> **Research Question 1b: What content and teaching approach contributes to an information technology career curriculum, using tech-savvy teaching tools, that could be developed to influence student perceptions towards information technology careers?**

2.6 Mixed-Methods Research Approach

The combined use of quantitative and qualitative methods in the same research is becoming an increasingly popular approach in the field of information technology. Mixed methods provide an opportunity to develop novel theoretical perspectives by combining the strengths of quantitative and qualitative methods (Tashakkori, Teddlie & Teddlie 1998). This approach offsets the weakness and draws on the strengths of both methods (Bryman 2006). A research study based on purely quantitative approach may not always provide rich insights into IT phenomena. Similarly, a research study based on purely qualitative approach may not provide findings that are robust and generalizable to other settings. The reason is the difficulty in collecting qualitative data from many different sources (Venkatesh, Brown & Bala 2013). A mixed-methods approach provides an opportunity for IT researchers to develop novel theoretical perspectives (Venkatesh, Brown & Bala 2013). Also, the mixed-methods approach helps in understanding complex data and gives a more complete and comprehensive account of the enquiry (Bryman 2006; Creswell et al. 2003).

Combining quantitative and qualitative types of research into an integrated framework has been criticized because these research approaches are said to be incompatible (Bryman 2006). Perhaps this explains the limited application of this method in the Information Systems (IS) field (Venkatesh, Brown & Bala 2013).

Despite calls for use of quantitative and qualitative research in IT, the use of mixed-methods in IS has seldom been used (Venkatesh, Brown & Bala 2013). In response to this need, Venkatesh, Brown and Bala (2013) developed a set of guidelines for conducting mixed-methods research together with an illustration of its applicability.

In their paper they propose six steps as guidelines for conducting mixed-methods research. The guidelines are:

- Step 1: Decide on the appropriateness of a mixed-methods approach
- Step 2: Develop strategies for mixed-methods research designs
- Step 3: Develop strategies for collecting and analysing mixed-methods data
- Step 4: Draw meta-inferences from mixed-methods results
- Step 5: Assess the quality of meta-inferences
- Step 6: Discuss potential threats and remedies.

These guidelines were followed by the researcher to select best mixed- method design for this research.

2.6.1 Quantitative Research

To measure the improvement of student perceptions of IT careers through implementing the IT Careers Curriculum, data from the IT Career Interest (ITCI) instrument was collected, before and after the IT Careers Curriculum. The quantitative measurement focused on the change in student perceptions and was tested through the following research sub-question:

> **Sub-Question 1c: Focussing on quantitative measures, how does the implementation of an information technology career curriculum, using tech-savvy teaching tools, impact student perceptions towards information technology careers?**

2.6.2 Qualitative Research

Using the Mixed-Methods research design, the change in student perceptions through the implementation of the IT Careers Curriculum were also tested through qualitative measures. Student focus groups were conducted after the conclusion of the IT Careers Curriculum. The following research sub-question qualitatively tested the students change in perceptions towards IT careers:

> **Sub-Question 1d: Focussing on qualitative measures, how does the implementation of an information technology career curriculum, using tech-savvy teaching tools, change student perceptions towards information technology careers?**

Teacher interviews were conducted after the conclusion of the IT Careers Curriculum. The following research sub-question qualitatively tested whether there were differences between the teachers' views and their students' in the changes towards perceptions of IT careers. Qualitative analysis through interviews with the IT class teachers were also undertaken to compare the teachers' views to their students' views towards information technology careers after the implementation of an information technology career curriculum. The following sub-question qualitatively tested the differences between these two views.

> **Sub-Question 1e: How do the views of the class teachers differ from their students' perceptions towards information technology careers after the implementation of an information technology career curriculum, using tech-savvy teaching tools?**

The content and learning approach that was developed from the literature on best practice for teaching the "millennial" generation, including the use of tech-savvy web-based learning tools was tested through the student focus groups. The following sub-question qualitatively tested the effectiveness of the learning experience from the students' perspective:

> **Sub-Question 1f: What was the effect of the information technology career curriculum, using tech-savvy teaching tools, on the students' learning experience?**

The content and learning approach that was developed from the literature on best practice for teaching the "millennial" generation, including the use of tech-savvy web-based learning tools was also tested through the teacher interviews. The following sub-question qualitatively tested the effectiveness of the learning experience from the teachers' observations as they taught the IT Careers Curriculum:

> **Sub-Question 1g: What was the effect of the information technology career curriculum, using tech-savvy teaching tools, from teachers' observations, on their students' learning experience?**

2.7 Chapter Summary

This Chapter has presented and explored a range of academic literature with regard to students in junior high school education and the factors that influence their decision to participate in IT courses in senior secondary school and tertiary studies, and ultimately IT careers. In order to accomplish this, literature from a diverse range of research disciplines, including information systems and computer science, education and educational psychology, careers psychology, sociology, was reviewed to provide a holistic view of the problem domain.

Literature regarding the current research into the limited enrolments and career selection of students found that student perceptions of IT careers played a significant role. Student perceptions of IT subjects were found to be impacted upon by limitations in junior high school IT curricula, the lack of understanding of what is taught in senior and tertiary IT courses, and poor stereotypes depicted in the media. Much of the research into low IT enrolments and career pathways has focused on gender – why girls / women opt out of pursuing a career in IT. Non-gender factors attributed to low enrolments in IT programs were found to include economic conditions (such as the Global Financial Crisis), and curriculum quality and lack of relevance to industry in secondary school IT courses. Individual factors, such as students' self-efficacy, attitudes, outcome expectations, social support, and social norms, have also been identified as effecting student perceptions of IT courses and careers. Prospective students were found to hold highly negative misperceptions about IT studies, related professions, and job availability. The literature posited that to fix the problem solutions need to be formulated in the early years of schooling – primary and lower secondary school. Finally, the school curriculum and the way in which it is taught and assessed was also identified as a factor influencing student perceptions.

Literature about career development theories that focus on careers choice development of school-age students were explored. Gottfredson's (2002, 2005) theory of Circumscription, Compromise, and Self-creation was investigated to understand the key student age groups where a student's self-career development occurs, and especially where careers are removed from further career exploration. This theory identified that the third stage of career development, orientation to social valuation - between ages nine and thirteen (late primary and junior high school) - was the point where students eliminate from further consideration any career path that they see as too low in prestige, irrelevant, mundane or that seems to be out of reach in terms of ability or effort required. From this literature review findings, year nine high school students were selected as the target group for this research.

Lent, Brown, and Hackett's Social Cognitive Career Theory (SCCT) (2002, 2006) was explored to identify the factors that influence student careers decision making, including Bandura's (1986) Social Cognitive Theory (SCT) on self-efficacy, and Lent et al. (2002, 2006) personal and environment factors (gender, culture, barriers, and supports) that affect student career exploration and career selection. From the literature review into SCCT, the type of careers intervention to be implemented in this research was found to require a focus on building students' self-efficacy and outcomes expectations.

Finally, Adya and Kaiser's (2005) social factors (family, peer group, and media), and structural factors (teachers and curriculum) were explored. The social factors of family and peer groups were found to play an important role in developing role models for students to assist their career exploration but were found to be difficult to influence in a career intervention strategy. The structural factors teachers and curriculum were also found to be important and linked to students' perceptions. Teachers were found to be an important role model for students, but often in junior high school, they have a disparate range of IT skills and lack of time, training and experience with IT to be able to effectively use IT in the classroom and deliver an inspiring IT curriculum (Adya and Kaiser 2005). Many students reported negative opinions of IT-specific subjects and general dissatisfaction with IT curriculum. The Australian National Curriculum was also examined and found to lack any IT Careers Curriculum from foundation to year ten level schooling. From this literature review findings, the careers invention that would have an impact on student perceptions towards IT careers was identified as an IT careers focus curriculum implemented in year nine, with a focus on improving students' self-efficacy and outcomes expectations towards IT.

The literature on the teaching tools that would improve the current "millennial" generations' self-efficacy and outcomes expectations were explored. Tech-savvy web-based learning tools such as wikis, blogs, and multimedia podcasting were identified. These tech-savvy web-based learning tools will be used in the IT Careers Curriculum intervention presented to year nine high school students to test the overarching research question of this study.

Mixed-method research was selected as the best approach to answering the overarching research question. Based on this approach, the overarching research question has been reviewed from a literature and methodological point of view. Seven sub-questions have arisen from the review focusing on specific aspects of the research as informed by the literature.

The next chapter presents the research plan as it relates to the research philosophy, design, methods, and approach.

Chapter 3 Methodology

3.1 Chapter Introduction

In Chapter 1 the overall direction of this study was identified as an investigation of how providing junior high school students with a comprehensive understanding of the scope and breadth of information technology careers would influence their perceptions of such careers. Through a review of the literature across several fields, Chapter 2 identified junior high school students as the key career developmental stage in a student's life where they progressively discount career alternatives that do not meet their image of self (circumscription) and amend their self-image to accommodate real-world constraints in favour of other career alternatives (compromise).

Students' self-efficacy, as well as outcomes expectations and other personal and environmental factors were identified as playing a significant role in shaping a student's self-image. Social Cognitive Career Theory (SCCT) examines the conditions that can limit or strengthen the ability to influence students' self-image. Personal, environmental and learning experience variables are seen to influence a student's interests and career choice goals. These variables can be examined as the social factors (e.g. family, peer group, and media), and the structural factors (e.g. teachers and curriculum). Each of these factors can play a role in either strengthening or limiting a student's self-efficacy, and also their outcome expectations of IT careers, leading to career choices.

This chapter details the research approach and methodology employed for this study. This includes explanation of the research philosophy, methodology, design and data collection method used in this study. There are several research approaches and techniques that can be used, but the choices made in this study are related to the research aim and overarching research question:

> **How does an information technology career focused curriculum, using tech-savvy teaching tools, impact on year nine student's' perceptions toward information technology careers?**

This Chapter commences with a discussion of the research philosophy for the study, outlining the ontological and epistemological position for the research in section 3.2. Section 3.3 discusses the research methodology for the thesis, and this is further elaborated on in section 3.4 where the use of the mixed-methods approach as the research methodology is discussed, including the quantitative and qualitative study methods used to measure the impact of the IT

Careers Curriculum intervention that is the focus for answering the overarching research question. Section 3.5 discusses the research plan outlining the steps taken by the researcher in answering the research questions adequately, accurately and validly.

Section 3.6 outlines the University of Southern Queensland and Education Queensland ethics and research approvals.

Section 3.7 describes the methodology used in the development of the Information Technology Career Interest Instrument (ITCI). It addresses the method for answering research sub-question 1a that was identified from the literature:

> **Research Question 1a: What factors contribute to an information technology career survey instrument to test changes in student perceptions towards information technology careers?**

Section 3.8 describes the methodologies, stages and hurdles involved in the development of the Curriculum Design. It addresses the method for answering sub-question 1b that was identified from the literature:

> **Research Question 1b: What content and teaching approach contributes to an information technology career curriculum, using tech-savvy teaching tools, that could be developed to influence student perceptions towards information technology careers?**

The mixed-methods quantitative and qualitative methodologies used to analyse the resultant two-week IT Careers Curriculum are then described.

Quantitative methodologies are discussed in section 3.9 in the analysis of the IT Career Interest Instrument (ITCI) and address the method for answering sub-question 1c that was identified from the literature:

> **Sub-Question 1c: Focussing on quantitative measures, how does the implementation of an information technology career curriculum, using tech-savvy teaching tools, impact student perceptions towards information technology careers?**

Qualitative methodologies are discussed in section 3.10 through the use of IT Careers Curriculum focus groups and section 3.11 through the use of IT teacher curriculum feedback interviews. These qualitative research methodologies address methods for answering sub-questions 1d, 1e, 1f, and 1g, identified from the literature:

> **Sub-Question 1d: Focussing on qualitative measures, how does the implementation of an information technology career curriculum,**

using tech-savvy teaching tools, change student perceptions towards information technology careers?

Sub-Question 1e: How do the views of the class teachers differ from their students' perceptions towards information technology careers after the implementation of an information technology career curriculum, using tech-savvy teaching tools?

Sub-Question 1f: What was the effect of the information technology career curriculum, using tech-savvy teaching tools, on the students' learning experience?

Sub-Question 1g: What was the effect of the information technology career curriculum, using tech-savvy teaching tools, from teachers' observations, on their students' learning experience?

3.2 Research Philosophy

This section presents the philosophies underlying this research. The research philosophy provides the grounding for any research assumptions that can guide the different choices made during the research process. There are three sets of assumptions essential to any research procedure, namely ontological, epistemological and methodological (Saunders, Lewis and Thornhill 2012).

Ontology is associated with the nature of things which is the belief of reality (Floridi 2004). According to Bryman (2001), there are two fundamental philosophical stances on ontology; positivism and constructivism. Positivism assumes the social phenomena is independent or separate from the actors within it. Constructivism portrays reality as a social construction where social phenomena and their meanings are continually being changed and revised through social interaction (Bryman 2001).

Epistemology examines what is the best way to study the world, how knowledge should be acquired and interpreted. This philosophical stance is applied throughout various research paradigms (Saunders, Lewis and Thornhill 2012). The three paradigms relevant to the current study are: positivism, interpretivism and pragmatism.

1. **Positivism**: Kuhn (2012) stated that the positivist approach is based on the belief that a single reality exists. This approach deals with verifiable approach, there is no room for subjective opinions of the researcher. Positivist research is normally associated with quantitative rather than qualitative research (Creswell 2009).
2. **Interpretivism**: Bryman and Bell (2011) stated that interpretivism involves access to reality which is only available through social constructions such as language and shared

meanings. There is no single reality. Interpretivism is generally associated with a qualitative research approach that attempts to understand phenomena via the meanings assigned to them by participants (Thanh & Le Thanh 2015; Walsham 2006).

3. **Pragmatism**: Pragmatism adopts the philosophical assumption that there are many ways of looking at the world and that there is no single view that can describe the entire picture (Saunders, Lewis & Thornhill 2012). Pragmatism is widely associated with mixed-method research (Ivankova, Creswell & Plano Clark 2007).

3.2.1 Research Philosophy of this Thesis

The ontological stance of this thesis is constructivism. The focus of this research is to develop an information technology careers focused curriculum for students in year nine that will have an impact on student perceptions towards an IT careers. In order to test the impact of the curriculum, this research developed a survey instrument to test changes in students' perceptions upon completing the IT careers focused curriculum, it also developed a set of focus group questions to further investigate students' change in perceptions from a qualitative perspective, and finally developed a set of interview questions to investigate the students' change in perceptions from their teachers perspective. In order to achieve this, the research requires insight into the current curriculum being taught in year nine IT classes. From the literature review, it was established that there is no IT careers curriculum being taught to students in foundation through to year ten schooling in Australia.

The epistemological position for this research can be described as pragmatism. It allows the researcher to concentrate on usefulness of outcome of the research to practice using the most appropriate and applicable methods. In this research, the researcher is also a practitioner, teaching one of the information technology classes, providing training to the other teachers in the IT careers curriculum, and therefore very close to the actors. Therefore, the pragmatism approach is the most useful approach to adopt in understanding this process. A pragmatist stance provides the researcher a greater opportunity to uncover the richness of the factors that influence and impact the delivery of an information technology careers focused curriculum to year nine students.

3.3 Research Methodology

"Research methodology" is the means used to find the answers to the problem being investigated, by taking the steps needed to conduct the study. To enable the researcher to gain the necessary information and insights into the dynamic nature of factors influencing students' perceptions of information technology careers, the mixed-methods approach is used.

The mixed-methods approach to research is applied to combine the procedures, methods, methodologies and language of both quantitative and qualitative in a single study (Johnson and Onwuegbuzie 2004). Creswell et al. (2003) mentioned different types of methods or strategies that can be used to conduct the mixed-method approach. They are the: sequential explanatory strategy, sequential exploratory strategy, sequential transformative strategy, concurrent triangulation strategy, concurrent nested strategy, and concurrent transformative strategy.

This research uses the sequential explanatory strategy where quantitative data is collected first and then followed by qualitative data. The quantitative data provides the big picture, while the qualitative data provides analyses of the specific and significant aspects of this picture.

As outlined in the literature review, there is ample research supporting the contention that learning experiences through teachers and the curriculum can have an important effect on both the student's self-efficacy and their outcome expectations. Gottfredson's (1981) Circumscription and Compromise Theory identifies four career developmental stages in a student's life. It is during the junior high schooling years (seven to ten) that students eliminate from further consideration any career path that they see as too low in prestige, irrelevant, mundane or that seems to be out of reach in terms of ability or effort required (Gottfredson 2006). The challenge placed on information technology education and the information technology industry is that students' perceptions of information technology are that it is seen as mundane and repetitive, and many are eliminating it from consideration as a career during these junior high school years through circumscription, and once this occurs it is very challenging to reverse.

Niles and Harris-Bowlsbey (2002) state that career decisions can be affected by life experiences, personal values, self-knowledge, self-efficacy, and knowledge about careers. McInerney et al. (2006) found that while there were a number of factors that were significant to students' career choices, it is their self-efficacy towards Information Technology that is the primary influence. Brown and Lent's (2012) Social Cognitive Career Theory (SCCT) highlights the importance that self-efficacy, as well as outcomes expectations and other personal and environmental factors (e.g. gender, culture, barriers, and supports), play in shaping a student's self-image.

Adya and Kaiser (2005) discuss how these variables can be examined as the social factors (e.g. family, peer group, and media), and the structural factors (e.g. teachers and curriculum). Each of these factors can play a role in either strengthening or limiting a student's self-efficacy and also their outcome expectations of IT careers, leading to career choices.

Learning experiences through teachers and the curriculum can have an important effect on both the student's self-efficacy and their outcome expectations (Brown and Lent 2012). Hence, the focus of this study becomes an investigation of appropriate Information Technology curriculum for junior high school students and teaching methods that have the highest potential to impact on raising the perceptions of the information technology discipline and student information technology careers perceptions.

There are different social and structural factors that can affect a student's career choice. Social factors such as family and peers play a large role in defining a student's role models and due to poor perceptions from both, have limited the number of students considering IT as a career. Changing either family or peer perceptions of IT careers is a long-term process, policies to change these perceptions have been and continue to be the focus of professional bodies like the Australian Computing Society (ACS). Structural factors such as teachers and the IT curriculum also have a major impact on students' perceptions of IT careers.

The research is conducted using two study methods which are survey (quantitative) and focus group/interview discussions (qualitative). The development of an IT Careers Curriculum intervention which will have the impact of providing students with a better understanding of IT careers pathways was chosen as the focus of this research, as being more achievable in the timeframe for this study. Thus, the first stage of the study necessarily involves the design and development of an IT Careers Curriculum intervention package to provide year nine IT teachers with the materials to educate their students on IT careers using tech-savvy tools for best learning engagement. An Information Technology Career Interest (ITCI) Instrument was developed and used within the junior high school information technology classes to quantitatively measure changes in student perceptions after completing of the IT Careers Curriculum.

After the implementation of the IT careers curriculum, a local convenience sample of students from the schools participating in the research, took part in a qualitative focus group. The focus group discussion was used to further understand the factors affecting the students' perceptions towards IT careers. In research conducted by Gilbert (2008), he mentioned that participants in a group might raise issues relevant to the matter being investigated that had not been realized by the researcher previously. The technique used in the focus group discussion is the Nominal Group Technique (NGT) which is a method for group brainstorming that encourages contributions from everyone (Gallagher et al. 1993). This technique can provide both qualitative and quantitative information and as such is a mixed-method approach (Potter, Gordon & Hamer 2004).

Finally, the teacher qualitative interviews were conducted with a local convenience sample of teachers from the participating schools in the research. According to de Laine (1997), there are three basic interview models: structured, or formal interviews; focused, or semi-structured interviews; and unstructured interviews. The technique used in the teacher interview discussion is the semi-structured interview model. Semi-structured interviews use a prepared but incomplete script which requires improvisation (Myers and Newman, 2007). It is the most common type of interview used in Information Technology and allows the researcher to “delve more deeply into the social situation” (Myers and Newman, 2007, p. 12). The interview plan should accommodate some flexibility, openness and improvisation to enable the interviewer to look for surprises and explore lines of questioning (Myers and Newman, 2007).

Table 3 summarises the research methodology providing insights into the study by introducing the following criteria: methodology, data collection method, objectives of study and sample design.

Criteria	Study
Philosophical worldview	Pragmatism
Methodology	Quantitative (Surveys) and Qualitative (Focus Group and Interview Discussion)
Objectives	Build Information Technology Careers Curriculum, using tech-savvy teaching tools, that will have an impact on students’ perceptions of Information Technology careers.
Sampling design	Non-probability sampling
Sample	Year nine students in four Toowoomba regional high schools Size (n=82)

Table 3: Research Methodology

3.4 Mixed-Methods Research Design

A research design describes the required steps that should be taken by the researcher in answering the research questions adequately, accurately and validly. The study focuses on analysing the perceptions of year nine high school students towards information technology careers. Analysis of the responses of participants in this study will contribute to fill or address the gap in literature regarding the use of information technology careers focused curriculum on changing the perceptions of year nine high school students towards information technology careers. The study is conducted in sequential stages, with the survey preceding the focus group discussion followed by the final interview discussion.

The data gathering methods used in this research are: surveys, focus group discussions, and interview discussions. In order to address the overarching research question and the sub-questions that were identified from the literature, the research involves a staged approach. Each stage in the research was aligned with a specific project stage in the work being done by the researcher with the year nine information technology classes.

3.5 Research Plan for the Study

In the context of educational innovations, including curriculum development, evaluation is intended to support more rational decision-making than would otherwise be possible (Reeves, 1992a). It should occur in each of the major phases of a project, namely, design, development, implementation, and institutionalisation (Bain, 1999). Thus, although it is possible to make a conceptual distinction between design and development on the one hand and data collection and analysis on the other, in practice, aspects of either may occur in parallel. For example, data about student reaction to the materials should be collected and analysed sufficiently early in the overall process to allow it to inform the final design.

Reeves (1992b) argued that, if evaluation methods are tools to support decision-making, then they should be selected according to the nature of the decisions to be made or questions to be answered. The past couple of decades has seen a shift in evaluation techniques from traditional experimental and quasi-experimental approaches towards a “mixed method approach” combining two or more evaluation methodologies (Mulholland, Au and White, 1998). Available methodologies include interviews, focus groups, questionnaires, observations, implementation logs, anecdotal records, ratings, expert review and tests (Reeves, 1992b). In this model, evaluation becomes a process in which information is gathered from multiple sources using both qualitative and quantitative techniques. Interpretations and conclusions are arrived at through triangulation (Jones et al., 1996).

The approach taken in this study has been informed by these approaches to educational evaluation. Hence, a mixture of qualitative and quantitative methods has been used depending upon the context in which data were being gathered and the purposes for which they were intended.

3.5.1 Proposed Schedule of Research

Initially it was not possible to specify more than a broad outline of the curriculum to be produced. As the description of the materials was refined, the nature and scope of the project became clearer. The research was originally conceived to be two, four-week curriculum phases conducted through an action research cycle with a redevelopment phase for the curriculum prior to the second cycle. Table 4 represents the approximate project schedule as envisaged at that time.

Project Phase	Year (s)	Activities
Preliminary Phase	2016 - 2017	• Information Technology Careers Instrument (ITCI) Development • Curriculum Development • Teacher Resources Development • USQ Ethical Clearance • Education Queensland Authorisation • Phase 1 School Approvals – School Principals, Teachers and Parents
Phase 1 Pre-Test Data Collection	2017	• ITCI Instrument Pre-Test Online Survey Data Collection – all Students in Phase 1 Information Technology Classes (both control and curriculum groups)
Phase 1 Curriculum Implementation	2017	• Implementation of the four-week Information Technology Careers Curriculum – Students in Phase 1 Information Technology Classes (curriculum group only)
Phase 1 Post-Test Data Collection	2017	• ITCI Instrument Post-Test Online Survey Data Collection – all Students in Phase 1 Information Technology Classes (both control and curriculum groups)
Phase 1 Curriculum Review	2017	• **Quantitative Analysis**: – Repeated Measures Analysis of Variance (ANOVA) between Pre- and Post ITCI Data • **Qualitative Analysis**: – Student Focus Group – random selection of Students in Phase 1 Information Technology Classes (curriculum group only) – Teacher Interview – all Teachers in Phase 1 Information Technology Classes (curriculum group only) – Congruence Method (Pattern Matching) Analysis of Student Focus Group and Teacher Interviews
Refine Curriculum	2017	• Refining of Curriculum based on Phase 1 Review • Further Teacher Training • Phase 2 School Approvals – School Principals, Teachers and Parents

Phase 2 Pre-Test Data Collection	2018	• ITCI Instrument Pre-Test Online Survey Data Collection – all Students in Phase 2 Information Technology Classes (both control and curriculum groups)
Phase 2 Curriculum Implementation	2018	• Implementation of the refined four-week Information Technology Careers Curriculum – Students in Phase 2 Information Technology Classes (curriculum group only)
Phase 2 Post-Test Data Collection	2018	• ITCI Instrument Post-Test Online Survey Data Collection – all Students in Phase 2 Information Technology Classes (both control and curriculum groups)
Phase 2 Curriculum Review	2018	• **Quantitative Analysis**: – Repeated Measures Analysis of Variance (ANOVA) between Pre- and Post ITCI Data Collected in Phase 2 – Multivariate Analysis of Variance (MANOVA) between Phase 1 and Phase 2 ITCI Data Collected • **Qualitative Analysis**: – Student Focus Group – random selection of Students in Phase 2 Information Technology Classes (curriculum group only) – Teacher Interview – all Teachers in Phase 2 Information Technology Classes (curriculum group only) – Congruence Method (Pattern Matching) Analysis of Student Focus Group and Teacher Interviews
Final Curriculum Review	2018 - 2019	• Final Curriculum Refining based on Phase 2 Review • Release of Final Four Week Curriculum to all Schools in Study and Education Queensland (State Education Department)

Table 4: Initial Project Schedule

Upon discussing the proposed two, four-week curriculum phases with multiple prospective schools in the region, the feedback received was that with the current very tight education constraints that classes are under, there would be limited scope for any school to accommodate this level of engagement. Feedback was sought and what was agreed to as a workable compromise was to limit the curriculum to a single two-week curriculum. This, unfortunately, removed the ability to apply action research, so the project methodology was changed to a single-phase curriculum investigation with pre-testing and post-testing through the Information Technology Career Interest (ITCI) Instrument, as well as student focus groups and teacher interviews at a number of the schools involved. Table 5 summarises key activities changed as a result of the school engagement limitation.

Project Phase	Year (s)	Activities
Preliminary Phase	2016 - 2017	• Information Technology Careers Instrument (ITCI) Development • Curriculum Development • Teacher Resources Development • USQ Ethical Clearance • Education Queensland Authorisation • School Approvals – School Principals, Teachers and Parents
Pre-Test Data Collection	2018	• ITCI Instrument Pre-Test Online Survey Data Collection – all Students in Information Technology Classes (both control and curriculum groups)
Curriculum Implementation	2018	• Implementation of the two-week Information Technology Careers Curriculum – Students in Information Technology Classes (curriculum group only)
Post-Test Data Collection	2018	• ITCI Instrument Post-Test Online Survey Data Collection – all Students in Information Technology Classes (both control and curriculum groups)
Curriculum Review	2018	• **Quantitative Analysis**: – Repeated Measures Analysis of Variance (ANOVA) between Pre- and Post ITCI Data • **Qualitative Analysis**: – Practitioner Self-Reflections - Researcher's Self-Reflection of the IT Careers Curriculum and Learning Activities undertaken while teaching at a Regional Toowoomba High School. – Student Focus Group – random selection of Students in Information Technology Classes (curriculum group only) – Teacher Interview – all Teachers in Information Technology Classes (curriculum group only) – Congruence Method (Pattern Matching) Analysis of Student Focus Group and Teacher Interviews
Final Curriculum Review	2018 - 2019	• Final Curriculum Refining based on Curriculum Review Analysis • Release of Final two-week Curriculum to all Schools in Study and Education Queensland (State Education Department)

Table 5: Revised Project Schedule

The initial stage of this research involved an analysis of the current information technology enrolment trends in Australian tertiary institutions which confirmed the significant reduction that had been observed in a paper published by Pricewaterhouse Coopers in 2015 (PricewaterhouseCoopers 2015). Professor Leon Sterling in 2013, then President, Australian Council of Deans of Information and Communications Technology (ACDICT), also published a letter to then Australian Association for Information Systems (AAIS) President, Associate

Professor Don Kerr, outlining ACDICT's concerns about the ICT Skills shortage (ACDICT 2013). This was also supported by the Australian Computer Society (ACS) (2012); Australian Industry Group (AiG) (2012); Australian Workforce and Productivity Agency (AWPA) (2013). The research then analysed the current trend in Queensland secondary school's information technology enrolments, which further confirmed that there was decreasing student engagement with the discipline in senior information technology classes as well.

The choice of data collection method is guided by the nature of the research questions since the research questions give rise to the type of data that is eventually collected (Onwuegbuzie & Leech 2006). Surveys, focus group discussions, interview discussion and practitioner self-reflection analysis are the primary research methods used in this study. Table 6 illustrates the structure of the research method:

Method	Relevance to the Study
Information Technology Careers Interest Survey	First year university business students who had recently completed high school IT classes – Participants (n=80)
Information Technology Careers Interest Pre-Test Survey	Year Nine Information Technology Class Students at Four Regional Toowoomba High Schools – Participants (n=102)
Information Technology Careers Interest Post-Test Survey	Year Nine Information Technology Class Students at Four Regional Toowoomba High Schools – Participants (n=98)
Practitioner Self-Reflections	Researcher's Self-Reflection of the IT Careers Curriculum and Learning Activities undertaken while teaching at a Regional Toowoomba High School.
Student Focus Group Discussion	Year Nine Information Technology Class Students at Two Regional Toowoomba High Schools.
Teacher Interview Discussion	Year Nine Information Technology Class Teachers at Two Regional Toowoomba High Schools.

Table 6: Research Methodology

Design, development and validation of the design and content of the IT Careers Curriculum are treated separately since they do not belong to any of the data collection procedures. Where the analysis of data required statistical treatment, this was performed using SPSS and the analysis of the qualitative data was performed using NVIVO..

The remainder of this Chapter will describe the methods used for the collection and analysis of data to address the research question and sub-questions. Instruments and procedures will be grouped together for description according to the period in which they were first administered specifically for this study.

3.6 Ethics and Research Approvals

In undertaking this research study, ethical considerations are of paramount importance. Ethics refers to "the appropriateness of [the researcher's] behaviour in relation to the rights of those who become the subject of [their] work, or are affected by it" (Saunders, Lewis & Thornhill 1997). Ethical considerations are significant because such issues are directly linked to the integrity of the study (Bryman 2006). Ethics approval from the University of Southern Queensland (USQ) was required prior to any school arrangements. The USQ Human Research Ethics Committee approved that the proposed research met the requirements of the National Statement on Ethical Conduct in Human Research (2007) (H17REA187 - Full approval provided in Appendix 3.1).

Various ethical issues need to be considered while formulating the research plan. In this research, anonymity and confidentiality, which encourage the participants to give more open and honest responses, were strictly assured (Collis & Hussey 2013).

The research aims and objectives are explained to participants and efforts are made to ensure that participants understand the general aspects of the research. The principle of voluntary participation is also assured, and individuals' wishes are respected. Individual differences concerning the understanding and interpretation of questions are also respected and clarified as politely as possible.

The following outline describes the ethical principles followed in relation to the research project overall and the regulations specific to conducting research with adolescents in the Queensland educational context.

3.6.1 Informed Consent

The researcher before embarking on this research project obtains informed consent from each of the research participants. Informed consent as an ethical principle means that potential participants are made aware of the research study and understand what the research study is about. In the context of this study, an application for research into Education Queensland Schools was applied for (Appendix 3.2). This process required all information packages, including principal consent form (Appendix 3.3), teacher consent form (Appendix 3.4), parent/caregiver consent (Appendix 3.5) forms and parents/guardians information letter (Appendix 3.6) to be developed prior to contacting schools. The same documentation was provided to the Toowoomba Catholic Education Office, however, unfortunately, they did not respond to the request, which ruled out using any of the School's directly associated with the Toowoomba Catholic Education Office.

To work or volunteer in regulated child-related employment or operate a regulated child-related business in Queensland, may require the application for a Queensland Government Bluecard. This research was originally considered to require a Bluecard as a requirement of Education Queensland. An application was lodged and Education Queensland Research Services investigated whether the researcher would need to obtain a Queensland Government Blue Card, but it finally deemed after a month of discussion, that as the researcher was a registered teacher in Queensland so this was not warranted. Once approval was obtained from Education Queensland Research Services (Appendix 3.7), formal approval from the schools involved in the curriculum trial and the schools in the control group was sought (Appendix 3.8).

3.6.2 Confidentiality/Anonymity

The issue of confidentiality is an important and sensitive issue in the context of social research. The teachers and students who agree to participate in this research study were informed from the outset by the researcher that they will not be identified by their names but rather allocated identification codes.

3.6.3 Security of Data Collected

Research participants are given assurances by the researcher that any data collected during the study will always be securely maintained. Assurances were also required under the ethics approval obtained from USQ, Australia by the researcher that any data collected would be securely stored and accessible only to the researcher.

3.7 Information Technology Career Interest Instrument Survey Development

This first stage of the research involved the development of the IT Career Interest (ITCI) Survey instrument.

3.7.1 ITCI Instrument Development Sampling Method

Sekaran and Bougie (2016) defined sampling as: "the process of selecting a sufficient number of elements from the population". Sampling is a key research process where the selected elements can be used as the foundation for estimating or anticipating a fact, situation or outcome regarding the population. By scientifically choosing an appropriate sample of sufficient size, a generalization can be made about the whole population from which a sample is obtained.

Creswell (2009) and colleagues mentioned that since a sample should be representative of the population, it is important for the researcher to be cautious in defining sample size in order to ensure accurate findings. As the objective of the sub-question 1a is to develop a testing instrument that will measure students' perceptions of IT careers, it is therefore necessary to gather information from students who have recently undertaken high school IT classes.

Sampling strategy

The ITCI instrument development uses non-probability sampling. This kind of sampling is different from probability sampling in that the population does not have an equal probability to be chosen in the study.

Sampling Process

The purposive sampling technique which is a form of non-probability sampling is adopted in the research for the administration of the ITCI instrument development. The purposive sampling technique also known as judgment sampling is "the deliberate choice of an informant due to the qualities the informant possesses" (Tongco 2007). This kind of sample is used when the purpose is to gain information from particular target groups. Due to the objective of the research, the high school IT students do not come from just any group but are intentionally selected from a convenience sample of first year USQ business students who recently undertook high school IT classes.

Convenience sampling is used to collect data within the purposive sampling. Convenience sampling involves: "collecting information from members of the population who are conveniently available to provide it" (Cavana, Delahaye & Sekaran 2001).

3.7.2 ITCI Instrument Development Data Collection

Data collection for the ITCI instrument development phase of the research was through a primary data source survey activity.

Survey research is popular and an accepted method that is used for gathering data. The aim is to obtain views or concerns in a structured manner. Bryman (2006) showed that questionnaires and structured interviews are the most common methods applied in survey research. The distinctive feature about survey research is its capability to include a wide coverage of people or events within a specified period. Creswell et al. (2003) in his research further states that survey design provides a quantitative or numeric description of trends, attitudes, or opinions of a population by studying a same of that population. The survey in this study is in the form of an online questionnaire. According to Brown (2001), questionnaires in general are any written instruments that present respondents with a series of questions or statements to which they are to react either by writing out their answers or selecting from among existing answers. This type of written survey allows for flexibility on the part of researchers to include both open-and closed-ended types of questions and can serve a variety of purposes.

The survey questionnaire are designed to be concise, unambiguous, and easy for a respondent to complete. Clarke (1999) mentioned that the questionnaire is an instrument for measuring the ideas that go into its design. Therefore, the questionnaire must not only reflect the survey's aims, but also must be understood by the respondents in a clear and unambiguous way. Clear and well-structured questionnaires are important for obtaining valid results, since poorly framed questions or badly structured questionnaires can easily discourage respondents and lead to a low response rate.

The ITCI instrument development in the study was designed to collect data to answer the research sub-question 1a:

> **Research Question 1a: What factors contribute to an information technology career survey instrument to test changes in student perceptions towards information technology careers?**

3.7.3 ITCI Instrument Development Pre-test

Based on recommendations from Collis and Hussey (2013), the ITCI instrument was tested and piloted as fully as possible before distribution. Questionnaires should be pre-tested with colleagues and with those who are part of the target population (Collis and Hussey 2013). Colleagues, who may know little about the subject, can often detect glaring errors. Those who are part of the target population can also help in improving the clarity of instructions; identifying unclear or ambiguous questions or questions that respondents may feel uneasy about answering; commenting on unclear and unattractive layouts; and adding any other comments (Saunders, Lewis & Thornhill 1997).

ITCI Instrument Development Pilot

A pilot of the ITCI instrument development survey was conducted in the study. Saunders, Lewis and Thornhill (1997) stated that the pilot test refines the questionnaire so that respondents have no difficulties in answering the questions. In a similar vein, Oppenheim (1992) stated: “Questionnaires do not emerge fully fledged; they have to be created or adapted, fashioned and developed to maturity after many abortive tests”.

First, the questionnaire (Appendix 6.7) was sent to the researcher’s academic supervisors who have many years’ experience in designing questionnaires. In the second phase the survey instrument was sent to several information systems colleagues for their feedback (Appendix 6.8). The third phase involved seeking feedback from students in a first-year university IT course.

Comments were received from the three phases on the wording of some questions, and the layout of the questionnaire. All suggested changes are made to ensure the clarity of the questionnaire. The final version of the questionnaire is provided in Appendix 6.9.

3.7.4 ITCI Instrument Development Data Analysis Method

The methodology used to develop the Information Technology Careers Instrument (ITCI) followed Clark and Watson (1995) key components for developing scale items and Hinkin’s et al. (1997) process for developing reliable and valid measurement instruments. A literature review for the ITCI scale items was undertaken. It consisted of a search for studies addressing students’ interest in STEM and STEM careers, students’ perceptions of STEM professionals, and social cognitive career theory applied in science, technology, engineering and mathematics. As discussed in Chapter 2, research suggested that interest in careers was often related to self-efficacy, outcome expectations, and previous learning experiences identified in Lent, Brown, and Hackett’s (2002) Social Cognitive Career Theory (SCCT). Instruments used in the investigation all had a high reliability (Cronbach’s Alpha > 0.8) and were grounded in Social Cognitive Career Theory (SCCT):

Only the information technology items from these surveys were utilised to develop an appropriate instrument to answer Research Sub-Question 1a. A convenience sample of eighty first year USQ business students, who recently undertook high school IT classes, were involved in answering the original fifty-five information technology items and their responses were analysed using factor analysis. The factor analysis was conducted to reduce the number of items to a small sub-set of the original set of identified instruments, The aim of the resultant set of items was 1) answer the Research Sub-Question 1a, 2) to give students adequate time to respond to each question, and 3) still have an acceptable reliability for use in the research.

3.8 Curriculum Design and Development

Stage two of the research involved the design and development of the IT Careers Curriculum intervention. As should be evident from the description of the design and development of the two-week IT Careers Curriculum, various evaluation strategies were employed to ensure that the design adhered to the principles derived from the review of research and that the content was plausible and valid.

The IT Careers Curriculum has been developed based on the findings from the literature as outlined in Chapter 2. The literature explored a range of academic literature regarding students in junior high school education and the factors that influence their decision to participate in IT courses in senior secondary school and tertiary studies, and ultimately IT careers.

Student perceptions of IT subjects were found to be impacted upon by limitations in junior high school IT curricula, the lack of understanding of what is taught in senior and tertiary IT courses, and poor stereotypes depicted in the media. The literature posited that to fix the problem, solutions need to be formulated in the early years of schooling – primary and lower secondary school, and that the school curriculum and the way in which it is taught and assessed was identified as a factor influencing student perceptions. From these literature review findings, the careers invention that would have an impact on student perceptions towards IT careers was identified as an IT careers focus curriculum implemented in year nine, with a focus on improving students' self-efficacy and outcomes expectations towards IT.

The literature on the teaching tools identified that tech-savvy web-based learning tools such as wikis, blogs, and multimedia podcasting would improve the current "millennial" generations' self-efficacy and outcomes expectations, and therefore improve their perceptions towards IT careers. These tech-savvy web-based learning tools were used in the design and development of the learning activities in the IT Careers Curriculum intervention to test the overarching research question of this study.

The procedures identified in this section have been selected to provide a degree of formalisation of the evidence that, firstly, the careers content was valid for the purpose of changing student perceptions and, secondly, the teaching activities were developed to be of sound pedagogical practice.

The IT Careers Curriculum design and development in the study is designed to answer the Research Sub-Question 1b:

Research Question 1b: What content and teaching approach contributes to an information technology career curriculum, using tech-savvy teaching tools, that could be developed to influence student perceptions towards information technology careers?

3.8.1 Careers Content Validation

The Interactive Information Communication and Technology (ICT) Career Wheel (https://www.careersfoundation.com.au/) was chosen as the key source of careers content for this research. It was developed by the Queensland Government Chief Information Office, based on the Skills Framework for the Information Age (SFIA) version 6, as a tool for IT career decision making. The Australian Computing Society Careers Foundation subsequently took over the running of the Interactive ICT Career Wheel and made it universally available. The ICT Interactive Career Wheel breaks IT careers into four streams:

1. Technology/application builders are responsible for all aspects of building ICT systems, applications and technologies.
2. Technology services covers all areas of the delivery of ICT services to users, from helpdesk to network management, systems administration to account management.
3. Enterprise implementation covers aspects of ICT that relate to changes to the management or operation of the enterprise.
4. Enterprise governance includes all aspects of policy and strategy including strategic information management and enterprise architecture.

The Interactive ICT Career Wheel identifies entry points from high school, industry, TAFE and university, and it includes a variety of roles depending on qualifications and experience.

3.8.2 Curriculum Learning Activity Validation

Once the Interactive ICT Career Wheel was identified as the source for the curriculum IT careers content, the curriculum learning activities for the new curriculum unit were then developed, including all teaching materials and lesson plans, incorporating the careers content. The focus of this unit was on current topics and issues relevant to the student cohort (year nine).

The curriculum unit was developed as a tech-savvy careers focused two-week (eight lesson) unit of work which was run within the current year nine computer classes as an alternate unit of work and was taught by the same mix of IT and non-IT teachers currently running these classes. All resources for the teaching staff were pre-developed and provided to the IT class teachers with online support from the researcher.

The curriculum focus was on engaging the students using tech-savvy digital media tools with the focus on each tool being used to research different careers paths in the Information Technology discipline. This resulted in the unit being significantly different to the current content that is taught in junior high school which has little careers focus and often utilises more basic tools such as PowerPoint, Word and Excel (Genrich, Toleman and Roberts 2014). It was designed to incorporate the SFIA framework, National Curriculum Technology - Digital Technologies standard learning objectives and the Australian Curriculum ICT capabilities.

Originally, the four-week planned curriculum focused on four different tech-savvy digital media tools that would be used over the four weeks to teach and reinforce the large array of information technology careers. Week one was to focus on the development of reception pitches about selling different information technology careers using presentation tools such as PowerPoint with which students already were familiar. Week two was to focus on the development of wikis for different types of information technology careers. Week 3 was to focus on the development of audio podcasts, providing informative panel discussions about different information technology careers. Finally, week four was to focus on the students developing a video recruitment advertisement for different information technology careers.

After the research project was revised to two weeks, discussion with the teachers involved was undertaken and two of the four tech-savvy tools were selected to be used in the curriculum unit.

In week one of the two-week curriculum, students work were asked to work in groups, using Microsoft PowerPoint – a tech-savvy tool they were already well versed in, to develop a reception elevator pitch. McCollough et al. (2016) state that elevator pitches are a staple for teaching students the skill of conveying ideas effectively and succinctly. The authors expand upon the traditional approach to elevator pitches, where one student presents to a judge (passenger on an elevator). They propose a modified version, the reception pitch, where a group of students present to a panel of judges. Their paper discusses the benefits that reception elevator pitches have over the more traditional elevator pitch, especially that it allows all members to be involved in the pitch, and the format is interactive allowing the audience to ask questions and provide immediate feedback.

The reception elevator pitch required students to work in groups to investigate and present to the class one of the careers from the Interactive ICT Career Wheel, with the aim of convincing their fellow classmates to further pursue this IT career. Each reception elevator pitch was critiqued by the class on its content and persuasiveness.

The tech-savvy tool in week two of the two-week curriculum was a Wiki. Students worked in groups to investigate another career from the Interactive ICT Career Wheel. This information was incorporated into the development of a Wiki that could be used to provide their fellow classmates with information about the career. Each Wiki was critiqued by the class on its content and persuasiveness.

3.8.3 Schools Involvement

The original proposal was for a four-week IT Careers Curriculum unit to be undertaken within several schools and a control group of students in each school as well. Both groups would undertake the pre-test and post-test IT Career Interest (ITCI) Instrument.

All State High Schools in the Toowoomba region were contacted in stage one, two weeks prior to the commencement of term one, with information packages being sent out to the schools. Follow-up phone calls were made to ensure that the information had been passed on to the appropriate person in that school, either Principal, Deputy Principal, Head of Department – Information Technology, or Year Nine Coordinator. Unfortunately, this resulted in no responses to the project – the only feedback received was that due to tight schedules four weeks was a large cost to the school.

A follow-up with all state high schools in the Toowoomba region, two weeks prior to the Easter break, with revised information packages being sent out to the schools outlining the amended two-week curriculum . Follow-up phone calls were made to ensure that the information had been passed on to the appropriate person in that school, either Principal, Deputy Principal, Head of Department – Information Technology, or Year Nine Coordinator. This revised IT Careers Curriculum unit was initially accepted to be undertaken at Centenary Heights High School in the first two weeks of term 2. Unfortunately, after numerous emails and unreturned phone calls, it was deemed that while the Deputy Principal was supportive, the Head of Department – Information Technology and her team were not, and the round two attempts were shelved. Other than an initial email outlining that the school operates on a yearly assessment schedule which was making it difficult to incorporate the two-week IT Careers Curriculum, no other feedback was provided.

The researcher reviewed the proposed content and the teaching activities again and reviewed the list of Schools being contacted. It was decided to make one final attempt to expand the smaller regional schools, high top (prep to year ten) schools and to several Independent Schools in the region. Round three resulted in four Schools accepting to undertake the two-week IT Careers Curriculum - Downlands College, Toowoomba Christian Outreach College and Toowoomba Grammar School from the Private Schools Sector, and Oakey State High School from the State School Sector. These Schools all agreed to undertake the two-week IT Careers Curriculum at the start of term 3. Participants in each data gathering activity were advised through their schools of the general nature of the research, that their participation was voluntary, that confidentiality of individual data was assured and that any results would be reported in summary form and without identifying information about individual participants.

3.8.4 Year Nine IT Teacher Involvement

Once approval was given, the teachers involved from the two-week IT Careers Curriculum schools were provided with resources for them to be able to dynamically teach the new curriculum unit. The aim being to provide these teachers with suitable materials so that they could provide the students with a careers focused curriculum that had the potential to change their perceptions of Information Technology; and thereby increase the potential future cohort of students taking Senior Secondary School Information Technology (Information Processing and Technology, and Information Technology Systems) courses, and Tertiary Information Technology degrees (TAFE and University).

3.8.5 Design, Development and Implementation

The Curriculum Design and Development for the IT Careers Curriculum is detailed in chapter 4, using tech-savvy teaching tools, that were implemented and tested with year nine students to ascertain if it can influence students' perceptions towards IT careers based on the literature, and the content and learning activity validation. The stages involved in the proposed design and development of the originally planned four-week IT Careers Curriculum are provided based on these findings. Discussion of the hurdles and subsequent reduction to a two-week IT Careers Curriculum based on feedback from schools is discussed, and the final detailed lesson-by-lesson two-week IT Careers Curriculum intervention outlined.

The IT Careers Curriculum, using tech-savvy teaching tools, including a lesson-by-lesson plan and resources were provided to the teachers involved in the intervention prior to the commencement of the two-week IT Careers Curriculum. Video and phone conferences were held with each teacher to ensure their understanding and comfort in using the curriculum unit. These resources were refined throughout the two-week curriculum, based on the observations of the researcher (who was involved in teaching the curriculum at one of the four schools), and communicated to each teacher.

Chapter 5 details the implementation of the IT Careers Curriculum, using tech-savvy teaching tools, with year nine students to ascertain if it can influence students' perceptions towards IT careers. It includes the researcher's personal journalised reflection on their own involvement as an active participant, teaching the IT Careers Curriculum at one of the four schools as an alternative qualitative set of findings towards research sub-question 1b.The process used in the collection of the researcher's reflections involved the researcher, upon completion of each lesson, reviewing both the careers content and the learner activity used for that lesson. This information was journalised and used in the review of the two-week curriculum. Any areas of significant concern identified were communicated with the other teachers undertaking the curriculum at the other schools.

3.9 IT Career Interest (ITCI) Instrument Analysis

Stage three of the research involved the quantitative measuring of student perceptions towards IT Careers using the IT Careers Interest (ITCI) Instrument immediately before and immediately after they had undertaken the IT Careers Curriculum.

3.9.1 ITCI Instrument Sampling Methodology

As the objective of the sub-question 1c is to measure the students' change in perceptions toward IT careers using the ITCI instrument, it is therefore necessary to gather information from current students who are in year nine IT classes in high school.

Sampling strategy

The measurement of students' change in perceptions toward IT careers using the ITCI instrument uses non-probability sampling.

Sampling Process

The purposive sampling technique which is a form of non-probability sampling is adopted in the research for the administration of the ITCI instrument to current students who are in year nine IT classes in high school. Due to the objective of the research, the high school IT students do not come from just any group, but are intentionally selected from a convenience sample of current students who are in year nine IT classes in high school, each school was originally planned to collect data from a control group and a curriculum group.

3.9.2 ITCI Instrument Data Collection

Data collection for the ITCI instrument stage of the research was through two primary data source survey activity stages conducted prior to and after the implementation of the IT Careers Curriculum:

ITCI Pre-Test

This stage involved the surveying of all students in the sample (both control groups and curriculum groups) prior to the two-week curriculum, to gauge their initial interest about the discipline and careers in Information Technology using the revised version of the ITCI Instrument that was developed in stage one of the research plan (Appendix 6.9).

ITCI Post-Testing

Post-testing involved the re-surveying of all students surveyed in the pre-test using the same ITCI instrument. A comparison between the pre-testing and post-testing scores was conducted to determine the change in the students' interests in the discipline and careers in Information Technology.

The quantitative measurement from the ITCI instrument surveys in the study was designed to collect data to answer the Research Sub-Question 1c:

> **Sub-Question 1c: Focussing on quantitative measures, how does the implementation of an information technology career curriculum, using tech-savvy teaching tools, impact student perceptions towards information technology careers?**

3.9.3 ITCI Instrument Pilot

Based on recommendations from Collis and Hussey (2013, the survey instrument was tested and piloted as fully as possible before distribution. The ICTI instrument developed in stage one of the research plan (Appendix 6.9) was sent to the researcher's academic supervisors who have many years' experience in designing questionnaires. In the second phase the ITCI instrument was sent to several information systems colleagues for their feedback. The third phase involved seeking feedback from students in year nine IT high school classes.

Comments were received from the three phases on the wording of some questions, and the layout of the ITCI instrument. All suggested changes were made to ensure the clarity of the survey instrument. The final version of the survey instrument is provided in Appendix 6.10.

3.9.4 ITCI Instrument Data Analysis

Data analysis procedures used with the ITCI instrument survey data were drawn from the recommendations outlined in Manning and Munro (2007): preparing data for analysis, exploring the data, analysing the data, representing the data analysis, and validating the results. The aim is to find answers to the stated research question.

Once the ITCI pre- and post- surveys were completed by both the curriculum classes and the control groups, several analyses were planned to be performed within the study:

- Students' ITCI between control and trial groups
- Students' ITCI before and after the IT Careers Curriculum

The data collected from the Pre- and Post- surveys for each student of the ITCI instrument were paired during this stage of the experiment. Each ITCI survey contained a coded unique identifier that was used in the pairing. Respondents identified in the matching process who had only been involved in one of the surveys were discarded as they could not be used in subsequent analysis. The data collected from both pre- and post- surveys have been included in Appendix 6.11.

Due to low number of respondents in the Control group and the concern that they were all from the same school, the decision was made to discard the control group data and focus only on the respondents from the IT Careers Curriculum group.

The data was recoded and imported into SPSS where a Descriptive Statistics Frequency Analysis was undertaken to understand the breakdown of the respondents from the IT Careers Curriculum group. Outliers were removed using Standard Deviation (Std. Dev.) Analysis, Analysis of Univariate, and Analysis of Multivariate Outliers.

Repeated Measures Analysis of Variance (ANOVA) of the Pre and Post Test ITCI Means was performed with SPSS to determine whether the differences within the curriculum groups' scores on the ITCI were significant between the pre-test and the post-test in answer to Research Sub-Question 1c.

3.10 IT Careers Curriculum Student Focus Groups

Stage four of the research involved conducting student focus groups to qualitatively analyse the students' perceptions towards IT Careers and the effects that the learning activities had on them immediately after they had undertaken the IT Careers Curriculum.

Changes in students' perceptions through the implementation of the IT Careers Curriculum were tested through qualitative measures. Student focus groups were conducted after the conclusion of the IT Careers Curriculum. These focus groups were designed to collect data to answer the following two research sub-questions:

> **Sub-Question 1d: Focussing on qualitative measures, how does the implementation of an information technology career curriculum, using tech-savvy teaching tools, change student perceptions towards information technology careers?**

> **Sub-Question 1f: What was the effect of the information technology career curriculum, using tech-savvy teaching tools, on the students' learning experience?**

3.10.1 Student Focus Group Methodology

Focus group design is common to qualitative designs and there are many studies in the literature that have used this approach to collect data. Focus group discussions are particularly useful for exploratory research as they can produce powerful insights (Stewart, Shamdasani and Rook 2007). They generally include between four and twelve participants and a moderator who poses the questions (Hollander 2004), but with children or adolescent participants, a smaller group of five or six students is appropriate (Vaughn, Shay Schumm and Sinagub 1996). In focus group discussions, it is imperative that both the moderator and the question design should be compatible with the group being interviewed (Stewart, Shamdasani and Rook 2007). Some of the disadvantages of using a focus group technique are: the researcher has less control than in an individual interview; moderators require special skills; the data are often difficult to analyse (Kreuger 1998 in Babbie, 2000); and with children or adolescent participants, more flexibility, direction and interaction may be required (Vaughn, Shay Schumm and Sinagub 1996). It is important that the discussion and questions be phrased to the age and level of understanding of the participant (Stewart, Shamdasani and Rook 2007). Awareness of age-related behaviours, such as showing-off, and how peer pressure can shape responses are important considerations when conducting focus groups with adolescents (Krueger and Casey 2000). The process of developing focus group discussions involves formulating research questions, developing protocols, soliciting participants, arranging venues, facilitating focus groups, transcribing, analysing data, and reporting the findings.

Focus Group Question Development

The objective of sub-question 1d was to test the students' change in perceptions toward IT careers through qualitative measures. The objective of sub-question 1f was to test the effectiveness of the learning experience from the students' perspective. The focus group questions were developed as open-ended questions to address both of these research sub-questions. These questions were developed from analysis of the literature and observations by the researcher while conducting the two-week IT Careers Curriculum at one of the Schools (Downlands College).

The first question asked each student to focus on their understanding of Information Technology Careers prior to undertaking the two-week IT Careers classes. It was broken into two parts:

- Before doing the two-week careers class, what did you think a computing career was?
- Describe one of the careers in computing that you knew about before doing the class.

Then the students were asked to discuss why they had selected to do the year nine Information Technology class at their school.

The next set of questions focused on their understanding of Information Technology Careers after undertaking the two-week IT Careers classes. This information was used to corroborate the findings of the IT Career Interest Instrument (ITCI) Analysis. This question was broken into two parts:

- Has your understanding of a computing career changed?
- Discuss one of the interesting things you discovered during the class.

The final set of open-ended questions focused on the content and activities involved in the two-week IT Careers Curriculum. The information from these last two questions was used as part of the final evaluation and development prior to release to all schools of the IT Careers Curriculum. This question was also broken into two parts:

- What did you enjoy about the careers class?
- What do you think could be improved about the careers class?

These questions were tested and piloted as fully as possible before their use in the focus groups. The focus group questions were sent to the researcher's academic supervisors who have many years' experience in research using focus group techniques. In the second phase the focus group questions were sent to several information systems colleagues for their feedback. The third phase involved seeking feedback from students in year nine IT high school classes.

Comments were received from the three phases on the wording of the questions. All suggested changes were made to ensure the clarity of the focus group. The final version of the open-ended focus group questions is provided in Appendix 3.12.

Focus Group Protocols

Student were informed about the purpose of the research verbally prior to the commencement of the focus groups. The focus group discussions were audio recorded on the researcher's iPhone and the recordings have been stored as per USQ Ethical Guidelines. The researcher transcribed the audio recordings and the transcripts were compared with the recordings for accuracy. All items transcribed were checked to ensure they were valid representations of the focus group discussions. The focus group discussion transcripts have been provided in Appendixes 7.1 and 7.2.

Students were given a sheet of A4 paper prior to the start of the focus group (Appendix 3.12) where they were asked to firstly list on one side at least three careers in computing that they knew about before they undertook the two-week IT Careers classes. They then were asked to list on the other side at least three interesting things they had discovered during the two-week IT Careers classes. They were asked to create both lists on separate sides of the paper to help them focus on the specific question given without referring back to be previous question. This information was used to help them in the actual focus group. The focus groups were conducted using the Nominal Group Technique (NGT) which is a method for group brainstorming that encourages contributions from everyone (Gallagher et al. 1993).

Focus Group Participants and Venue

The qualitative measurement of students' change in perceptions toward IT careers and students' perspective on the learning activities undertaken in the IT Careers Curriculum used focus groups, involving a sample set of students who actively participated in the IT Careers Curriculum selected by the teacher from the year nine IT classes. For the purpose of this study the researcher conducted the focus groups, the focus groups discussions were held at two of the four schools due to staff and student availability - Downlands College and Toowoomba Christian Outreach College, and both focus groups were undertaken in the week after the conclusion of the two-week IT Careers Curriculum.

3.10.2 Student Focus Group Analysis

The predictive findings were developed prior to the focus group discussions to answer research sub-question 1d and research sub-question 1f, based on an analysis of the literature, and observations by the researcher while conducting the two-week IT Careers Curriculum at one of the Schools (Downlands College). The focus group predictive findings have been provided in Appendix 7.3.

The transcripts from the focus group discussions were imported into NVIVO 12 Professional and the student statements were coding for qualitative analysis. One of the most widely used tactics across all qualitative research is the practice of coding (Kalpokaite and Radivojevic, 2019). Codes are essentially short descriptive or inferential labels that are assigned to data segments in order to condense and categorize the dataset (Miles, Huberman, & Saldaña, 2014; Saldaña 2013). Codes can be used to identify recurring patterns, organise the chunks of data that go together, and trigger deeper reflection on the data's meaning (Kalpokaite and Radivojevic, 2019). Coding is divided into two main stages: first cycle codes are those that are initially assigned to the data, while second cycle codes build on these initial codes and group them into meaningful categories, themes, or constructs (Miles, Huberman, & Saldaña, 2014). The themes of ideas from the student focus group discussions were indexed using Miles, Huberman, & Saldaña's (2014) qualitative data analysis method.

The majority of qualitative analysis methods are based on the identification of themes, patterns, processes, and/or profiles (Miles, Huberman, & Saldaña, 2014). This is achieved by searching for patterns or regularities across the data, which is most typically done by comparing and contrasting the data segments and thus delineating the overarching themes, patterns, and/or processes (Flick, 2009).

Once the student focus group discussion transcripts where coded using Miles, Huberman, & Saldaña's (2014) qualitative data analysis method, Yin's (2014) congruence method (pattern matching) technique for case study analysis was used to match empirically-based patterns with predicted findings developed prior to the data collection. Section 7.4 of this study outlines the analysis and findings from the student focus group discussions.

3.11 IT Careers Curriculum Teacher Interviews

The final stage of the research involved conducting teacher interviews to qualitatively analyse the teachers' observations of their students' perceptions towards IT Careers and their perceptions of the effects that the learning activities had on their students immediately after they had undertaken the IT Careers Curriculum.

Teachers' observed changes in their students' perceptions through the implementation of the IT Careers Curriculum were tested through qualitative measures. Teacher interviews were conducted after the conclusion of the IT Careers Curriculum. These interviews were designed to collect data to answer the following two research sub-questions:

> **Sub-Question 1e: How do the views of the class teachers differ from their students' perceptions towards information technology careers after the implementation of an information technology career curriculum, using tech-savvy teaching tools?**
>
> **Sub-Question 1g: What was the effect of the information technology career curriculum, using tech-savvy teaching tools, from teachers' observations, on their students' learning experience?**

3.11.1 Teacher Interview Methodology

Interviews allow the researcher to probe and follow up the non-verbal behaviour, responses, feelings and motives in order to enrich qualitative data (Davies 2006). There are a number of ways that interviews can be conducted, including "as part of participant observation or even as a casual conversation" (Mertens 1997, p. 321). The interview is a common technique, and one of the most important data collection techniques used in case-study and interpretive research (Myers and Newman 2007). "Data from interviews are idiographic" and the background, experiences, gender, age and nationality of the researcher should be acknowledged, it is important to situate the researcher as well as the interviewee during the research write-up (Myers and Newman 2007, pp. 15 - 16).

According to de Laine (1997), there are three basic interview models: structured, or formal interviews; focused, or semi-structured interviews; and unstructured interviews. Semi-structured interviews use a prepared but incomplete script which requires improvisation (Myers and Newman 2007). It is the most common type of interview in Information Systems and allows the research to "delve more deeply into the social situation" (Myers and Newman 2007, p. 12). The interview plan should accommodate some flexibility, openness and improvisation to enable the interviewer to look for surprises and explore lines of questioning (Myers and Newman 2007). It is also important to set the stage for the interview. This involves: finding the interviewees, gaining their consent; agreeing on the time, location, and them of the interview;

arranging the physical layout of the room and the equipment to be used; and preparing the appearance and demeanour of the interviewer (Myers and Newman 2007).

Interviews may not be as simple as depicted and can be fraught with difficulties (Myers and Newman 2007). Some of the problems with conducting interviews include: interviewing strangers under time pressure; lack of trust of the interviewer; lack of time leading to incomplete data collection; the level of entry into the organisation; elite bias; the Hawthorne effect (temporary changes in behaviour in response to environmental conditions); constructing knowledge while gathering data; and ambiguity of language (Myers and Newman 2007). The interviewer also needs to learn to deal with differing behaviours, such as shyness, showing off and boredom, during the interview (Myers and Newman 2007).

Interview Question Development

The objective of sub-question 1e was to obtain the teachers' observations of their students' change in perceptions toward IT careers through qualitative measures. The objective of sub-question 1g was to obtain from the teachers their perceptions of the effectiveness of the learning experience on their students. The interview questions were developed as semi-structured questions to address both of these research sub-questions. These questions were developed from analysis of the literature and observations by the researcher while conducting the two-week IT Careers Curriculum at one of the Schools (Downlands College). The third question was added as a result of the quantitative findings as outlined in Chapter 6.

Teachers were asked to comment on three key issues:

- What was the impact the two-week curriculum had on their students' interest in IT careers?
- What improvement did they have for the two-week curriculum, to further increase student interest in IT careers?
- What could have been the cause of the large number of issues with year nines answering the survey.

These questions were tested and piloted as fully as possible before their use in the teacher interviews. The interview questions were sent to the researcher's academic supervisors who have many years' experience in research using interview techniques. In the second phase the interview questions were sent to several information systems colleagues for their feedback. The third phase involved seeking feedback from high school teachers.

Comments were received from the three phases on the wording of the questions. All suggested changes were made to ensure the clarity of the interviews. The final version of the semi-structured interview questions is provided in Appendix 3.14.

Interview Protocols

Teachers were informed about the purpose of the research as part of the school/teacher consent information initially sent to each school and again verbally prior to the commencement of the interviews. The interviews were audio recorded on the researcher's iPhone and the recordings have been stored as per USQ Ethical Guidelines. The researcher transcribed the audio recordings and the transcripts were compared with the recordings for accuracy. All items transcribed were checked to ensure they were valid representations of the focus group discussions. The focus group discussion transcripts have been provided in Appendixes 6.4, 6.5 and 6.5.

The interviews were conducted using semi-structured interviews which are considered the most common type of interview in Information Systems and allows the research to "delve more deeply into the social situation" (Myers and Newman 2007).

Interview Participants and Venue

The qualitative measurement of the teachers' observations of their students' change in perceptions toward IT careers and the teachers' perspective on the effectiveness of the learning activities undertaken in the IT Careers Curriculum used semi-structured interviews, involving a sample set of teachers who actively participated in the teaching of the IT Careers Curriculum. For the purpose of this study the researcher conducted the interviews, the teacher interviews were held at two of the four schools due to staff and student availability - Downlands College and Toowoomba Grammar School, and both interviews were undertaken in the week after the conclusion of the two-week IT Careers Curriculum.

3.11.2 Teacher Interview Analysis

The predictive findings were developed prior to the teacher interviews to answer research sub-question 1e and research sub-question 1g, based on an analysis of the literature, and observations by the researcher while conducting the two-week IT Careers Curriculum at one of the Schools (Downlands College). The focus group predictive findings have been provided in Appendix 7.7.

The transcripts from the teachers' interviews were imported into NVIVO 12 Professional and the teacher statements were coding for qualitative analysis. The themes of ideas from the teacher interview discussions were indexed using Miles, Huberman, & Saldaña, 2014; Saldaña (2013) qualitative data analysis method. Once the teacher interview discussion transcripts where coded using Miles, Huberman, & Saldaña's (2014) qualitative data analysis method, Yin's (2014) congruence method (pattern matching) technique for case study analysis was used to match empirically-based patterns with predicted findings developed prior to the data collection. Section 6.3 of this research outlines the analysis and findings from the teacher interviews.

3.12 Summary of Chapter 3

In this chapter the researcher provided a comprehensive and detailed explanation of the methodology used in this mixed-methods research. The researcher discussed the research design sample size of the populations used in the various phases of the research, and the role of the researcher in each phase of the research. The researcher detailed the approaches used to collect and analyse data and discussed the ethical implications of the study.

The research was comprised of five stages as outlined in the revised proposed schedule of research. Each stage of the research was developed to address the overarching research question and one or more of the research sub-questions that were identified from the literature. The overarching research question being:

> **How does an information technology career focused curriculum, using tech-savvy teaching tools, impact on year nine student's' perceptions toward information technology careers?**

Stage one involved the developed a new instrument, the IT Career Interest Instrument (ITCI), for determining junior high school students' interest in Information Technology careers. The ITCI instrument development in the study was designed to collect data to answer the research sub-question 1a:

> **Research Question 1a: What factors contribute to an information technology career survey instrument to test changes in student perceptions towards information technology careers?**

The qualitative findings that address this research sub-question for stage one of the research are analysed in the chapter 6, section 6.2 and a discussion of the findings are provided in chapter 8.

The research developed a two-week IT Careers Curriculum that was implemented in four schools within the region to investigate whether the inclusion of Information Technology careers information would have an effect of these students' level of interest through the IT Career Interest Instrument (ITCI). The researcher implemented the IT Careers Curriculum personally in one of the four schools, a personal reflection of this involvement will be provided in Chapter 5. The IT Careers Curriculum design and development in the study is designed to answer the Research Sub-Question 1b:

> **Research Question 1b: What content and teaching approach contributes to an information technology career curriculum, using tech-savvy teaching tools, that could be developed to influence student perceptions towards information technology careers?**

Chapter 4 will discuss the Curriculum Design and Development for the IT Careers Curriculum from the literature in answer to this research sub-question and a discussion of the findings are provided in chapter 8.

Chapter 5 further investigates this research sub-question by analysing the implementation of the IT Careers Curriculum to ascertain if it can influence students' perceptions towards IT careers, including an analysis of teaching the curriculum based on the researcher's reflective personal journal notes, and a discussion of the findings are provided in chapter 8.

Following the implementation of the two-week IT Careers Curriculum, a mixed-methods research approached using both quantitative and qualitative analysis was conducted. Data collection of the IT Career Interest Instrument (ITCI) and quantitative analysis of the strengths and weaknesses of the instrument was reported. The quantitative measurement from the ITCI instrument surveys in the study was designed to collect data to answer the Research Sub-Question 1c:

> **Sub-Question 1c: Focussing on quantitative measures, how does the implementation of an information technology career curriculum, using tech-savvy teaching tools, impact student perceptions towards information technology careers?**

The quantitative findings that address this research sub-question for stage three of the research are analysed in the chapter 6, section 6.3, section 6.4 and section 6.5, and a discussion of the findings are provided in chapter 8.

Qualitative analysis was conducted through focus groups with students and interview with the teachers from the four schools involved in the two-week IT Careers Curriculum for further investigation into the impact of the two-week IT Careers Curriculum.

Student focus groups were conducted after the conclusion of the IT Careers Curriculum. These focus groups were designed to collect data to answer the following two research sub-questions:

> **Sub-Question 1d: Focussing on qualitative measures, how does the implementation of an information technology career curriculum, using tech-savvy teaching tools, change student perceptions towards information technology careers?**
>
> **Sub-Question 1f: What was the effect of the information technology career curriculum, using tech-savvy teaching tools, on the students' learning experience?**

The qualitative findings that address these research sub-questions for stage four of the research are analysed in the chapter 7, section 7.2 and a discussion of the findings are provided in chapter 8.

Teacher interviews were conducted after the conclusion of the IT Careers Curriculum. These interviews were designed to collect data to answer the following two research sub-questions:

> **Sub-Question 1e: How do the views of the class teachers differ from their students' perceptions towards information technology careers after the implementation of an information technology career curriculum, using tech-savvy teaching tools?**
>
> **Sub-Question 1g: What was the effect of the information technology career curriculum, using tech-savvy teaching tools, from teachers' observations, on their students' learning experience?**

The qualitative findings that address these research sub-questions for stage five of the research are analysed in the chapter 7, section 7.3 and a discussion of the findings are provided in chapter 8.

Chapter 4 Curriculum Design and Development

4.1 Chapter Introduction

The previous chapter established the research methods that are utilized in this study. The chapter also presented the plan to design, develop and implement the Information Technology Careers Curriculum intervention. This chapter outlines the design and development of the Information Technology Careers Curriculum intervention that will improve student perceptions of information technology careers.

Section 4.2 provides a discussion of the design and development process drawn from the literature. Section 4.3 concludes the chapter by presenting a detailed outline of the lesson plans for the IT careers content and learning activities for the two-week IT Careers Curriculum.

This chapter specifically addresses Research Sub-Question 1b:

> **Research Question 1b: What content and teaching approach contributes to an information technology career curriculum, using tech-savvy teaching tools, that could be developed to influence student perceptions towards information technology careers?**

4.2 Curriculum Design and Development Process

There are three key areas of the literature that inform the design and development of the IT Careers Curriculum intervention.

- Age group selection that an IT Careers intervention will have the most impact based on Gottfredson's (2002, 2005) theory of Circumscription, Compromise, and Self-creation;
- The social or structural factor or factors that a IT Careers intervention will have the most impact based on Lent and Brown's (2006) Social Cognitive Career Theory (SCCT) framework for understanding how people develop career-related interests and Adya and Kaiser's (2005) Social and Structural Factors; and
- The Tech-Savvy Web-based Learning Activities that will meet the learning styles of the current "Millennial Generation" of students.

4.2.1 Age Group Selection

The literature investigation of Gottfredson's (2002, 2005) theory of Circumscription, Compromise, and Self-creation found that the key student age group where a student's self-career development occurs, and especially where careers are removed from further career exploration was the third stage of career development, between ages nine and thirteen (late primary and junior high school). This was the point where students eliminate from further consideration any career path that they see as too low in prestige, irrelevant, mundane or that seems to be out of reach in terms of ability or effort required.

From this literature review findings, year nine high school students were selected as the target group for the IT Careers Curriculum intervention.

4.2.2 Social or Structural Factor(s) Selection

The literature investigation of Lent, Brown, and Hackett's Social Cognitive Career Theory (SCCT) (2002, 2006) identified the factors that influence student careers decision making. This included Bandura's (1986) Social Cognitive Theory (SCT) on self-efficacy, and Lent et al. (2002, 2006) personal and environment factors (gender, culture, barriers, and supports) that affect student career exploration and career selection.

From the literature review into SCCT, the type of careers intervention to be implemented in this research was found to require a focus on building students' self-efficacy and outcomes expectations.

Adya and Kaiser's (2005) social factors (family, peer group, and media), and structural factors (teachers and curriculum) were explored. The social factors of family and peer groups were found to play an important role in developing role models for students to assist their career exploration but were found to be difficult to influence in a career intervention strategy. The structural factors teachers and curriculum were also found to be important and linked to students' perceptions. The Australian National Curriculum was also examined and found to lack any IT Careers Curriculum from foundation to year ten level schooling.

From this literature review findings, the careers invention that would have an impact on student perceptions towards IT careers was identified as an IT careers focus curriculum implemented in year nine, with a focus on improving students' self-efficacy and outcomes expectations towards IT.

4.2.3 Tech-Savvy Web-Based Learning Tools Selection

The literature investigation into the learning activities that would improve the current "millennial" generations' self-efficacy and outcomes expectations were found to be tech-savvy web-based learning tools such as wikis, blogs, and multimedia podcasting.

These tech-savvy web-based learning tools will be used in the IT Careers Curriculum intervention presented to year nine high school students to test the overarching research question of this study and research sub-question 1b.

4.3 Year Nine IT Class Lesson Plans

4.3.1 Original Proposed Curriculum

The originally proposed curriculum was developed as a tech-savvy careers focused, four-week series of four 60 minute lessons per week, with units of work that would be taught within the current year nine computer classes as an alternate unit of work and would have been taught by a mix of IT and non-IT teachers who currently run these classes.

The focus of the proposed first week of the curriculum was to be on investigating the breadth of IT careers by utilising the Interactive ICT Career Wheel currently maintained by the Australian Computing Society (ACS) Careers Foundation in groups with each group researching an area of the Wheel and presenting their findings to the class in the form of an elevator pitch. The focus of the second week of the curriculum was to have each group further research their area of the Wheel from week 1, and to develop a wiki page from this investigation. The focus of the third week of the curriculum was to have the students take their research from the first two weeks and to develop an audio podcast in the form of an interview role-play with one student interviewing one or more other students who work in their area of the Interactive ICT Careers Wheel. The final week of the curriculum was to have each group develop a YouTube style advertisement focusing on each group's areas of the Wheel, the aim being to promote those types of careers.

4.3.2 Revised Curriculum

The revised two-week curriculum continued to have the same careers focus, with the tech-savvy activities focused on students researching the types of IT careers. The two-week curriculum drew the tech-savvy tools most closely aligned to the current National Curriculum Technology - Digital Technologies from the four originally proposed activities. It was deemed through discussion with the year nine teachers involved that the key elements of communications and collaboration using reception pitches and wiki development were the best fit for integration into their current curriculum. Lesson Plans and resources were provided to the teachers involved prior to the start of the curriculum unit. Each week was comprised of four, 60-minute lessons. Schools with varying timetables could then modify these lessons to suit their own structures. Video and phone conferences were held with each teacher to ensure their understanding and comfort in using the curriculum unit.

These resources were refined throughout the two-week curriculum, based on the observations of the researcher, and communicated to each teacher. The first week focused on providing students with an understanding of the breadth of careers within the Information Technology domain.

Week 1 Lesson 1

The first lesson involved the teachers discussing the USQ IT Careers Research Project and then assisting the class in completing the IT Career Interest (ITCI) Instrument pre-test online survey.

Upon completion of the pre-test online survey, the class discussion focused on what were the students' thoughts of Information Technology, sharing of their current perceptions of the types of activities someone working in the field would undertake. They were also encouraged to discuss the types of IT related tools they use in their daily lives such as the Internet and social media, and the changes they have observed in IT technology in their lives.

The class then discussed "disruptive technologies", with the teacher providing an initial explanation and encouraging the class to provide current and future examples, such as smartphones, virtual reality and augmented reality and how they have and/or will affect the way we live, do business and education.

At the end of the lesson, the students were given an electronic copy of the IT Careers Prospects and Trends Report, December 2017, a careers document developed by the University of Southern Queensland to provide insight into IT careers for potential students (Appendix 3.9). Students were asked to read this document for homework.

Week 1 Lesson 2

Lesson 2 focused on the IT Career Prospects and Trends Report developed by the University of Southern Queensland with the class. The teachers discussed the anticipated growth in IT qualified positions, especially in emerging technologies and IT security. Topics such as the Internet of Things (IoT) and Cloud Computing were also discussed as was their impact on IT careers.

Some discussion was also given to Australia's involvement in IT Milestones, such as the CSIRO’s development of Wi-Fi technology and Google Maps, providing students with an understanding that Australians plays a strong roll in global IT.

The nine skills for success in IT were discussed, with the emphasis placed on problem-solving, communications and team-work, and where coding fits into these skills.

Students were then introduced to the Interactive ICT Career Wheel, maintained by the Australian Computing Society (ACS) Careers Foundation (Appendix 3.10). Each of the four quadrants of the Wheel were discussed to help students understand the scope of IT careers from creative/artistic, through logical, sales/marketing, to technical. The specific types of occupations in each quadrant were discussed with the teacher picking a few at random, and drilling down to show the underlying careers pages that have been developed for each, including the video, qualifications and skills needed to work in that career, and the salary range for each.

The class was then broken into four groups, each group was allocated one of the Marketing / Consulting IT Careers from the Interactive ICT Career Wheel. Each group was given the task of reading through the information about that particular career and watching the video included. Each group was then asked to report back two key points about that career that they found interesting, and the salary range of the career.

At the end of the lesson, the four groups were randomly given a quadrant from the IT Careers from the Interactive ICT Career Wheel and asked to read/watch the information about the different types of careers in that career area for homework.

Week 1 Lesson 3

Lesson 3 focused initially on teaching the students about elevator pitches. They were first shown a YouTube video by Sean Wise, business columnist for The Globe and Mail, author, partner at Ryerson Futures Inc, and as a consultant for CBC on the venture reality show Dragons' Den (http://www.youtube.com/watch?v=Tq0tan49rmc) which discussed what an elevator pitch was, the normal duration, and the key points that should be put across. Students were each then given the "High 5" Elevator Pitch worksheet (Appendix 3.11) by Connie Reimers-Hild from the Institute of Natural Resources at the University of Nebraska-Lincoln. The class then discussed each of the five steps outlined in the worksheet:

1. Step One: What are you Pitching?

2. Step Two: Who is Your Target Audience?
3. Step Three: “Hook” Your Audience with a Wow Factor!
4. Step Four: Why You? Paint a Vivid Picture and Rescue Your Audience
5. Step Five: When? Revise and Rehearse with THE ASK!

A modified version of McCollough, Devezer and Tanner’s (2016) alternative structure to elevator pitches, the reception format, was presented to the class. Their original reception pitch format required teams to develop their pitches and present them at an industry evening. For this activity, students were asked to pitch to their peers in their IT class. Each group was required to develop a PowerPoint™ presentation to accompany their pitch, and all members of the group were to be involved in the presentation, rather than the pitch being an individual effort.

Each of the four groups allocated in lesson two was asked to develop their Reception elevator pitch utilising the five steps from the "High 5" Elevator Pitch Worksheet for their given quadrant from the IT Careers from the Interactive ICT Career Wheel. Students were given the remainder of the lesson to work on their Reception elevator pitch.

Week 1 Lesson 4

Students were given the first half of Lesson 4 to finalise and rehearse their Reception / Elevator Pitch. Each group then presented their Pitch for their given quadrant from the IT Careers from the Interactive ICT Career Wheel.

A discussion was undertaken after each Pitch, as to whether the group had provided enough information to answer:

- What are they pitching?
- Was it pitched to the right audience?
- Did the pitch Wow the audience?

A score out of ten was given by the other three groups and a small reward of a chocolate bar was given to the group with the average highest score.

Week 2 Lesson 1

The second week of lessons commenced with a discussion on wikis, including the history of the term and a discussion of the types of wikis that the students have used. They were then shown a YouTube video by Common Craft, called “Wiki in Plain English” (https://www.youtube.com/watch?v=-dnL00TdmLY) which included a short explanation of wikis and how they can be used to coordinate a group. The video introduced a wiki website as a resource for helping a group of campers organize and coordinate information for a camping trip. Topics discussed in the video included: why email is a poor choice for coordinating a group's input; the basics of using wikis; how a group can edit a wiki to add, remove and edit their camping supplies list; and how to add a new wiki page to account for diverse needs.

As a follow on from the discussion about the types of wikis that the class identified as having used, the class had a focused discussion on Wikipedia. The class discussed the advantages and disadvantages of Wikipedia, using the following online resources:

- University of Newcastle UK, Robinson Library: Wikipedia – The Pros and Cons <https://libhelp.ncl.ac.uk/loader.php?fid=2099&type=1&key=2bfc2dc8f3b60a57b3f61624e49fd468>;
- prosancons.com: Pros and cons of using Wikipedia <http://www.prosancons.com/general/pros-cons-using-wikipedia/>; and
- Youth Village, South Africa: The Advantages and Disadvantages of using Wikipedia for Research: <https://www.youthvillage.co.za/2014/10/advantages-disadvantages-using-wikipedia-research/>.

The teacher then demonstrated the ease that a Wikipedia article can be edited, making a deliberate incorrect change, and then checking back regularly through the lesson until it had been corrected.

The class discussed the differences between wikis and office cloud apps, such as Google Docs. Students were encouraged to share their experiences using office cloud apps. Then the class brainstormed the advantages and disadvantages of both tools, with the teacher leading the class to identify the following two issues: 1) wikis do not allow simultaneous editing, while Google Docs does, and 2) the limited revision history of Google Docs over a wiki.

Students homework was to think about how they would develop a wiki page for their given quadrant from the IT Careers from the Interactive ICT Career Wheel.

Week 2 Lesson 2

Teachers were shown how to develop a wiki using http://www.wikidot.com/education. A common wiki page was created for the class prior to the start of the lesson, including a top-level page and four sub-pages for each of the quadrants from the IT Careers from the Interactive ICT Career Wheel.

Lesson 2 commenced with each student creating their own wikidot.com account, then adding the class wiki page to their account. The students were given a basic introduction to using wikidot and shown where to find the wikidot.com online resources. Each group was asked to develop a wiki page for their given quadrant from the IT Careers from the Interactive ICT Career Wheel, with the following elements included on their wiki careers page:

- At least 2 hyperlinks
- An image
- 3 kinds of headings
- Table of contents
- Horizontal rule
- Use bolding, italics
- Embed a video
- Use bulleted and numbered lists
- Embed a quizlet with at least 10 cards

Students then spent the remainder of the lesson in their groups, developing their skills in using wikidot.com.

Week 2 Lesson 3

Lesson 3 required the students to continue the wikidot.com careers wiki pages in their groups started in lesson 2. As the students worked, the teacher facilitated each group, spending time with each, assisting them in their wiki development. The teacher also kept an eye out in each group and selected something each group had done well, pointing it out at the end of the lesson. Students were also encouraged to peer assist each other in the creation of the required wiki page elements.

Teachers were advised that typically this activity should take 2 days to complete providing that students stay on task. They were advised to ensure that students may not complete within this timeframe if they are too into their topic, that they might spend more time looking for information and less time writing on the wiki.

Week 2 Lesson 4

The two-week IT Careers Curriculum concluded with groups being given a third of the lesson to finalise their wikis. Each group then presented their wiki for their given quadrant from the IT Careers from the Interactive ICT Career Wheel.

A discussion was undertaken after each wiki was presented, as to whether the group had provided enough information to answer:

- Does it inform about the IT career area?
- Was it pitched to the right audience?
- Did the wiki Wow the audience?

A score out of ten was given by the other three groups and a small reward given to the group with the average highest score.

The final portion of the lesson involved the teachers recapping the USQ IT Careers Research Project and then assisting the class in completing the IT Career Interest (ITCI) Instrument post-test online survey.

4.4 Summary of Chapter 4

This chapter presents the design and development of the Information Technology Careers Curriculum and addresses Research Sub-Question 1b identified from the literature in chapter 2:

> **Research Question 1b: What content and teaching approach contributes to an information technology career curriculum, using tech-savvy teaching tools, that could be developed to influence student perceptions towards information technology careers?**

Section 4.2 discussed the theoretical research from Gottfredson's (2002, 2005) theory of Circumscription, Compromise, and Self-creation; Lent and Brown's (2006) Social Cognitive Career Theory (SCCT) framework for understanding how people develop career-related interests; and Adya and Kaiser's (2005) Social and Structural Factors that were linked to students' perceptions. Learning activities that would improve self-efficacy and outcomes expectations were found to be tech-savvy web-based learning tools such as wikis, blogs, and multimedia podcasting.

This research identified that the careers invention that would have an impact on student perceptions towards IT careers was a IT careers focus curriculum, using tech-savvy web-based learning tools, implemented in year nine, with a focus on improving students' self-efficacy and outcomes expectations towards IT.

Section 4.3 outlined the lesson plans for IT careers content and learning activities for the two-week IT Careers Curriculum. This included a discussion of the originally planned four-week curriculum that outlines the other learning activities that could have been used in the study.

Chapters 5 to 7 will quantitatively and qualitatively test the impact of the two-week IT Careers Curriculum. Each chapter will address one or more research sub-question identified through the literature review that will build a detailed set of findings towards addressing the overarching research question. Chapter 8 will then present all findings from these chapters to ascertain the level of improvement in students' perceptions towards IT careers the IT Careers Curriculum.

Chapter 5 Curriculum Implementation

5.1 Chapter Introduction

The overarching research question introduced in Chapter 1 posited that providing junior high school students with a comprehensive understanding of IT careers would influence their perceptions of such careers:

> **How does an information technology career focused curriculum, using tech-savvy teaching tools, impact on year nine students' perceptions toward information technology careers?**

Chapter 2 identified junior high school as the key career developmental stage where students discount career alternatives that do not meet their image of self and amend their self-image to accommodate real-world constraints in favour of other career alternatives. Structural factors, such as teachers and curriculum, were identified as possible methods of strengthening a student's perceptions of IT careers. A tech-savvy IT careers focused curriculum using web-based learning tools was recognised as a possible approach to influence students' perceptions of IT careers.

Chapter 3 described the content and learning activity validation and design, the process involved in obtaining schools' and teachers' involvement in the intervention, and the development and implementation of the two-week IT Careers Curriculum that was used in four Toowoomba region schools. Chapter 4 outlined the design, development and implementation of the IT Careers Curriculum, using tech-savvy teaching tools, based on the literature. It provided a lesson-by-lesson discussion of the lesson plans and the resources provided to the teachers involved in the intervention. Video and phone conferences were held with each teacher to ensure their understanding and comfort in using the curriculum unit.

These resources were refined throughout the two-week curriculum, based on the observations of the researcher, and communicated to each teacher.

This Chapter provides an alternative validation of the curriculum, through the researcher's own reflections of teaching the two-week IT Careers Curriculum at Downlands College (one of the four Toowoomba region schools), as such it provides further insight into answering the research sub-question 1b:

> **Research Question 1b: What content and teaching approach contributes to an information technology career curriculum, using**

tech-savvy teaching tools, that could be developed to influence student perceptions towards information technology careers?

Prior to the commencement of term 3, the Deputy Principal of Downlands College contacted the researcher to inform that the Year nine IT teacher had left the school and that they were seeking to recruit and new teacher for the class, but had not been successful by the beginning of term 3. After some negotiations, it was agreed that the primary researcher, who was a registered teacher, would assist the school by teaching the year nine IT class, along with the year eleven and twelve senior computing class for the first two weeks of term to allow for more time to recruit a suitable new teacher, allowing the two-week IT Careers Curriculum class to be undertaken during this time.

As an active participant in the research, the researcher journalised their reflections on each lesson taught. Each reflective journal entry involved a review of the career content and the learner activity used for that lesson. Any areas of significant concern identified were communicated with the other teachers undertaking the curriculum at the other schools. The following is the researcher's reflection on teaching the two-week IT Careers Curriculum.

5.2 Primary Researcher's Reflection on Teaching the IT Careers Curriculum

5.2.1 Week 1 Lesson 1 Reflections

Careers Content Reflection

The class was made up of twenty students, fifteen boys and five girls. Based on the literature findings previously discussed, the gender balance was not investigated in this study, as it has been the primary focus most of the current careers intervention research (Hunter and Boersen 2017; Hunter and Boersen 2016; Gorbacheva et al. 2014; Craig, Fisher and Lang, 2007; Lang, 2010; Bain and Rice, 2006; Ashcraft et al. 2012; Clayton, Beekhuyzen and Nielsen, 2012).

Students were enthusiastic when I discussed the USQ IT Careers Research Project with them, and after discussing the survey terms of reference with them, all but one student opted to complete the IT Career Interest (ITCI) Instrument pre-test online survey.

The initial class discussion on the students' understanding of Information Technology focused mainly on topics of coding, security and computer maintenance. The types of IT-related tools they use in their daily lives focused mostly on applications software, such as Word, Excel and PowerPoint, Google searching and Facebook. The discussion about the changes they have observed in IT technology focused on topics such as the NBN and smartphone technology. It should be noted that all students at Downlands College have a tablet computing device provided by the school.

The term “disruptive technologies”, was a new concept to the class, but once I had explained with a couple of examples, the class was able to provide numerous current and future examples and they were able to provide many examples of how these technologies affected how they live, do business and their education.

The discussion in this lesson was purposely left very open, allowing the students to explore different examples from their own personal backgrounds, providing they did not digress to far from the topics. This allowed all students to engage in the discussion, not just the “geeky” ones.

The school’s learning management system allowed easy dissemination of the electronic copy of the IT Careers Prospects and Trends Report, which was given to students to read through as homework and which would form the basis for the second lesson.

5.2.2 Week 1 Lesson 2 Reflection

Careers Content Reflection

Discussion about the anticipated growth in IT qualified positions was of great interest to the students. Their responses were that they did not think the IT industry had so many opportunities. Students who had family or friends working in the industry were able to share what they knew of these types of jobs in the local market. The discussion about how the IoT and Cloud Computing will impact further jobs was robust, with students suggesting that personal assistants will take the place of office workers through to security issues if private information was all stored in the cloud. It should be noted that this lesson was run soon after the media hype about Cambridge Analytica (Cadwalladr and Graham-Harrison 2018).

Students were surprised at the level of Australian involvement in different IT Milestones, such as the CSIRO’s development of Wi-Fi technology and Google Maps. When asked if they thought there would be more such development coming out of Australia, many students were cynical, expressing that that type of thing does not appear to be happening anymore.

All students in the class engaged with the Interactive ICT Career Wheel developed by the Australian Computing Society (ACS) Foundation. The top-level diagram outlining the four main IT career paths provided the students with many more IT career options then they had considered, some were completely new to them. The depth of information, including video, salary range and necessary qualifications that students call up for each occupation appeared to be of great interest with students drilling down on several career types while they initially explored the Wheel.

Due to the number of students in the Downlands class, five groups were created at this point. The first group activity where students were allocated one of the Marketing / Consulting IT Careers selected at random from the areas on the Careers Wheel to report two key points about what they found interesting, and the salary range of the career was enthusiastically undertaken. Each group provided one speaker who gave a well-developed account of their allocated career. Each group was also asked if they had heard of that career before and whether they would consider it in the future. Most groups indicated that it could be of future interest.

Each group was then randomly given a quadrant from the IT Careers from the Interactive ICT Career Wheel, with two groups splitting the hardware/software between them. Each group was asked to read/watch the information about the different types of careers in that career area for homework.

Actions Arising from Career Content Reflections

Students did not engage as well with the nine skills for success in IT. While I spoke about the importance of these skills and gave examples, the class did not get very involved in the discussion. This may require a varied exercise where they first develop their own list of important skills, then compare their lists with the IT Careers Prospects and Trends Report.

5.2.2 Week 1 Lesson 3 Reflection

Learning Activity Reflection

The class watched the YouTube video and then discussed the various aspects of an elevator pitch: key points, content and duration. We then discussed the difference between an elevator pitch and a reception elevator pitch, most notably the use of presentations tools and multiple presenters. The idea of presenting in a group, rather than one-on-one, appealed to the class.

The "High 5" Elevator Pitch worksheet (Appendix 4.1) was displayed on the data projector, and each group was asked to discuss each of the five steps outlined in the worksheet, based on their quadrant from the IT Careers from the Interactive ICT Career Wheel. Students were given time to work on each step and I walked around assisting each group. Once each group had worked through up to step 4, they were then given the rest of the lesson to fully research their quadrant and to prepare their reception elevator pitch.

Actions Arising from Career Content Reflections

I was initially concerned that switching the terminology between elevator and reception pitch would cause some confusion for the students, but they were able to easily adapt the "High 5" Elevator Pitch worksheet to the reception pitch structure.

5.2.4 Week 1 Lesson 4 Reflection

Learning Activity Reflection

Students were given the first half of the lesson to finalise and rehearse their reception elevator pitch. Several students in two of the groups were not present for lesson 3, so these groups were given extra time to amend their reception elevator pitch to take this into account. Table 7 outlines the learning activity outcome of Week 1 Lesson 4 for the Downlands College Year Nine IT class.

Group	Learning Outcome
Group 1	The first group to present were the Product Development (Hardware) quadrant group. This group was comprised of four boys. This group produced a detailed background on the various hardware development career paths with their focus being on electronic engineering. Their “wow” factor was a discussion about the scope of electronic engineering jobs, the salary range and they focused on the development of robotics in manufacturing. I provided them with an example of the automated detonator production line at Orica Explosives as an extra example. This group was given an average score of 7 out of 10 by the other groups.
Group 2	The second group that presented were the Business Services quadrant group. This group was comprised of four boys. This group discussed how IT and business knowledge produce solutions to clients and industry. Their focus was somewhat narrow, rather than looking at the whole of their quadrant. Their “wow” factor was a discussion about how Quantum Computing could be used in the future. I spoke about some of the other roles such as Project Managers and Social Media Analytics to supplement their discussion. This was one group that appeared to be working well and I did not spend as much time with them as I did some of the other groups, which unfortunately led to the narrow focus. This group was given an average score of 6 out of 10 by the other groups.
Group 3	The third group that presented was the Content and Design quadrant group. This group was comprised of three of the girls in the class and one of the boys. This group discussed careers that develop multimedia content and web design. They produced a very well researched presentation and provided a broad scope of the various careers in this field. Their “wow” factor was in discussing games design. I followed their presentation up with some discussion about the types of skills that are important in the development of games, such as artificial intelligence. This group was given an average score of 8 out of 10 by the other groups.
Group 4	The fourth group was the Technology Services quadrant group. This group originally comprised of four boys but two were not in attendance on the day for reception elevator pitches, and as such extra time was given to this group during the first three presentations. This group discussed technical careers, which matched the interests of the two boys involved. Their use of PowerPoint for their pitch was limited, but they were able to speak at length about networking and security careers. They did not present a “wow” factor to their pitch, which was reflected in the low average score of 5 out of 10 by the other groups.

Group 5	The fifth group was the Product Development (Software) quadrant group. This group originally comprised of two girls and two boys but one of the boys were not in attendance on the day for reception elevator pitches, and as such extra time was given to this group during the first four presentations. This group produced a well-developed background on the various software development career paths with their focus being on IT entrepreneurship. Their “wow” factor was their discussion on developers such as Elon Musk, Bill Gates and Mark Zuckerberg, how they turned hobbies and home/dorm-room businesses into multi-billion-dollar enterprises. I added to this conversation by pointing out that having the right idea at the right time and the courage to do something about it is what makes a great entrepreneur. This group was given an average score of 8 out of 10 by the other groups.

Table 7: Week 1 Lesson 4 Learning Activity Outcomes

As there were two groups who both scored 8 out of 10 for their elevator pitches, both groups were awarded a small prize.

5.2.5 Week 2 Lesson 1 Reflection

Learning Activity Reflection The lesson commenced with a discussion about wikis, starting with the origin of the name. The class shared the types of wikis that they have personally used. As expected, Wikipedia was the first example given by the class.

The YouTube video called “Wiki in Plain English” was well received by the class, showing how wikis can be used to coordinate a camping trip. Discussion as to why email is a poor choice for coordinating a group's input came out of watching the video and this lead to a further discussion about other online tools that could also be used by the campers, such as creating a website and cloud apps such as Google Docs. The original lesson plan included a discussion on cloud apps later in the lesson, but I decided to bring it forward to this point.

The class discussed the differences between wikis and cloud apps, and they shared their own experiences with using cloud apps. I pointed out that each tool has its own use, depending on what it is needed for. The class identified the following two issues that need to be considered when selecting between cloud apps and wikis:

1) wikis do not allow simultaneous editing, while Cloud Apps do, and
2) cloud apps have limited revision history over a wiki.

To conclude the lesson, I then went back to discuss Wikipedia with the class. This was not necessarily linked explicitly to their understanding of wikis, but I felt it a good segway into the advantages and disadvantages of using Wikipedia for research in general. Three websites discussing these advantages and disadvantages were reviewed on the data projector and I discussed the importance of using the links to primary sources in Wikipedia rather than relying on the content of the article itself, as anyone can edit an article and at any time the article can be incorrect. To reinforce this, I opened a Wikipedia article and deliberately changed a key piece of data. We then checked back five minutes later to find the information had been corrected. As homework, I asked the class to think about how they would develop a wiki page for their given quadrant from the IT Careers from the Interactive ICT Career Wheel.

5.2.6 Week 2 Lesson 2 and 3 Reflection

Learning Activity Reflection

The focus of this lesson was to allow the students to explore and develop their wiki pages for their quadrant of the Interactive ICT Career Wheel.

Prior to the commencement of this lesson, I created a Downlands Year nine IT Wiki using Wikidot. It was during this stage that I noted that the setting up of the top-level wiki page was not as user-friendly as reported, having no Graphic User Interface (GUI) edit tool. To assist the students, I created the top-level page, a subpage for each of the five groups' quadrants in the Interactive ICT Career Wheel, and inserted code onto the top-level page to display the subpages. I immediately emailed this information to the other teachers conducting their classes at other schools in the research. The subpage GUI developed by Wikidot was much more user-friendly for the students to use, allowing them easier development of their wiki pages.

After all the students had registered for Wikidot and accessed the Downlands wiki, the class was given a basic introduction to using the wiki, and demonstration of where to find the Wikidot online resources. The following list of required elements was then given to the class, for each group to include in their wiki:

- At least 2 hyperlinks
- An image
- 3 kinds of headings
- Table of contents
- Horizontal rule
- Use bolding, italics
- Embed a video
- Use bulleted and numbered lists
- Embed a quizlet with at least 10 cards

Students were given the remainder of the lesson and the whole of lesson 3 to work in their groups on their Wiki pages, with one student being designated as the Wiki page editor and the other members of the group finding the content and multimedia elements. Students quickly worked out that using Word or Notepad was a quick way of to put the content together and send to the Wiki editor to inclusion. They also worked through the process of swapping rolls, by releasing edit control and allowing someone to take over when necessary. During this time, members of one group also provided support to other groups, showing how to embed videos and set up quizlets.

Actions Arising from Learning Activity Reflections

Originally, I had intended to use the Wikispaces platform, a K-12 free wiki site popular for educational wiki development, but unfortunately, the site was closed on 31st July 2018. I researched several educational lesson planning portals to ascertain what other K-12 education supported wikis were being used. Several the educational portals recommended the Wikidot platform, as it was free to use, licenced through Creative Commons, and did not embed advertising.

Wikidot requires all participants to have a login account, registered through an email address. This was not an issue for Downlands College as all students were provided with a school email address. There is a small-time overhead involved in getting each student to create their Wikidot account, then accept their email registration prior to starting their wiki development.

The teachers undertaking the IT Careers Curriculum were emailed immediately of the change from the Wikispaces platform to Wikidot, including changes to the resources outlining the implementation requirements and set-up steps to facilitate easy implementation in their classes. All teachers reported that this was implemented prior to this stage in the curriculum and that the extra login requirements did not impact on school systems or restrictions.

5.2.7 Week 2 Lesson 4 Reflection

Learning Activity Reflection

The final lesson concluded with each group being given fifteen minutes to finalise their wikis. Most groups had finished or were near to finishing their pages, and I encouraged each group to read carefully through their pages for typing mistakes and to check that all the links, images and embedded videos were working correctly. Each group then presented their wiki for their given quadrant from the Interactive ICT Career Wheel to the class. The class discussed whether the group had provided enough information to answer:

- Does it inform about the IT career area?
- What was good about the page (commendations)?
- What could have been improved on the page (improvements)?

Table 8 outlines the learning activity outcome of Week 2 Lesson 4 for the Downlands College Year Nine IT class.

Group	Learning Outcome
Group 1	The first group that presented their wiki page were the Business Services quadrant group. Overall, the class felt that the wiki page provided a detailed level of information that covered the breadth of the IT careers from the Interactive ICT Career Wheel. The commendations the other groups had for this page included easy to navigate links to the online Business Services information from the Interactive ICT Career Wheel; a well-structured subpage summarising the salaries for each type of career; a user-friendly set of quizlets identifying the key career types; and a suitable embedded video. Areas of improvement that the other groups suggested were that the image on the main page could have been resized to allow all the information to more easily fit on the one page, and more use of group developed subpages could have been made instead of just pointing to the Business Services information from the Interactive ICT Career Wheel. This group was given an average score of 7 out of 10 by the other groups.
Group 2	The second group that presented their wiki page was the Content and Design quadrant group. Overall, the class felt that the wiki page provided an excellent level of information that covered the breadth of the IT careers from the Interactive ICT Career Wheel. The commendations the other groups discussed included the placement of a contents list at the top of the page; the key career information was summarised on the wiki page rather than just linking to the Career Wheel; the embedding of the quizlets rather than linking to another page; and an appropriate embedded video. Areas of improvement that the other groups suggested were that a more interesting image could have been used, and the information could have been presented on subpages rather than having it all displayed on a single page. This group was given an average score of 8 out of 10 by the other groups.
Group 3	The third group that presented their wiki page were the Technology Services quadrant group. Overall, the class felt that the wiki page also provided an excellent level of information that covered the breadth of the IT careers from the Interactive ICT Career Wheel. The commendations the other groups discussed included the placement of a contents list at the top of the page; the key career information was summarised on the wiki page rather than just linking to the Career Wheel; the inclusion of the career images drawn from the Careers Foundation website; the embedding of the quizlets rather than linking to another page; and an embedded video that met the guidelines given. The was only one area of improvement that the other groups suggested which was that the information could have been presented on subpages rather than having it all displayed on a single page. This group was given an average score of 9 out of 10 by the other groups.
Group 4	The fourth group that presented their wiki page were the Product Development (Hardware) quadrant group. Overall, the class felt that the wiki page provided an adequate level of information that covered the breadth of the IT careers from the Interactive ICT Career Wheel. The commendations the other groups discussed included the key career information being summarised on the wiki page rather than just linking to the Career Wheel; a user-friendly set of quizlets identifying the key career types; and a suitable embedded video. Areas of improvement that the other groups suggested were that the quizlets could have been embedded rather than linking to another page; the image on the main page could have been resized to allow all the information to more easily fit on the one page, and the information could have been presented on subpages rather than having it all displayed on a single page. This group was given an average score of 7 out of 10 by the other groups.

Group 5	The fifth group that presented their wiki page were the Product Development (Software) quadrant group. Overall, the class felt that the wiki page provided some useful information of the IT careers from the Interactive ICT Career Wheel but was too focused on the Entrepreneur career and not enough information on other career types. The commendations the other groups discussed included the key career information being summarised on the wiki page rather than just linking to the Career Wheel; and an appropriate embedded video. Areas of improvement that the other groups suggested were that a more interesting image could have been used; the information could have been presented on subpages rather than having it all displayed on a single page; and that there were no quizlets included. This group was given an average score of 5 out of 10 by the other groups.

Table 8: Week 2 Lesson 4 Learning Activity Outcomes

The Technology Services quadrant group scored 9 out of 10 for their wiki, they were awarded a small prize. I finished the class with a recap of the USQ IT Careers Research Project, and then asked the students to complete the IT Career Interest (ITCI) Instrument post-test online survey.

5.3 Summary of Chapter 5

This chapter presents an alternative validation of the curriculum, through the researcher's own reflections of teaching the two-week IT Careers Curriculum at Downlands. This chapter provides further insight into answering the research sub-question 1b identified from the literature in chapter 2:

> **Research Question 1b: What content and teaching approach contributes to an information technology career curriculum, using tech-savvy teaching tools, that could be developed to influence student perceptions towards information technology careers?**

These reflections and insights were shared with the other three schools daily as extra resources for the teachers.

Reflection on Careers Curriculum Content

The students' understanding of Information Technology was that it involved coding, security and computer maintenance. Their main IT usage was applications software, such as Word, Excel and PowerPoint, Google searching and Facebook. Terms like "disruptive technologies" were new concepts that had not been previously taught to them in their IT classes.

The use of the Interactive ICT Career Wheel was found to be a curriculum teaching instrument that was well suited to these students, providing them with comprehensive information about the many different types of IT careers. Topics drawn from the ICT Career Wheel information such as the anticipated growth in IT qualified positions and the future direction of the IT industry resonated well with the students, instigating robust discussion in the class. Students in the class all expressed that they had not understood the breadth of the IT industry. The Careers Curriculum Content has been further investigated in the student focus groups in Chapter 7.

Reflection on the Learning Activities Reception pitches and Wikis were the two tech-savvy learning activities used within the two-week IT Careers Curriculum by the researcher. Initially there was some concern by the researcher that switching the terminology between elevator and reception pitch would cause some confusion for the students, but they were able to easily adapt the "High 5" Elevator Pitch worksheet to the reception pitch structure. The reception pitch concept was well received by the year nine students and they were able to complete their research into their given IT career and present their findings within the week one timeframe. The reception pitch allowed for groups to present their findings from the careers research, rather than having students present individually, and this was found to work well with this student level.

The wiki concept had several minor issues stemming from the need to change educational wiki providers due to the closure of the Wikispaces platform. The Wikidot platform was found to be less user-friendly, and the linking of the main wiki pages to sub-pages, embedding quizlets and videos required extra coding. The researcher spent extra class-time assisting students to work around these issues. Extra specific Wikidot resources were developed and shared to the other three schools to assist them through these changes. While the year nine students were able to complete all the wiki tasks within the timeframe of week two, upon reflection the researcher felt that more time would have been beneficial. Future lessons using Wikis should be given more time for the students to learn the platform before embarking on developing Wikis themselves. As only one student can edit the Wiki at a time, a systematic approach will need to be developed in the lesson plans to have the other students in the group working offline on their own content while Wiki page is being developed.

Sharing IT Curriculum Reflections

The IT Careers Curriculum, using tech-savvy teaching tools, including a lesson-by-lesson plan and resources were provided to the teachers at the other three schools involved in the intervention prior to the commencement of the two-week IT Careers Curriculum. Video and phone conferences were held with each teacher to ensure their understanding and comfort in using the curriculum unit.

These resources were refined throughout the two-week curriculum, based on the observations of the researcher, and communicated to each teacher. It was noted by the researcher that each school took these resources and the daily communicated reflections from the researcher, and adapted them to their own circumstances. This has been further investigated in the teacher interviews in Chapter 7.

Chapter 6 Quantitative Study

6.1 Chapter Introduction

A mixed-methods approach using both quantitative and qualitative research methods was identified in chapter 2 as the methodology for data collection and analysis to answer the overarching research question of this research. Several research sub-questions were identified from the literature to address each stage in the research. Chapter 3 discussed and justified the five stages of the research design and methods.

Section 6.2 discusses stage one of the research, the development of the Information Technology Careers Instrument (ITCI). The technology component from three Science, Technology, Engineering and Mathematics (STEM) survey instruments were used to develop the ITCI instrument. The original forty-eight items were reduced to the smallest number of items to include in a reliable instrument. Research Sub-Question 1a is addressed in this stage of the research:

> **Research Question 1a: What factors contribute to an information technology career survey instrument to test changes in student perceptions towards information technology careers?**

This research identified the junior high school years of a students' life as the key career developmental stage where they progressively discount career alternatives (Gottfredson's (2005) Circumscription, Compromise and Self-creation theory). Lent, Brown, and Hackett's (2002) Social Cognitive Career Theory (SCCT) together with the research from Adya and Kaiser's (2005) research identified structural factors (e.g. teachers and curriculum) as playing a role in either strengthening or limiting a student's expectations of IT careers. A two-week curriculum focusing on providing students in year nine (junior high school students) with better awareness of IT careers was developed and undertaken as part of stage two of the research.

In stage three of the research, students were surveyed before and after the two-week curriculum and the analysis of the data collected is outlined in this Chapter. Research Sub-Question 1c is addressed in this stage of the research:

> **Sub-Question 1c: Focussing on quantitative measures, how does the implementation of an information technology career curriculum, using tech-savvy teaching tools, impact student perceptions towards information technology careers?**

Section 6.3 discusses the steps taken to recode the data collected in stage three of the research for use in SPSS and the decision to discard the control group data due to limited responses, focusing only on the seventy respondents from the IT Careers Curriculum group.

Section 6.4 describes the process used in stage three of the research for the identification and removal of outliers through Standard Deviation (Std. Dev.) Analysis, Univariate and Multivariate Analysis, and Normality of Distribution Analysis to derive the forty-nine paired respondents for use in the final data analysis. Section 6.5 discusses the Repeated Measures Analysis of Variance (ANOVA) of the Pre and Post Test ITCI Means used to identify whether the data collected showed significance in the change of students' interest in Information Technology careers between the first ITCI survey and the second ITCI surveys after undertaking the two-week IT Careers Curriculum. A Paired T-Test Analysis on the individual Survey Questions was also undertaken to examine if there was any significant change between the first ITCI survey and the second ITCI survey for any individual survey question.

6.2 Development of Information Technology Careers Instrument (ITCI)

The methodology used to develop the Information Technology Careers Instrument (ITCI) followed Clark and Watson (1995) key components for developing scale items and Hinkin's et al. (1997) process for developing reliable and valid measurement instruments. The analysis of the data collection used in the development of the Information Technology Careers Instrument (ITCI) addresses Research Sub-Question 1a:

> **Research Question 1a: What factors contribute to an information technology career survey instrument to test changes in student perceptions towards information technology careers?**

6.2.1 Conduct a literature review to help develop relevant items

The literature review for the ITCI scale items consisted of a search for studies addressing students' interest in STEM and STEM careers, students' perceptions of STEM professionals, and social cognitive career theory applied in science, technology, engineering and mathematics. As discussed in Chapter 2, research suggested that interest in careers was often related to self-efficacy, outcome expectations, and previous learning experienced identified in Lent, Brown, and Hackett's (2002) social cognitive career theory. Three STEM careers instruments were identified by this literature review (Keir et al. (2014) STEM Career Interest Survey (STEM-CIS); Tyler-Wood, Knezek and Christensen (2010) STEM Career Interest

Questionnaire and STEM Semantics Survey; Mahoney (2010) Student Attitude toward STEM Questionnaire).

6.2.2 Create a broad item pool of items that will test the target aspect

The fundamental goal of the creation of the initial item pool is to "sample systematically all content that is potentially relevant to the target construct" Clark and Watson 1995, p. 310), in this case, a pool of items that focus on students' interests in information technology careers. The initial broad pool of items was drawn from the three existing career test instruments identified in the ITCI literature review. The three instruments focused on the Science, Technology, Engineering and Mathematics (STEM) areas. They all had high reliability (Cronbach's Alpha > 0.8) in the technology area and were grounded in Lent, Brown, and Hackett's (2002) Social Cognitive Career Theory (SCCT).

Keir et al. (2014) developed a STEM Career Interest Survey (STEM-CIS) to measure the "factors related to [junior high] school students' interest in and goals related to STEM subjects and potential careers" (p. 9). They tested the STEM-CIS instrument on students at seven schools in rural south-eastern United States (grades five to eight). The STEM-CIS was designed using a five-point Likert scale with forty-four items, eleven items in each of the Science, Technology, Engineering and Mathematics (STEM) areas (Appendix 6.1). The STEM-CIS was found to have a Cronbach's Alpha = 0.77 for the Science area, a Cronbach's Alpha = 0.89 for the Technology area; a Cronbach's Alpha = 0.86 for the Engineering area, and a Cronbach's Alpha = 0.85 for the Mathematics area.

Tyler-Wood, Knezek and Christensen (2010) developed a STEM Semantics Survey to measure the STEM career interest of students. They tested the STEM Semantics Survey on students at two schools in Hawaii and Vermont (grades six to eight). The STEM Semantics Survey was designed as a semantic differential scale, with students asked to select how they feel on a seven-point scale between two adjective pairs (e.g. To me, Technology is: fascinating/mundane). The survey is comprised of twenty-five paired adjective items, five items in each of the Science, Technology, Engineering and Mathematics (STEM) areas and five further items about students' general feeling towards careers in science, technology, engineering, or mathematics (Appendix 6.2). The STEM Semantics Survey was found to have a Cronbach's Alpha = 0.84 for the Science area, a Cronbach's Alpha = 0.91 for the Technology area; a Cronbach's Alpha = 0.92 for the Engineering area; a Cronbach's Alpha = 0.88 for the Mathematics area, and a Cronbach's Alpha = 0.93 for STEM careers.

Mahoney (2010) developed a Student Attitude toward STEM Questionnaire to measure the attitudes students' exhibit towards STEM education. They tested the Student Attitude toward STEM Questionnaire on students at two grade levels (year nine and eleven) at two US high schools. The Student Attitude toward STEM Questionnaire was designed as a variation of a four-level semantic differential scale, with students being asked to select between most, more, less and least for each item. The survey comprised of twenty-four items and students were asked to repeat their selection for each of the four STEM areas. In total students were asked to rate nine-six items (twenty-four science, twenty-four technology, twenty-four engineering, and twenty-four mathematics) (Appendix 6.3). The Student Attitude toward STEM Questionnaire was found to have a Cronbach's Alpha = 0.96 for the Science area, a Cronbach's Alpha = 0.95 for the Technology area; a Cronbach's Alpha = 0.97 for the Engineering area, and a Cronbach's Alpha = 0.96 for the Mathematics area.

The three STEM instruments had a total of one hundred and sixty-five items dealing with science, technology, engineering and mathematics. Only the forty-five items pertaining to technology and technology careers were utilised to develop the initial version of the ITCI survey (Information Technology Interest & Careers Survey) as the other three areas of STEM were outside of the focus of this study. The term technology was amended to the more specific term, "information technology" to avoid confusion in the resulting ITCI survey.

One instrument (Keir et al. 2014) used a five-point Likert scale and the other two instruments (Tyler-Wood et al. 2010, Mahoney 2010) used variations of semantic differential scales. A single type of scale needed to be adopted for ITCI, thus all items were converted to a five-point Likert scale to conform with the structure used by Keir et al. (2014). The amended eleven items using the more specific term, "information technology" is provided in Appendix 6.4.

The five technology and five technology careers items from the Tyler-Wood, Knezek and Christensen (2010) STEM Semantics Survey semantic differential scale was converted to a five-point Likert scale by taking the information technology and information technology careers statements ("to me, information technology is"; "to me, a career in information technology") and merging it with each adjective in the technology and general careers area of the survey, the resultant twenty items (Appendix 6.5) were developed and placed on a five-point Likert scale.

The twenty-four items from the Mahoney (2010) Student Attitude toward STEM Questionnaire were taken and modified to focus specifically on information technology. Each of the items was amended to include the term "information technology" where appropriate. (e.g. I do not like [information technology]). The resultant twenty-four items (Appendix 6.6) were developed and were also placed on a five-point Likert scale.

This resulted in a scale consisting of forty-eight items (Appendix 6.7). These items were then checked for face validity with colleagues in the School of Management and Enterprise at the University of Southern Queensland. Feedback was used from the face validity check to change the wording in several of the items and remove repeating questions (Appendix 6.8). The Information Technology Interest & Careers Survey (Appendix 6.9) was developed.

6.2.3 Factor analysis

An analysis was conducted using a convenience sample of first-year business university students. Eighty students were surveyed during their first-year business-computing course. The data collected was used to ascertain the number of factors resulting from the forty-eight items and to reduce the number of items to an amount easily completed in a ten-minute online survey.

"Factor analysis provides the tools for analysing the structure of the interrelationships among a large number of variables" (Hair et al. 2010, p. 94), defining the underlying structure of the variables in the analysis and condensing the information into a small set of factors.

A factor analysis (Table 9) was conducted on the forty-eight items to confirm the existence of two-factors,

1) interest in information technology and
2) interest in information technology careers.

Varimax is considered the most popular factor rotation method "focusing on simplifying the columns in a factor matrix" (Hair et al. 2010, p. 124). Based on the Rotated Factor Matrix using Varimax with Kaiser Normalization (Table 10) developed using SPSS, two items were identified as cross-loading on factor one and factor two and were thus removed (Items 6 & 11 indicated in red). Hair et al. (2010, p. 117) state that "loadings ± 0.5 or greater are considered to be practically significant". A further examination of the Rotated Factor Matrix identified thirteen items that had loadings between -0.5 and 0.5 which were not considered significant, and also removed (Items 1, 2, 4, 15, 16, 17, 18, 19, 20, 35, 37, 47 & 48 indicated in blue).

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	28.326	59.013	59.013	27.989	58.310	58.310	19.320	40.251	40.251
2	2.142	4.463	63.475	1.774	3.695	62.005	10.442	21.754	62.005
3	1.848	3.850	67.325						
4	1.402	2.921	70.246						
5	1.339	2.791	73.037						
6	1.054	2.195	75.232						
7	.945	1.969	77.201						
8	.861	1.793	78.994						
9	.837	1.744	80.738						
10	.678	1.413	82.151						
11	.625	1.302	83.453						
12	.597	1.243	84.696						
13	.571	1.189	85.885						
14	.554	1.154	87.039						
15	.506	1.053	88.092						
16	.461	.961	89.054						
17	.449	.935	89.988						
18	.430	.896	90.884						
19	.378	.787	91.671						
20	.364	.758	92.429						
21	.337	.703	93.131						
22	.319	.664	93.795						
23	.286	.596	94.391						
24	.276	.576	94.967						
25	.254	.529	95.496						
26	.212	.441	95.937						
27	.204	.426	96.363						
28	.187	.390	96.753						
29	.172	.359	97.112						
30	.166	.345	97.457						
31	.156	.324	97.782						
32	.140	.292	98.073						
33	.111	.232	98.305						
34	.105	.218	98.523						
35	.093	.194	98.718						
36	.082	.170	98.888						
37	.080	.166	99.054						
38	.067	.140	99.194						
39	.063	.132	99.326						
40	.062	.129	99.455						
41	.054	.112	99.567						
42	.043	.090	99.656						
43	.041	.086	99.742						
44	.036	.074	99.817						
45	.032	.067	99.884						
46	.023	.048	99.932						
47	.020	.041	99.972						
48	.013	.028	100.000						

Extraction Method: Principal Axis Factoring.

Table 9: Factor analysis of the original forty-eight items

Rotated Factor Matrix[a]

	Factor	
	1	2
1	.493	.690
2	.430	.556
3	.574	.465
4	.373	.496
5	.654	.421
6	.631	.557
7	-.738	-.345
8	-.694	-.384
9	.800	.362
10	.742	.345
11	-.694	-.560
12	.766	.417
13	.741	.309
14	.739	.482
15	-.218	-.849
16	.469	.711
17	-.042	-.578
18	-.441	-.750
19	.327	.526
20	-.467	-.638
21	.751	.362
22	.651	.355
23	-.589	-.418
24	.640	.370
25	.646	.294
26	-.731	-.430
27	.823	.324
28	.711	.426
29	.801	.343
30	-.644	-.451
31	.583	.368
32	.655	.487
33	.538	.295
34	.743	.464
35	.293	.226
36	.678	.370
37	.154	.221
38	.777	.397
39	-.626	-.396
40	-.598	-.418
41	.758	.458
42	-.750	-.489
43	.762	.284
44	-.696	-.411
45	.812	.178
46	.862	.257
47	-.401	-.715
48	-.442	-.641

Extraction Method: Principal Axis Factoring.
Rotation Method: Varimax with Kaiser Normalization.a
a. Rotation converged in 3 iterations.

Table 10: Rotated Factor Matrix on forty-eight items using Varimax with Kaiser Normalization

A Scree plot is used to identify the optimum number of factors that can be extracted, “the point at which the curve first begins to straighten out is considered to indicate the maximum number of factors to extract” (Hair et al. 2010, p. 110).

A factor analysis was repeated with the remaining thirty-three items together with a Scree plot (Table 11 and Figure 4).

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	21.691	65.730	65.730	21.385	64.804	64.804	13.590	41.181	41.181
2	1.409	4.269	69.999	1.094	3.315	68.118	8.889	26.937	68.118
3	1.044	3.164	73.162						
4	.940	2.849	76.011						
5	.842	2.550	78.561						
6	.723	2.192	80.753						
7	.607	1.839	82.592						
8	.542	1.641	84.233						
9	.515	1.560	85.793						
10	.493	1.493	87.286						
11	.465	1.408	88.694						
12	.414	1.255	89.949						
13	.386	1.169	91.119						
14	.339	1.027	92.146						
15	.303	.917	93.063						
16	.296	.896	93.959						
17	.236	.717	94.676						
18	.223	.676	95.352						
19	.198	.600	95.952						
20	.169	.512	96.464						
21	.165	.500	96.965						
22	.137	.415	97.380						
23	.128	.389	97.769						
24	.113	.343	98.112						
25	.103	.313	98.425						
26	.095	.289	98.714						
27	.084	.255	98.969						
28	.076	.230	99.200						
29	.069	.208	99.407						
30	.059	.178	99.585						
31	.056	.169	99.754						
32	.045	.137	99.892						
33	.036	.108	100.000						

Extraction Method: Principal Axis Factoring.

Table 11: Factor analysis on the remaining thirty-three items

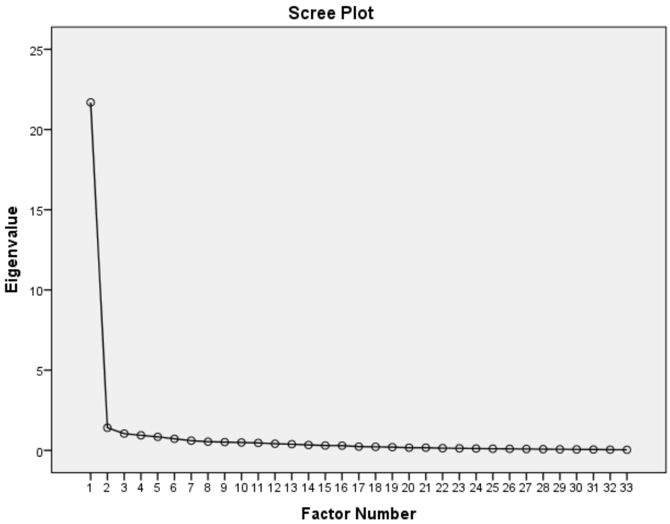


Figure 4: Scree plot of the remaining thirty-three items

Originally it believed that there were two constructs, 1) interest in information technology and 2) interest in information technology careers. However, the scree plot suggests the thirty-three items are a single construct. Close examination of the remaining thirty-three items suggests that there are several items of that use similar language (e.g. “To me, information technology is exciting” and “A career in information technology would be exciting”).

Clayton et al. (2012) identified that students who have a high self-efficacy of their own information technology abilities and a personal interest towards information technology will also have an interest in pursuing a career in information technology. Information Technology inventions that positively influencing participants’ attitudes towards IT result in the participant believing IT to be a viable and exciting career opportunity (Gorbacheva, Beekhuyzen, et al., 2014; Gorbacheva, Craig, et al., 2014). Therefore, it is posited that a person interested in information technology would be interested in a career in information technology.

Thus, the distinction about interest in information technology and interest in careers in information technology should be removed as suggested by the Scree plot.

“Reliability analysis is an assessment of the degree of consistency between multiple measurements of a variable” (Hair et al. 2010, p. 125). The reliability coefficient assesses the consistency of the entire scale. Cronbach's Alpha is the most widely used reliability coefficient measure (Hair et al. 2010). “The general agreed upon lower value for Cronbach's Alpha is 0.70” (Hair et al. 2010, p. 125). Reliability analysis was conducted on the thirty-three items resulting in a Cronbach's Alpha α=.784 (Table 12).

The Item-Total Statistics (Table 13) were analysed and the nine items that would improve Cronbach's Alpha were removed. The Cronbach's Alpha for the remaining twenty-four items was α=.978. Keeping a measure short is an effective means of minimising response biases caused by boredom or fatigue (Hinkin et al. 1997). As the survey was intended to run for a maximum of ten minutes, twenty-four items were considered too many, so further item removal was necessary. Further reductions were made by removing items that correlated least with the item-totals and items whose removal would result in higher a Cronbach's Alpha.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.784	.831	33

Table 12: Reliability analysis on thirty-three items

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
3	105.51	116.937	.697	.	.766
5	105.97	113.468	.703	.	.761
7	107.84	143.657	-.714	.	.819
8	107.76	144.259	-.706	.	.821
9	106.22	109.139	.804	.	.753
10	106.10	111.711	.791	.	.757
12	106.09	109.904	.840	.	.754
13	105.95	112.656	.756	.	.759
14	106.06	109.983	.829	.	.754
21	106.09	113.549	.759	.	.760
22	105.61	116.569	.638	.	.767
23	108.04	140.214	-.621	.	.813
24	105.66	115.442	.698	.	.764
25	105.86	115.664	.690	.	.765
26	107.97	143.417	-.738	.	.818
27	106.07	110.855	.830	.	.755
28	106.21	110.094	.812	.	.754
29	106.02	111.569	.833	.	.756
30	107.80	144.263	-.669	.	.822
31	105.99	114.316	.632	.	.764
32	105.70	114.213	.715	.	.762
33	105.70	117.327	.598	.	.768
34	106.05	109.516	.821	.	.753
36	106.10	113.711	.733	.	.761
38	106.14	109.766	.762	.	.755
39	107.45	145.314	-.649	.	.825
40	107.45	145.314	-.649	.	.825
41	106.25	107.962	.792	.	.752
42	107.65	146.965	-.779	.	.825
43	106.12	111.959	.726	.	.759
44	107.59	145.638	-.713	.	.824
45	106.19	111.648	.734	.	.758
46	106.36	109.576	.814	.	.754

Table 13: Item-Total Statistics for the thirty-three items

A final bank of thirteen items (shown in Table 14) remained with a Cronbach's Alpha α=.965. It was felt that this was enough items, as it would give students adequate time to respond to each question.

ITCI Instrument Items

Item 1	I enjoy learning about information technology.
Item 2	I will continue to enjoy information technology.
Item 3	Information technology is important to me.
Item 4	To me, information technology is fascinating.
Item 5	I am curious about information technology.
Item 6	I would like to learn more about information technology.
Item 7	I am interested in alternative programs in information technology.
Item 8	I like to use information technology for class work.
Item 9	I am curious about careers in information technology.
Item 10	I would like to learn more about careers in information technology.
Item 11	A career in information technology would be fascinating.
Item 12	I plan to use information technology in my future career.
Item 13	I feel comfortable talking to people who work in information technology careers.

Table 14: Final bank of thirteen items

6.3 ITCI Survey Analysis

The thirteen Items identified through the above development of Information Technology Careers Instrument (ITCI) analysis were developed into an online survey using the USQ Surveys online tool (Appendix 6.10). Two versions of the survey were created, each identical, called pre-ITCI survey and post-ITCI survey. In July 2018 the two surveys were conducted immediately prior to students undertaking the two-week curriculum discussed in Chapter 3 and immediately after the conclusion of the two-week curriculum in four secondary school year nine information technology classes. The ITCI data from the pre-test and post-test has been included in Appendix 6.11. The analysis of the data collection from the ITCI pre-test and ITCI post-test addresses Research Sub-Question 1c:

> **Sub-Question 1c: Focussing on quantitative measures, how does the implementation of an information technology career curriculum, using tech-savvy teaching tools, impact student perceptions towards information technology careers?**

The original data collection for each school was planned to collect ITCI survey data from two groups: a control group who would only undertake the two ITCI surveys, and an IT Careers Curriculum group who would undertake the two-week IT Careers Curriculum between each ITCI survey. Unfortunately, only two of the schools were able to provide a control group for the first ITCI survey and only one school for the second ITCI survey, limiting the respondents for this group.

The first Information Technology Careers Interest (ITCI) survey was conducted with students at four schools in the Darling Downs region, a hundred and eighteen respondents attempted the first ITCI survey, a hundred and two fully completing the survey and sixteen responses were identified as incomplete and discarded (Table 15).

School	Careers Curriculum Group	Control Group
School A	19	9
School B	20	11
School C	9	-
School D	34	-
Total Respondents	**82**	**20**

Table 15: Breakdown of Respondents for first ITCI Survey

The second Information Technology Careers Interest (ITCI) survey was conducted two weeks after the first survey, a hundred and three respondents attempted the second ITCI survey, ninety-eight fully completing the survey and five responses were identified as incomplete and discarded (Table 16).

School	Careers Curriculum Group	Control Group
School A	19	-
School B	18	14
School C	9	-
School D	38	-
Total Respondents	**84**	**14**

Table 16: Breakdown of Respondents for second ITCI Survey

The respondents were asked to provide an identification code for each ITCI survey, their initials, day and month of birth (e.g. RG1206). This was used to match the respondents of the first ITCI with their responses to the second ITCI survey. There were several respondents identified in this matching process who had only been involved in one of the surveys, these respondents were discarded as they could not be used in subsequent analysis (Table 17).

School	Careers Curriculum Group	Control Group
School A - School A	16	-
School B - School B	16	9
School C - School C	9	-
School D - School D	29	-
Total Respondents	70	9

Table 17: Breakdown of Matched Respondents between the two ITCI Surveys

The pairing of the first and second ITCI survey results resulted in seventy-nine useful respondents being identified, seventy respondents in the IT Careers Curriculum group and nine respondents in the Control Group. Due to the low number of Control group matched respondents and the concern that they were all from School B, the decision was made to discard the control group data and focus only on the seventy respondents from the IT Careers Curriculum group.

6.3.1 Recoding Data

Each of the remaining seventy respondents were given a unique participant number to identify each student in subsequent analysis. Each school was given a unique school number, and the thirteen items of the first ITCI survey and thirteen items of the second ITCI survey were recoded as follows:

- Strongly Agree coded as 5,
- Agree coded as 4,
- Neither Agree nor Disagree coded as 3,
- Disagree coded as 2, and
- Strongly Disagree coded as 1.

6.3.2 Descriptive Statistics

A SPSS Descriptive Statistics Frequency Analysis was conducted on the remaining seventy respondents (Table 18) to understand the breakdown of the IT Careers Curriculum group respondents across the four schools. No other descriptive data, such as gender was collected.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	School A	16	22.9	22.9	22.9
	School B	16	22.9	22.9	45.7
	School C	9	12.9	12.9	58.6
	School D	29	41.4	41.4	100.0
	Total	70	100.0	100.0	

Table 18: Frequency Analysis on Curriculum Group Respondents

6.4 ITCI Survey Data Analysis for Outliers

6.4.1 Standard Deviation (Std. Dev.) Analysis for Outliers

The Standard Deviation (Std. Dev.) for each of the seventy responses for the thirteen items of the first ITCI Survey and for the thirteen items of the second ITCI Survey was conducted. This analysis identified fifteen respondents with a Std. Dev of zero, where the respondent had selected all the same agreement level for all items in one or both surveys. Clark and Watson (1995) outline the importance of identifying and eliminating items that have highly skewed and unbalanced distributions. In a Likert scale, “these are items to which almost all respondents respond similarly” (Clark and Watson 1995, p. 315). Highly unbalanced items are undesirable for several reasons: when most respondents answer similarly, the items convey little information; these items are likely to correlate weakly with other items in the pool and could cause issues with subsequent structural analysis, and items with extremely unbalanced distributions can produce highly unstable correlation results (Clark and Watson 1995). The fifteen respondents identified in Table 19 were discarded as incorrectly completed responses to the first survey, second survey or both surveys. This resulted in fifty-five respondents remaining in the analysis.

Participant Number	First ITCI Survey	Second ITCI Survey
12	All Neither Agree nor Disagree	All Neither Agree nor Disagree
14	All Strongly Agree	8 Agree & 5 Strongly Agree
16	1 Agree & 12 Strongly Agree	All Strongly Agree
19	1 Agree & 12 Strongly Agree	All Strongly Agree
31	All Agree	All Agree
32	2 Neither Agree nor Disagree & 11 Agree	All Agree
36	All Neither Agree nor Disagree	All Neither Agree nor Disagree
40	All Strongly Disagree	7 Neither Agree nor Disagree, 3 Agree & 3 Strong Agree
46	8 Agree & 5 Strongly Agree	All Strongly Agree
47	10 Neither Agree or Disagree, 2 Agree and 1 Strongly Agree	All Neither Agree nor Disagree
51	1 Agree & 12 Strong Agree	All Strongly Agree
52	1 Neither Agree or Disagree, 2 Agree and 10 Strongly Agree	All Strongly Agree
56	1 Agree & 12 Strong Agree	All Strongly Agree
59	2 Neither Agree nor Disagree, 1 Agree & 10 Strongly Agree	All Strongly Agree
64	1 Disagree, 1 Neither Agree nor Disagree & 11 Agree	All Neither Agree nor Disagree

Table 19: Standard Deviation (Std. Dev.) Analysis for Outliers

6.4.2 Analysis of Univariate and Multivariate Outliers for ITCI Surveys

Manning and Munro (2007) recommend that univariate (extreme responses on a single variable) and multivariate (unusual patterns of responses across a range of different variables) outliers be examined and potentially considered for removal before any statistical analysis is undertaken.

The analysis was conducted to identify univariate outliers for the thirteen items in the first ITCI Survey and the thirteen items in the second ITCI Survey, histograms and boxplots (Figure 5) were visually inspected and standard scores were calculated for each respondent. This analysis identified three potential outliers (Table 6.20). Each of these respondents displayed standard scores with an absolute value in excess of 3.29 ($p < .001$).

Participant Number	ITCI Item BoxPlot (Figure 5)
13	PreITCI11
42	PostITCI07
58	PostITCI01, PostITCI05, & PostITCI09

Table 20: Potential outliers identified through Univariate Analysis

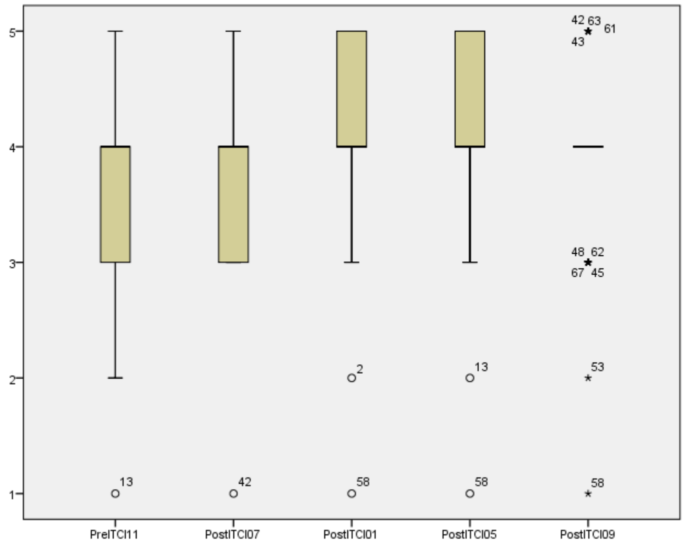


Figure 5: Univariate analysis Box-plots of potential outliers

A test for multivariate outliers was then conducted using the techniques described by Tabachnick and Fidell (1996, p. 67). Using data from the set of thirteen variables, the Mahalanobis distance was calculated for each case. Tabachnick and Fidell (1996) state that the Mahalanobis distance should be interpreted as a X^2 (chi-square) statistic with the degrees of freedom equal to the number of Independent Variables. The authors recommend that a criterion of $p < .001$ be used to evaluate whether a case is judged to be a multivariate outlier (Tabachnick and Fidell 1996, p. 64), and so a critical value of $X_{13}^2 = 34.528$ was used. No cases were identified with a Mahalanobis score in excess of this value and so no multivariate outliers were identified.

Based on the observed boxplots, univariate analysis and multivariate analysis, respondents 13, 42 and 58 were removed as outliers.

6.4.3 Normality of Distribution

Manning and Munro (2007) recommend that a test for Normality of Distribution also be conducted to see if the data results in a normal distribution and any outliers from the normal distribution potentially considered for removal before any statistical analysis is undertaken. Using the criteria presented by Tabachnick and Fidell (1996), for samples less than 300, where the Skewness zScore (Skewness Statistic divided by Std. Error) and the Kurtosis zScore (Kurtosis Statistic divided by Std. Error) should be less than an absolute value of 2.58, otherwise the Skewness and/or Kurtosis would be considered significant. Both Skewness and Kurtosis were examined for the ITCI Survey Items.

PreITCI Item 6 (zScore = 3.28) and PostITCI Item 1 (zScore = 3.17) were found to show a significant Skewness but there was no significant Kurtosis.

The histograms and box-plots (Figure 6) were again visually inspected and a second analysis of univariate and multivariate outliers was then conducted on ITCI Surveys. This analysis identified participant two as a potential outlier (Table 21). This respondent displayed a standard score with an absolute value in excess of 3.52 ($p < .001$).

Participant Number	ITCI Item BoxPlot (Figure 6)
2	PostITCI01

Table 21: Second round potential outliers identified through Univariate Analysis

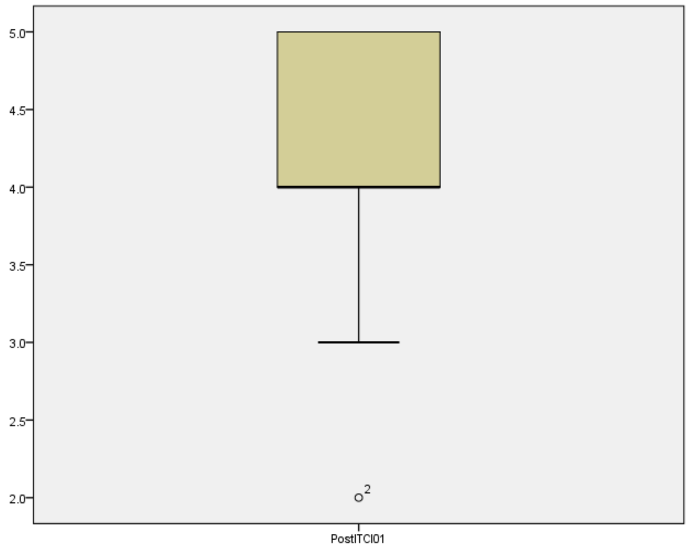


Figure 6: Second round Box-plot of potential outliers

A test for multivariate outliers was again conducted, no case was identified with a Mahalanobis score in excess of this value and so no multivariate outliers were identified.

Based on the observed boxplots, univariate analysis and multivariate analysis, respondent 2 was removed as an outlier.

A test for Normality of distribution was again conducted; only PreITCI Item 6 (zScore = 3.52) show a significant Skewness but again there was no significant Kurtosis.

The histograms and box-plots for PreITCI Item 6 were again visually inspected and a third analysis of univariate and multivariate outliers was conducted on the ITCI Surveys. The box plot identified respondents 34 and 39 (Figure 7). The univariate and multivariate analysis identified no further potential outliers.

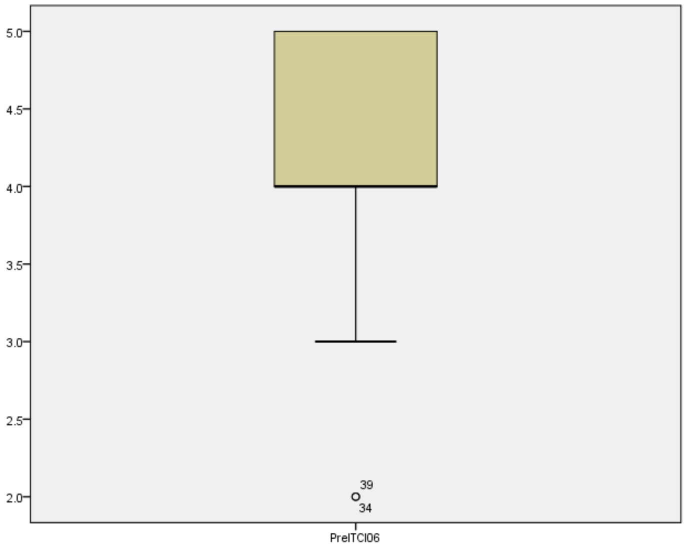


Figure 7: Final round Box-plot of potential outliers

Based on the observed boxplot for PreITCI06 respondents 34 and 39 were removed as outliers and final test for Normality of distribution was again conducted, the remaining 49 respondents showed no significant Skewness nor Kurtosis.

6.5 ITCI Survey Statistical Analysis

Two composite variables were created as the mean of the thirteen items in the first ITCI Survey (PreITCIMean) and the thirteen items in the second ITCI Survey (PostITCIMean) for use in all subsequent analyses of changes in student interest between the first and second surveys. Table 22 describes the Operationalisation of the Survey Constructs.

Abstract Concept	Variable Label	SPSS Variable Name	Operational Definition	Scale	Relevant Research Questions / Sub-Questions
Participant Number	Participant Number	Participant-Num	Item 1 coded as: 1, 2, 3 …	Nominal/ dichotomous	Research Question 1 Research Sub-Question 1c
Participant Code	Participant Code	Participant-Code	Item 2 coded as: Initials + Birth Day / Month	Nominal/ dichotomous	Research Question 1 Research Sub-Question 1c
School Number	School Number	SchoolNum	Item 3 coded as: 1 = “School A” 2 = “School B” 3 = “School C” 4 = “School D”	Nominal/ dichotomous	Research Question 1 Research Sub-Question 1c
Pre Test ITCI Mean	Pre Test ITCI Mean	PreITCIMean	Mean of the 13 Pre Test ITCI Survey Items	Interval	Research Question 1 Research Sub-Question 1c
Post Test ITCI Mean	Post Test ITCI Mean	PostITCIMean	Mean of the 13 Post Test ITCI Survey Items	Interval	Research Question 1 Research Sub-Question 1c

Table 22: Operationalisation of Survey Constructs

6.5.1 Testing assumption of equivalent variables: F-max

A test for the assumption of equivalent variance using F-max was undertaken to ensure that the ratio of the largest variance divided by the smallest variance (F-max) is less than 3. Manning and Munro (2007) state that if the F-Max is more than three the conclusion should be that the homogeneity of variance assumption has been violated.

The F-Max was calculated by dividing the variance for PostITCIMean (.259) by the variance for PreITCIMean (.207) which gave an F-max of 1.25, less than the critical value of 3, so we can assume the homogeneity of variance assumption has not been violated.

6.5.2 Repeated Measures Analysis of Variance (ANOVA) of the Pre and Post Test ITCI Means.

Repeated Measures Analysis of Variance (ANOVA) using time at two points as the factor was undertaken on the forty-nine remaining respondents using the composite variables of Pre Test ITCI Means and Post Test ITCI Means (Table 23).

Descriptive Statistics

	Mean	Std. Deviation	N
PreITCIMean	4.06	.455	49
PostITCIMean	3.99	.509	49

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Epsilon[b] Huynh-Feldt	Epsilon[b] Lower-bound
Time	1.000	.000	0	.	1.000	1.000	1.000

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.
a. Design: Intercept
Within Subjects Design: Time
b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Time	Sphericity Assumed	.107	1	.107	2.441	.125	.048	2.441	.334
	Greenhouse-Geisser	.107	1.000	.107	2.441	.125	.048	2.441	.334
	Huynh-Feldt	.107	1.000	.107	2.441	.125	.048	2.441	.334
	Lower-bound	.107	1.000	.107	2.441	.125	.048	2.441	.334
Error(Time)	Sphericity Assumed	2.095	48	.044					
	Greenhouse-Geisser	2.095	48.000	.044					
	Huynh-Feldt	2.095	48.000	.044					
	Lower-bound	2.095	48.000	.044					

a. Computed using alpha = .05

Table 23: Repeated Measures Analysis of Variance (ANOVA)

A one-way repeated-measures analysis of variance was conducted examining the change in respondent's IT Careers Interest as the dependent variable measured at two points in time – prior to a two-week IT Careers Curriculum, and two weeks later at the conclusion of the two-week IT Careers Curriculum. The value of F-max was 1.25 and so homogeneity of variance was assumed. Mauchly's test of sphericity was not significant, W=1, x22=.000, with no p value, and so sphericity is assumed. The change in the mean of the respondent's IT Careers Interest, which changed from 4.0597, SD=.45488 prior to the two-week IT Careers Curriculum, to 3.9937, SD=.50852 after the curriculum was not significant $F(1, 48) = 2.441$, $p>.05$.

Repeated Measures Analysis of Variance (ANOVA) using time as the factor was also undertaken between the four schools using the composite variables of Pre Test ITCI Means and Post Test ITCI Means (Table 24).

SchoolNum	Pre ITCI Mean	Pre ITCI Std. Deviation	Post ITCI Mean	Post ITCI Std. Deviation	N
1	4.04	.61	3.99	.56	12
2	4.14	.41	3.97	.54	12
3	3.78	.46	3.70	.57	7
4	4.12	.35	4.12	.41	18
Total	4.06	.45	3.99	.51	49

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Time	Sphericity Assumed	.124	1	.124	2.818	.100	.059	2.818	.376
	Greenhouse-Geisser	.124	1.000	.124	2.818	.100	.059	2.818	.376
	Huynh-Feldt	.124	1.000	.124	2.818	.100	.059	2.818	.376
	Lower-bound	.124	1.000	.124	2.818	.100	.059	2.818	.376
Time * SchoolNum	Sphericity Assumed	.110	3	.037	.829	.485	.052	2.487	.215
	Greenhouse-Geisser	.110	3.000	.037	.829	.485	.052	2.487	.215
	Huynh-Feldt	.110	3.000	.037	.829	.485	.052	2.487	.215
	Lower-bound	.110	3.000	.037	.829	.485	.052	2.487	.215
Error(Time)	Sphericity Assumed	1.985	45	.044					
	Greenhouse-Geisser	1.985	45.000	.044					
	Huynh-Feldt	1.985	45.000	.044					
	Lower-bound	1.985	45.000	.044					

a. Computed using alpha = .05

Table 24: Repeated Measures Analysis of Variance (ANOVA) by School

The change in the means of the respondent's IT Careers Interest between school groups also did not show any significance $F(3, 45) = .829$, $p>.05$.

- School A changed from 4.0449, SD=.60787 prior to the two-week IT Careers Curriculum to 3.9936, SD=.56284 after the curriculum.
- School B changed from 4.1410, SD=.40682 to 3.9679, SD=.54339 to 3.9679, SD=.54339.
- School C changed from 3.7802, SD=.46032 to 3.7033, SD=.56601.
- School D did not change 4.1239, SD=.34917 prior to the two-week IT Careers Curriculum and 4.1239, SD=.40971 afterwards.

The results of this analysis were that there were no positive changes in student's perception of IT careers for any of the surveyed schools.

6.6 Summary of Chapter 6

This Chapter has outlined the quantitative analysis steps undertaken in stage one of the research to determine the items for inclusion in the Information Technology Careers Instrument (ITCI) survey using reliability analysis to reduce the survey items from forty-eight to thirteen. The analysis of the data collection used in the development of the Information Technology Careers

Instrument (ITCI) addressed Research Sub-Question 1a identified from the literature in chapter 2:

> **Research Question 1a: What factors contribute to an information technology career survey instrument to test changes in student perceptions towards information technology careers?**

The steps taken in stage three of the research to recode the data for use in SPSS and the process used to inform the decision to discard the control group data due to limited responses. The Chapter also outlines the process used for the identification and removal of outliers through Standard Deviation (Std. Dev.) Analysis, Univariate and Multivariate Analysis, and Normality of Distribution Analysis to derive the forty-nine paired respondents for use in the final data analysis.

This Chapter has analysed the quantitative data, also in stage three of the research, collected from the two surveys, before and after the students had undertaken the two-week IT Careers Curriculum using Repeated Measures Analysis of Variance (ANOVA) of the Pre and Post Test ITCI Means. The results of this analysis were that statistically there was no significant improvement in student perceptions towards IT careers as a result of the two-week IT Careers Curriculum. The analysis of the data collection from the ITCI pre-test and ITCI post-test addressed overarching Reseach Question and Research Sub-Question 1c identified from the literature in chapter 2:

> **Sub-Question 1c: Focussing on quantitative measures, how does the implementation of an information technology career curriculum, using tech-savvy teaching tools, impact student perceptions towards information technology careers?**

Chapter 7 will focus on the qualitative analysis conducted on the student focus groups and teacher interviews conducted after the completion of the two-week curriculum and both surveys. It provides an alternative view to the quantitative analysis findings in this Chapter. Chapter 7 will discuss the differences between the quantitative and qualitative analysis chapter findings and will provide reflection on the factors that lead to the limited number of control group respondents and the large number of outliers that were experienced in the surveys.

Chapter 7 Qualitative Analysis

7.1 Chapter Introduction

Chapter 6 analysed the quantitative data collected from the two surveys, before and after the students had undertaken the two-week IT Careers Curriculum. The result of this analysis was that statistically there was no significant improvement in student perceptions towards IT careers as a result of the two-week IT Careers Curriculum. This Chapter continues the use of the mixed-methods approach to analyse the qualitative data collected through focus groups of students, from stage four of the research, and interviews with the teachers, from stage five of the research, involved in the two-week IT Careers Curriculum.

Section 7.2 discusses the questions that were developed for the focus group discussion. Section 7.2.2 describes the method of transcribing and coding the student focus group sessions, using Miles, Huberman, & Saldaña's (2014) qualitative data analysis method. Section 7.2.3 discussed the development of the four predictive findings and the analysis conducted on the qualitative data using Yin's (2014) congruence method (pattern matching) technique for case study analysis to match empirically-based patterns with predicted findings developed prior to the data collection.

Section 7.3 discusses the questions that were developed for the teacher interviews. The teacher interviews analysis was contacted using the same methods (Miles, Huberman, & Saldaña's (2014) qualitative data analysis method and Yin's (2014) congruence method) to analyse the data collected as was used for the focus group data. Section 7.3.2 describes the method of transcribing and coding the teacher interview sessions. Section 7.3.3 discussed the development of the three predictive findings and the analysis conducted on the qualitative data.

7.2 Student Focus Groups

There are two research sub-questions addressed in this, the fourth stage of the research:

> **Sub-Question 1d: Focussing on qualitative measures, how does the implementation of an information technology career curriculum, using tech-savvy teaching tools, change student perceptions towards information technology careers?**

> **Sub-Question 1f: What was the effect of the information technology career curriculum, using tech-savvy teaching tools, on the students' learning experience?**

In order to answer these two research sub-questions, four focus group questions were developed from analysis of the literature and observations by the researcher while conducting the two-week IT Careers Curriculum at one of the Schools (Downlands College), as discussed in the methodologies chapter, section 3.10.

7.2.1 Student Focus Group Questions

Focus Group Question One

Focus group question one focused on exploring the students' understanding of Information Technology Careers prior to undertaking the two-week IT Careers classes. This question was broken into two parts:

- ***Before doing the two-week careers class, what did you think a computing career was?***
- ***Describe one of the careers in computing that you knew about before doing the class***.

Focus Group Question Two

Focus group question two explored the student's year nine IT class subject selection:

- ***Why did you selected to do the year nine Information Technology class?***

Focus Group Question Three

Focus group question three focused on exploring the students' understanding of Information Technology Careers after undertaking the two-week IT Careers classes. This information was used to corroborate the findings of the IT Career Interest Instrument (ITCI) Analysis. This question was broken into two parts:

- ***Has your understanding of a computing career changed?***
- ***Discuss one of the interesting things you discovered during the class.***

Focus Group Question Four

Focus group question four focused on the content and activities involved in the two-week IT Careers Curriculum. This question was also broken into two parts:

- ***What did you enjoy about the careers class?***
- ***What do you think could be improved about the careers class?***

Students were informed about the purpose of the research verbally prior to the commencement of the focus groups.

The focus groups were conducted using the Nominal Group Technique (NGT) which is a method for group brainstorming that encourages contributions from everyone (Gallagher et al. 1993).

Two focus groups were conducted with students from two of the four schools involved in the two-week curriculum. School B had six students (four male and two female) who were representative of the class mix. School D had eight students (all male) which, again, was representative of their current class enrolment. The focus group discussions were audio recorded on the researcher's iPhone and the recordings have been stored as per USQ Ethical Guidelines.

7.2.2 Transcribing and Coding the Students Focus Group Qualitative Data

The researcher transcribed the audio recordings and the transcripts were compared with the recordings for accuracy. All items transcribed were checked to ensure they were valid representations of the focus group discussions. Full transcripts of the two focus groups are included in Appendix 7.1 and Appendix 7.2.

The transcripts were uploaded into NVivo 12 Professional, and the student statements were coded using Miles, Huberman, & Saldaña (2014) two stage method of coding. In stage one the transcripts were coded into four nodes based on the four questions asked. The four nodes that were developed in NVivo 12 from these questions were: 1) Previous Perceptions; 2) Choose IT; 3) Changed Perceptions; and 4) Curriculum Discussion.

Stage two coding examined the four initial NVivo 12 nodes to build upon and group them into meaningful themes. The first three nodes, "Previous Perceptions", "Choose IT" and "Changed Perceptions", were examined and found to be at a point where no further themes could be identified. The fourth node, "Curriculum Discussion" was examined and two themes were identified from the examination: "Positive Curriculum Discussion" and "Negative Curriculum Discussion". The stage two coding examination resulted in five nodes being identified and used in the focus group qualitative analysis: 1) Previous Perceptions; 2) Choose IT; 3) Changed Perceptions; 4) Positive Curriculum Discussion; and 5) Negative Curriculum Discussion.

7.2.3 Focus Group Qualitative Analysis

Yin (2014), recommends the congruence method (pattern matching) as a desirable technique for analysis where empirically-based patterns are matched with predicted findings developed prior to the data collection.

The predictive findings were developed prior to the focus group discussions to answer research sub-question 1d and research sub-question 1f, based on an analysis of the literature, and observations by the researcher while conducting the two-week IT Careers Curriculum at one of the Schools (Downlands College). The focus group predictive findings have been provided in Appendix 7.3.

Careers in information technology are coding centric.

Predictive Finding 1: Students believe that a career in information technology is programming/coding centric.

Students were first asked whether prior to the two-week curriculum, what they thought a career in IT involved. The following (Figure 8) is the resultant word map developed using NVivo 12 Professional, displaying the top 50 terms including stemmed words. It shows the terms programming and coding as two of the most predominant. This matched the findings from the literature review where it was noted that students had the mistaken impression that all information technology was about programming and coding. Students also used the term “thought” often when answering the questions, such as “I thought that …” which is why it also appears significant in the word map.

Figure 8: Focus Group Word Map (What an IT Career Involves)

Further analysis of the transcripts from the Student Focus Groups supports the predictive finding. 67% of the students from School A focus group mentioned that they had initially understood a career in IT to involve programming/coding. The following are two examples of the responses given by School A focus group students:

> School A Male Student A: *I [thought] it was a lot of the programming... Almost anything that included electronic, I though came under the IT umbrella, anything from*

> *hardware to the programming of it and the manufacturing, what goes into the hardware.*
>
> School A Female Student A: *Programming, desk job, boring, my understanding was [that it was] about numbers and how computers work.*

All the students from School C focus group commented that they had initially understood a career in IT to involve programming/coding. The following are two examples of the responses given by School C focus group students:

> School C Male Student A: *I do not really know that many careers that are clearly have IT involved. It [will] be about coding and creating new ideas, creative ideas using coding.*
>
> School C Male Student D: *I thought [it was about] coding and programming applications and a lot of maths, I didn't know much about it.*

Predictive Finding One Conclusion:

The initial perception that the students in the two focus groups had of information technology careers matches the research's predicted finding - students in both focus groups overwhelmingly thought that an information technology career entails a job focused on programming/coding.

Limited understanding during subject selection

Predictive Finding Two: Students select junior high school information technology classes without any clear understanding of what the classes will cover.

Students were asked to indicate why they chose the year nine information technology class to ascertain what decisions lead to this choice. The following (Figure 9) is the resultant word map, displaying the top 50 terms including stemmed words, which shows the terms thought, computers and interesting standing out. Other terms that appear as significant in the word map include coding and basics.

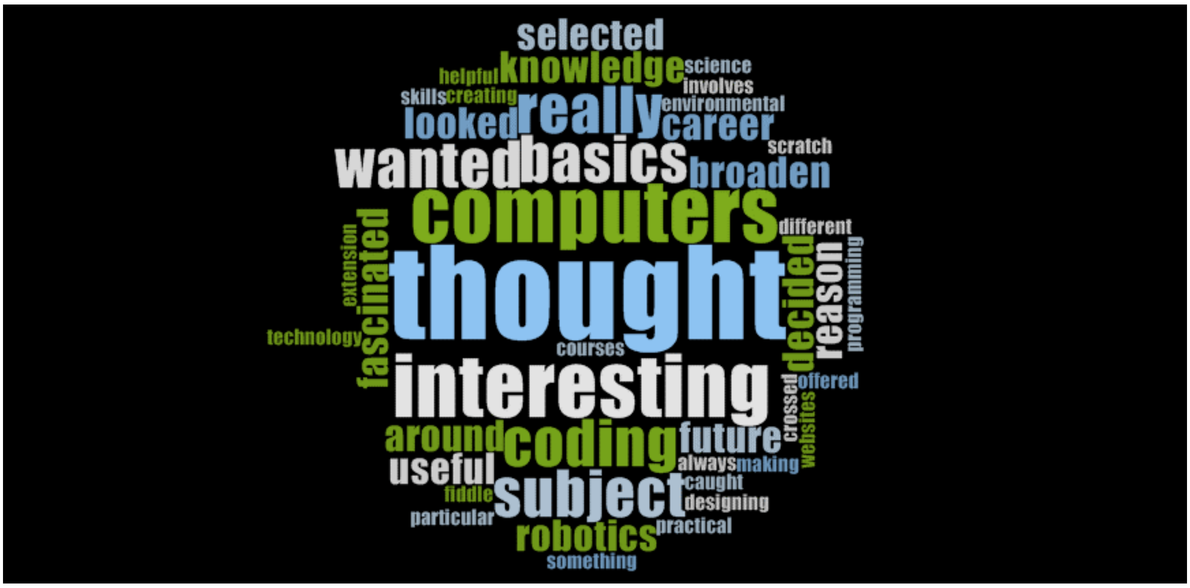


Figure 9: Focus Group Word Map (Year nine Class Selection)

As noted in section 7.2.1, students used the term "thought" often when answering the focus group questions. The terms computing and interesting match the findings from the literature where it was noted that students who had an interest or high self-efficacy towards information technology selected to undertake information technology classes. The prevalence of the term coding supports the mistaken impression discussed in section 7.2.1 that all information technology was about programming and coding. The prevalence of the term basics point to students' impressions that these information technology classes focused on basic IT concepts.

Further analysis of the transcripts from the Student Focus Groups showed a mixed set of reasoning behind the students' year nine IT class selection. Two students from School A focus group indicated that they had undertaken a year eight IT class and had based their decision to do another class on their experience in that class.

> School A Male Student C: *I did IT in grade eight, so I thought that if I did IT in grade nine, I'd broaden my knowledge of it further. When we were doing it, it was much more interesting than just writing numbers, for instance using all the different word, excel capabilities, it was much more interesting than just using a bunch of numbers.*

The other students from School A focus group had not taken the year eight IT class. Their decision to select the year nine IT class was based on several other factors, such as the need for IT knowledge for future careers, interest in programming, suggestions from family, and interest in robotics.

School A Female Student B's decision was based on her perceived need to have some IT knowledge for her chosen future career.

I did not do information technology in year eight, but I am looking into a career in environmental science and I know that technology is something that could be in my future, so I wanted to broaden my knowledge on it.

School A Male Student A's decision was based on his perceived interest in programming.

During [year nine class] selection, I read through all [of the classes offered] and IT caught my eye so that is really why I chose it. I [thought] it was a lot of the programming stuff really, just interested me.

School A Male Student B's decision was based on his interest gained from a family member.

I just enjoyed IT, I had a stepbrother, I connected to him when he was doing that kind of stuff, and he taught me about … hardware and that type of stuff, how things work.

School A Male Student D's decision was based on his perceived interest in robotics

I really had an interest in robotics and IT is an extension of robotics.

School A Male Student A's decision was based on his perceived interest in programming.

During [year nine class] selection, I read through all [of the classes offered] and IT caught my eye so that is really why I chose it. I [thought] it was a lot of the programming stuff really, just interested me.

School A Male Student B's decision was based on his interest gained from a family member.

I just enjoyed IT, I had a stepbrother, I connected to him when he was doing that kind of stuff, and he taught me about … hardware and that type of stuff, how things work.

School A Male Student D's decision was based on his perceived interest in robotics

I really had an interest in robotics and IT is an extension of robotics.

All students in School C focus group had undertaken a year eight IT class prior to selecting IT in year nine. None of the students cited this as a reason for their selection of year nine IT. Similar to School A focus group students, their decision to select the year nine IT class was based on several other factors.

Five of the eight students' decisions were based on their perceived interest/fascination in computers.

School C Male Student E: *I've been fascinated with computers since I was young, so I thought it would very helpful to learn more about computers so I could use them for practical reasons, and I thought the subject would help with that.*

School C Male Student A's decision was based on his perceived need to have some IT knowledge for his chosen future career.

I selected IT because I would learn some basic useful skills. Basic coding, coding is useful in [many] different areas. If I [know] the basics, I [will be] able to know the basics for a lot of future careers.

School C Male Student C's decision was that knowledge of IT could be used for a future hobby.

So basically, I wanted it as a hobby, for later in life. Designing websites or creating a game.

School C Male Student D's decision was based on his perceived interest in programming

I decided to do ICT because it looked interesting, before I'd go on Scratch and fiddle around making games, and I thought I'd like to do a subject that involves around coding.

Predictive Finding Two Conclusion:

The initial perception that the students had selected their year nine IT classes without any clear understanding of what the classes covered matches the researcher's predicted finding. Table 25 shows the breakdown of the combined focus groups justification for their current subject selection, only one student (School A Male Student A) indicated that the class enrolment information was part of their decision making, the rest of the students based their decision on perceived future usage or general interest in IT and/or programming.

No. Students	Subject Selection Justification
2	Previous year eight IT class
2	Perceived requirements in future careers
2	Interest in programming / coding.
5	General interest in computers.
1	Interest gained through a family member.
1	Perceived future hobby
1	Interest in robotics

Table 25: Justification for IT Class Selection

IT Careers Curriculum Positive Impact on Student Interest

Predictive Finding Three: The two-week IT Careers Curriculum would have a positive impact on students' interest in an information technology career.

Students were asked to indicate if their interest in IT careers had changed after the two-week IT Careers Curriculum. Figure 10 displays the resultant word map, displaying the top 50 terms including stemmed words, which shows the terms researched, thought, and looking standing out. Other terms that appear as significant in the word map include careers, robotics, jobs and interesting. The word map from the focus group discussions indicates that there has been some shift in these students' interest in IT careers. Terms like researched, looking, as well we, careers and looking suggests that they are starting to examine IT careers. It is interesting that robotics has appeared to be a prominent term, indicating another mistaken impression of IT careers. The following are the responses from the two focus groups.

All School A and School C focus group students indicated that their awareness of the scope of IT careers had been raised through the two-week careers' classes, and that this new awareness had opened them to increased interest in IT careers.

Figure 10: Focus Group Word Map (IT Careers Curriculum positive impact)

> School A Female Student A: *Absolutely, I do not think you can walk away from the activities we did and not say that [my view had changed]. Because the way it was structured, I think everyone took away that there was much more about IT, I didn't*

know much about it originally, I was expecting to learn different things, but what surprised me was how specific they were in each field.

School C Male Student F: *My understanding changed after looking at the [Career Wheel] and there is a lot of different jobs colliding with IT, which I never quite thought could happen, and there is a lot of other jobs than programming. I researched cyber security.*

Predictive Findings 3 Conclusion:

Based on the focus group findings, both focus groups indicated that all students felt that their awareness/interest in IT careers had increased after undertaking the two-week curriculum. This strong qualitative finding supports the key research question and provides a counterbalance to the quantitative findings. The teacher interviews include qualitative investigation into the reasons why there is a difference in findings between the survey-based quantitative findings and the focus group based qualitative findings.

Tech-savvy Learning Activities

Predictive Finding Four: The two-week IT Careers Curriculum utilising two different tech-savvy learning activities would be enjoyable to the students.

Students were asked to discuss what they enjoyed about the two-week IT Careers Curriculum and what they felt needed improvement. Their responses fell into two categories, those that focused on their enjoyment of learning about IT careers, and those that focused on the curriculum activities used in the class.

Analysis was undertaken, using NVivo 12 Professional, of the focus group's responses to this question. Each student's response was rated as positive or negative towards IT careers and the tech-savvy learning activities. Fifty percent of the students from School A were coded as having a positive experience towards learning about IT careers.

Figure 11 displays the resultant word map of the positive experience towards learning about IT careers, displaying the top 50 terms including stemmed words, which shows the terms things, like, and learning standing out. Other terms that appear as significant in the word map include different, interesting and opportunities. Terms such as like and learning, as well we, different, interesting and opportunities suggests that the positive aspects of the IT careers curriculum were that it was different to what they had experienced in the rest of the year nine IT class.

Figure 11: Focus Group Word Map (Positive Experience towards the IT Careers Learning Activities)

The following are the responses from the two focus groups.

> School A Female Student A (Career +ve): *I liked the group work that was really fun. Just the way it was set up, and how you could delegate, and do your own thing but you also had to collaborate, knowing it was an important skill in any career was very interesting.*

Eighty-seven and a half percent of the students from the students in School C indicated that they also enjoyed learning about IT careers.

> School C Male Student D (Career +ve): *... I was amazed at the types of jobs that involved ICT and found the [ICT Career] Wheel great to discover this.*

Eighty-three percent of the students from School A were coded as having a positive experience towards the tech-savvy learning activities in the two-week curriculum.

> School A Male Student A (Curriculum +ve): *The opportunity of the Career Wheel, that we could explore each career and go into detail about each one.*

Predictive Finding Four Conclusion:

Based on the focus group findings, both focus groups indicated that all students felt that their experience was positive towards learning about IT careers through the two-week curriculum.

School A also indicated a positive experience towards the tech-savvy learning activities. Two students in School C also indicated a positive experience, the other students did not comment.

A final open-ended question was asked to students in both focus groups, encouraging the students to provide constructive feedback on possible improvements that could be made to the two-week IT Careers Curriculum. No student in either focus group indicated that they had any negative sentiments towards the IT careers content of the two-week curriculum.

The main improvement identified through this question was that students liked the group work aspect of the tech-savvy learning activities in the two-week curriculum but would have liked the groups to be changed between each week.

> School A Male Student A: *I really liked the opportunity to learn from my peers, but there were times that some people got a little off the topic. The randomly assigned topics were good, forcing people to be fish out of water on some topics.*

> School A Male Student B: *Group work was great but changing the groups each week might have been good too, instead of the same group for [reception] pitches and the wikis.*

The qualitative finding from the focus groups that there has been an improvement in students' interest in IT careers during the two-week curriculum supported the overarching research question and research sub-question 1d and provided a counterbalance to the quantitative findings. The findings from the focus group that the learning activities from the two-week curriculum had been positively received from the students supported research sub-question 1f.

7.3 Teacher Interviews

There are two research sub-Questions addressed in this, the fifth stage of the research:

> **Sub-Question 1e: How do the views of the class teachers differ from their students' perceptions towards information technology careers after the implementation of an information technology career curriculum, using tech-savvy teaching tools?**

> **Sub-Question 1g: What was the effect of the information technology career curriculum, using tech-savvy teaching tools, from teachers' observations, on their students' learning experience?**

The interview questions were developed as semi-structured questions to address both of these research sub-questions. These questions were developed from analysis of the literature and observations by the researcher while conducting the two-week IT Careers Curriculum at one of the Schools (Downlands College), as discussed in the methodologies chapter, section 3.11. The third question was added as a result of the quantitative findings as outlined in Chapter 6.

7.3.1 Teacher Interview Questions

Teacher Interview Question One

- ***What was the impact the two-week curriculum had on their students' interest in IT careers?***

Teacher Interview Question Two

- ***What improvement did they have for the two-week curriculum, to further increase student interest in IT careers?***

Teacher Interview Question Three

- ***What could have been the cause of the large number of issues with year nines answering the survey.***

The teachers were informed about the purpose of the research as part of the consent process and again verbally prior to the commencement of the interviews. The teacher interviews were conducted using the Myers and Newman (2007) semi-structured interview approach.

Three interviews were conducted with teachers from three of the four schools involved in the two-week curriculum. The two-week curriculum at School B was undertaken by the researcher and the classroom teacher who took over the class after the two-weeks observed the class in week two. Additionally, the researcher recorded a reflective journal throughout the two-week curriculum, as discussed in chapter 5 and the classroom teacher was interviewed. School C had one teacher who was interviewed. School D had two teachers involved in the two-week curriculum; both were interviewed. The teacher interview discussions were audio recorded on the researcher's iPhone and the recordings have been stored as per USQ Ethical Guidelines.

7.3.2 Transcribing and Coding the Teacher Interviews Qualitative Data

The transcripts of the interviews were uploaded into NVivo 12 Professional, and the teachers' statements were coded using Miles, Huberman, & Saldaña (2014) two stage method of coding. In stage one the transcripts were coded into three nodes based on the questions asked.

The researcher transcribed the audio recordings and the transcripts were compared with the recordings for accuracy. All items transcribed were checked to ensure they were valid representations of the teacher interview discussions. Full transcripts of the three interviews are included in Appendix 7.4, Appendix 7.5 and Appendix 7.6.

The transcripts were uploaded into NVivo 12 Professional, and the teacher statements were coded using Miles, Huberman, & Saldaña (2014) two stage method of coding. In stage one the transcripts were coded into three nodes based on the three questions asked. The three nodes that were developed in NVivo 12 from these questions were: 1) Curriculum Impact; 2) Improving Curriculum; and 3) Surveying Students.

Stage two coding examined the three initial NVivo 12 nodes to build upon and group them into meaningful themes. The three nodes, "Curriculum Impact", "Improving Curriculum" and "Surveying Students", were examined and found to be at a point where no further themes could be identified. The stage two coding examination resulted in three nodes being identified and used in the teacher interview qualitative analysis: 1) Curriculum Impact; 2) Improving Curriculum; and 3) Surveying Students.

The following is an analysis of the predicted findings against the interview findings.

7.3.3 Teacher Interview Qualitative Analysis

Yin's (2014) congruence method (pattern matching) technique was used to match empirically-based patterns with predicted findings developed prior to the data collection.

The predictive findings were developed prior to the teacher interview discussions to answer research sub-question 1e and research sub-question 1g, based on an analysis of the literature, and observations by the researcher while conducting the two-week IT Careers Curriculum at one of the Schools (Downlands College). The teacher interview predictive findings have been provided in Appendix 7.7.

IT Careers Curriculum Positive Impact on Student Interest

Predictive Finding One: The two-week IT Careers Curriculum had a positive impact on students' interest in an information technology career. Analysis was undertaken, using NVivo 12 Professional, of the teachers' interview responses to this question. Figure 12 displays the resultant word map of the positive impacts the teachers reported on their students' interests towards IT careers, displaying the top 50 terms including stemmed words, which shows the terms year, career, and think standing out. Other terms that appear as significant in the word map include class, interest and gaming. The term year and careers were prominent, with teachers discussing the best point in their students junior schooling to conduct the careers curriculum.

Figure 12: Teacher Interviews Word Map (Positive Impact on Student Interest)

The four teachers interviewed from three of the schools were asked if they thought the two-week curriculum had an impact on student interest.

Teachers indicated that they observed a positive impact on their student throughout the two-week curriculum.

> School A Classroom Teacher: *I know that some of the students who had no knowledge of the careers beforehand were surprised at actually what is out there, and what you need IT skills for, so I certainly think it had an impact. … I think when they see the overlap between marketing, or maths and engineering, and that may be already where they are heading, then that's where you start to gain more interest.*

Teachers in School D discussed their own shift in their understanding of their student's knowledge of IT careers. They had always assumed students undertaking year nine IT classes had a good understanding of IT careers, but their observation over the two-week curriculum that this was not the case.

> School D Classroom Teacher A: *I was surprised how little they knew before, I guess you assume the age group they are in that technology-wise they know what careers*

could be done, but had very little idea, very narrow… gaming, just gaming and a little bit of coding.

I would definitely run the careers curriculum again; it was definitely worthwhile being on board with the project. Many staff make the mistake that these guys can use technology well, which we do not, but I must admit making the mistake of assuming they understood the types of careers there were in IT, which they do not.

Predictive Finding One Conclusion:

The four teachers acknowledged that they witnessed an improvement in their students' interest in IT careers during the two-week curriculum. This also matches the findings also from the focus groups. Teachers also acknowledged that they had changed their own perceptions of their student's knowledge of IT careers.

Tech-savvy Learning Activities

Predictive Finding Two: The tech-savvy activities provided good learning opportunities for the students to increase their interest in IT careers.

Figure 13 displays the resultant word map of the teacher's observations about the tech-savvy learning activities, displaying the top 50 terms including stemmed words, which shows the terms careers, time, and year standing out, with teachers discussing their observations about activities that may have required more time for their students to fully master, as well as, the benefits the teacher's observed from teaching the careers content.

Figure 13: Teacher Interviews Word Map (Tech-savvy Learning Activities)

The teachers from the three schools were asked to discuss whether the tech-savvy activities provided good learning opportunities to increase student interest in IT careers. The teachers indicated that the activities were well received by their students and that they had appeared to have had a positive impact on their interest in IT careers.

> School D Classroom Teacher B: *I think the ICT Career Wheel was useful, it may not be immediate but for subjects in year ten it will be in the back of their minds, when it may not have been before.*

A final open-ended question was given to the teachers as a follow up to Predictive Finding Three, asking if they had any suggested improvements to the two-week curriculum to improve student interest, especially ways to further increase interest in IT careers for the students. The teacher's feedback focused on three main suggestions: the duration of the tech-savvy activities, embedding the IT Careers Curriculum throughout the IT classes, and bring professionals into the classroom to share their careers.

A common suggestion from all three schools was that there may need to be some adjustments to the duration of the tech-savvy activities in the IT Careers Curriculum.

> School A Classroom Teacher: *Maybe in the future, we could give a smaller introduction to the IT careers, and then reinforce the level or diverse careers as they start each new topic. I think what we did was valid, I could see the students getting something out of it …*

> School C Classroom Teacher: *For me as a teacher, having one or two more lessons on working through the Career Wheel, especially watching more of the videos, would have been great. I think [the reception / elevator pitches] worked alright, I do think more time and practice in giving [presentations], for a lot of the groups they were not used to working in the groups in this sort of style, delegating the jobs and that sort of things.*

The teachers also highlighted that using wikis as a teaching tool was interesting but that more time or training on this resource was needed.

> School C Classroom Teacher: *I thought the idea of … creating wikis was nice but it was a brand new concept for me too, so I may have needed more prep time myself, but it was good for the students to see how they worked.*

School C Classroom Teacher suggested that collaborative tools like Google Docs which can be accessed by all members of the group simultaneously might be a possible alternate option to using a Wiki, which only allows one person to change the page at a time.

> *… where all students in the group could have been working on the task at the same time. I understand the benefit of the wiki is that it can be shared online, where Google Docs is only available to the team working on it.*

The School D Classroom Teachers indicated that the reception / elevator pitches worked well in their class but due to time constraints, they did not cover the wiki portion of the curriculum.

> *We did the [elevator / reception pitches] but by the time we finished that, we did not move on to the wikis.*

Another suggestion from the teachers was the option to embed the IT Careers Curriculum throughout the IT classes, rather than for it to be a single two-week curriculum.

The School A Classroom Teacher suggested embedding the curriculum across year nine and ten IT classes

> *… going forward I think I'd just use it for 15 minutes here and there as you go through the topics. In theory, if they do this throughout year nine and ten, they should gain a good appreciation of the diverse types of IT careers.*

The School D Classroom Teachers suggested embedding it from the beginning of junior high school years (seven and eight)

> *Doing the careers course with just year nine [students] is only targeting a small amount of students, they had already selected IT in year eight. In our context, our school it would be better to run the careers class in year seven or eight before they do year nine subject selection. … we would then integrate or link the Career Wheel into the rest of the topics covered to reinforce rather than just relying on the one two-week point in their course. We would be happy to run the course; the content wasn't too heavy for students in those levels.*

The School A Classroom Teacher also suggested the idea to bring professionals into the classroom to share their careers.

> *Another idea would be to bring in some professionals. What I'll probably do in a few weeks when we are looking at computer systems is get one of our IT technicians to come in with a laptop and pull it apart. I'll also encourage the students to ask the technician*

about his job and what he does. I think this is a good idea for teachers to do in all subjects.

School D Classroom Teachers indicated that the IT Careers Curriculum was beneficial and that they would be utilising it going forward with some minor contextual changes.

We would use the careers curriculum again; we might modify it slightly but the Career Wheel was good. Boys being boys, in that age group we added the task of looking at the money [income] first and how much study is involved in each career.

Predictive Finding Two Conclusion:

Based on the teacher interviews, their suggestions include an increase in the duration of the careers exploration and elevator/reception pitch presentations activity; short duration follow up IT careers activities at the start of each new IT topic throughout their junior high school IT subjects; and an exploration as to whether the curriculum unit would be more beneficial in years seven or eight.

The qualitative finding from the teacher interviews that the teachers had observed an improvement in students' interest in IT careers during the two-week curriculum supported the overarching research question and research sub-question 1e and provided a counterbalance to the quantitative findings. The findings from the teacher interviews that they had observed that learning activities from the two-week curriculum had been positively received from the students supported research sub-question 1g.

Use of Surveys with junior high school cohorts

Predictive Finding Three: Likert scale survey questions are not reliable as data collection tools when collecting data from junior high school level students.

This question was posed to the four teachers due to the conflicting findings between the quantitative analysis findings (as discussed in Chapter 6) that there was no significance of change in students perceptions of IT careers; and the positive findings from the qualitative analysis from the student focus groups (previously discussed in this Chapter).

Figure 14 displays the resultant word map of the issues with the use of surveys with junior high school cohorts, displaying the top 50 terms including stemmed words, which shows the terms think, year, and survey standing out. Other terms that appear as significant in the word map include work and questions. The term year and survey were prominent, with teachers discussing their own experiences using surveys with year nine students.

Teachers interviewed from the three schools were asked what they thought could be the cause of the issues found with year nines answering the survey.

Figure 14: Teacher Interviews Word Map (Use of Surveys with junior high school cohorts)

School A Classroom Teacher indicated that they had experienced poor survey responses from this year level in the past and suggested an alternative to using surveys that has worked previously in their school:

> *Getting them to write a sentence generates probably more individualised answers, but obviously, this is harder to collate. And as long as a teacher supervising and reminding them that it must be appropriate, and it will be read. That probably works better, that combination of A, B, C, D and a reason why. That is how I have seen survey work a little better with teenagers.*

School C Classroom Teacher indicated that the high number of surveyed student responses in the surveys considered outliers could be a student attitude or work ethic issue:

> *I have struggled with the work ethic with the students in this class, but I don't think even the weakest student would have had any issues with [understanding the survey*

options of] strongly disagree to strongly agree. …there is often a lot of talk about the year nine's when it comes to NAPLAN, how they do more poorly than the year three and six's, that it is possibly an issue with the work ethic of this year level in general.

Upon reflection, the School C Classroom Teacher indicated that they could have given more time for the class to answer the two surveys, possibly work through the survey questions as a group, and they could have emphasised the importance of correctly answering the questions:

I presumed that none of the students would think to donkey vote their way through. It could be something to do with year nines "I'll just answer all strongly agree as it is easy, rather than think about my answer". I may not have given them a lot of time as well, if I hadn't given them enough time to think carefully about each question and the bell is about to ring …

School D Classroom Teacher A indicated they had also experienced poor survey responses from this year level in the past and suggested that focus groups or one-on-one interviews work better for this age level:

I think that is indicative of the surveys we have seen with that age group, especially boys, do not take them seriously. They do care about these things, but you get that by talking to them rather than through a survey, the way or mode of a survey rubs up against them.

School D Classroom Teacher B suggested that the presentations in the two-week curriculum could have been used as a tool for observing changes to student interest levels.

We could examine more closely at the end of their presentations, getting them to discuss whether they found the careers to be of interest, and whether they are now considering IT careers for the future. Maybe as a one or two minute video, you would get a lot more from that.

Predictive Finding Three Conclusion:

The four teachers acknowledged that in their past experiences, Likert scale surveys were unreliably filled in by students in junior high schooling. Other data collection tools such as focus groups and interviews where the students were asked to give their opinions were more likely to result in more useful data.

7.4 Summary of Chapter 7

Chapter 6 analysed the quantitative data collected from the two surveys, before and after the students had undertaken the two-week IT Careers Curriculum. The result of this analysis was that statistically there was no significant improvement in student perceptions towards IT careers as a result of the two-week IT Careers Curriculum.

This Chapter has analysed the qualitative data collected through focus groups of students and interviews with the teachers involved in the two-week IT Careers Curriculum to explore whether the qualitative data indicates a different result.

The fourth stage of the research qualitatively analysed the data collected from the Student Focus Groups about the students' perceptions towards IT Careers. It addressed the overarching Research Question posited in chapter 1 and Research Sub-Question 1d identified from the literature in chapter 2:

> **Sub-Question 1d: Focussing on qualitative measures, how does the implementation of an information technology career curriculum, using tech-savvy teaching tools, change student perceptions towards information technology careers??**

The initial perception toward IT careers of the students in both focus groups was overwhelmingly that they thought that an information technology career entails a job focused on programming / coding. Students select year nine IT classes without any clear understanding of what the classes covered, with students basing their decision on perceived future usage or general interest in IT and/or programming.

Both focus groups indicated that they felt that their awareness of/interest in IT careers had increased after undertaking the two-week curriculum. Both focus groups felt that their experience was positive towards learning about IT careers through the two-week curriculum. This strong qualitative finding supports the key research question and provides a counterbalance to the quantitative findings.

The qualitative analysis of the data collected from the Student Focus Groups about the effect of the two-week IT curriculum learning activities on the students' learning experience addressed Research Sub-Question 1f identified from the literature in chapter 2:

> **Sub-Question 1f: What was the effect of the information technology career curriculum, using tech-savvy teaching tools, on the students' learning experience?**

Students were asked to provide constructive feedback on possible improvements that could be made to the two-week IT Careers Curriculum. The main improvement identified was that they liked the group work aspect of the tech-savvy learning activities but felt that it would be beneficial to have the groups change between each week.

The fifth stage of the research qualitatively analysed the data collected from the Teacher Interviews about their observations of their students' perceptions towards IT Careers. It addressed the overarching Research Question posited in chapter 1 and Research Sub-Question 1e identified from the literature in chapter 2:

> **Sub-Question 1e: How do the views of the class teachers differ from their students' perceptions towards information technology careers after the implementation of an information technology career curriculum, using tech-savvy teaching tools?**

When asked about the outcomes the teachers interviewed had seen from the two-week curriculum, all four teachers recognised that they had observed an improvement in their students' interest in IT careers. These observations correlate with the qualitative findings collected from the student focus groups. The teachers also recognised that their understanding of what their student's knowledge of IT careers had shifted, realising that currently their student's understanding was narrowly focused on coding and technical careers.

Discussion about the high number of incomplete surveys and outliers in the survey data resulted in the teachers sharing their own experience with year nine students. The teachers interviewed agreed that they had also witnessed unreliability of using surveys with year nine students. They suggested that from their experience other data collection tools such as focus groups and interviews where the students were asked to give their opinions resulted in more useful data.

The qualitative analysis of the data collected from the Teacher Interviews about their observations of the effect of the two-week IT curriculum learning activities on their students' learning experience addressed Research Sub-Question 1f identified from the literature in chapter 2:

> **Sub-Question 1g: What was the effect of the information technology career curriculum, using tech-savvy teaching tools, from teachers' observations, on their students' learning experience?**

Other modifications that these interviewed teachers suggested as future improvements to the two-week curriculum were to consider increasing the duration of the careers exploration and elevator/reception pitch presentations activity. Changing the two-week curriculum to having an IT careers activity at the start of each new IT topic throughout the junior high school IT subjects. Exploring whether the curriculum unit would be more beneficial in years seven or eight.

The qualitative finding from both the focus groups and the teacher interviews that there has been an improvement in students' interest in IT careers during the two-week curriculum supports the key research question and provides a counterbalance to the quantitative findings.

Chapter 8 will provide further discussion on the conflicting findings between the quantitative analysis and the qualitative analysis found in this study and will propose recommendations for future research in this area.

Chapter 8 Discussion

8.1 Chapter Introduction

This chapter contextualises, summarises and interprets the main findings from the five stages of the mixed-methods research approach outlined in chapter 3. The aim of this chapter is to discuss the findings in terms of the research question, and the seven research sub-questions. Where applicable the discussion will link the literature to the research outcomes.

The summary and interpretation in this chapter are provided within the context of the study findings from chapters 4, 5, 6 and 7 and prior research findings reviewed in chapter 2. While chapters 4, 5, 6 and 7 reported the results of the development and implementation of the information technology curriculum, and the mixed-methods research activities used to test the research question and sub-questions against this implementation, this chapter lays emphasis on the interpretation and importance of the findings to articulate key discussion areas that impact research and practice. This chapter brings the research objectives and activities together to discuss the findings of the research along with the reflection on research work conducted and the prominent themes emerging from the overarching research question and seven research sub-questions.

Section 8.2 provides discussion of the findings in relation to existing literature and theory. Section 8.3 discusses the findings in relation to the overarching research question and each of the seven research sub-questions. Finally, section 8.4 discusses the implications from the findings of the study.

8.2 Discussion on Findings from the Literature

Chapter two explored a range of academic literature with regard to students in junior high school education and the factors that influence their decision to participate in IT courses in senior secondary school and tertiary studies, and ultimately IT careers. In order to accomplish this, literature from a diverse range of research disciplines, including information systems and computer science, education and educational psychology, careers psychology, and sociology, was reviewed to provide a holistic view of the problem domain.

Literature regarding the current research into the limited enrolments and career selection of students found that student perceptions of IT careers played a significant role. Student perceptions of IT subjects were found to be impacted upon by limitations in junior high school IT curricula, the lack of understanding of what is taught in senior and tertiary IT courses, and poor stereotypes depicted in the media. Much of the research into low IT enrolments and career pathways has focused on gender – why girls / women opt out of pursuing a career in IT. Non-gender factors attributed to low enrolments in IT programs were found to include economic conditions, curriculum quality, and the lack of relevance to industry in secondary school IT courses. Individual factors, such as students' self-efficacy, attitudes, outcome expectations, social support, and social norms, were identified as affecting student perceptions of IT courses and careers. Prospective students were found to hold negative misperceptions about IT studies, related professions, and job availability. The literature posited that to fix the problem, solutions need to be formulated in the early years of schooling – primary and lower secondary school. Finally, the school curriculum and the way in which it is taught and assessed was also identified as a factor influencing student perceptions. From this initial investigation into the literature, an examination was undertaken into career development theories that focus on career choice development of school-age students were explored, the social and structural factors that influence students career decision making, and the learning activities best suited to the current "millennial generation".

Gottfredson's Theory of Circumscription, Compromise, and Self-creation

Gottfredson's (2002, 2005) theory of Circumscription, Compromise, and Self-creation was investigated to more fully understand the key student age groups where a student's self-career development occurs, and especially where careers are removed from further career exploration. This theory identified that the third stage of career development, orientation to social valuation - between ages nine and thirteen (late primary and junior high school) - was the point where students eliminate from further consideration any career path that they see as too low in prestige, irrelevant, mundane or that seems to be out of reach in terms of ability or effort required.

> **Outcome from the findings of the Literature:** From this literature review, year nine high school students were identified as the target group for this research.

Bandura's (1986) Social Cognitive Theory (SCT) on self-efficacy and Lent, Brown, and Hackett's Social Cognitive Career Theory (SCCT) (2002, 2006) were explored to identify the factors that influence student careers decision making, and the personal and environment factors (gender, culture, barriers, and supports) that affect student career exploration and career selection.

Bandura's Social Cognitive Theory (SCT)

Bandura's (1986) Social Cognitive Theory (SCT) was explored to understand how students' self-efficacy influence their career decision making. Bandura (1986) identified that self-efficacy beliefs provide answers to questions pertaining to whether we can perform specific tasks and these beliefs play a central role in the career decision-making process. Students move towards those occupations requiring capabilities they think they either have or can develop, and they move away from those occupations requiring capabilities they think they do not possess or that they cannot develop.

Bandura (1986) posited four sources that shape self-efficacy beliefs. The most influential of these sources is personal performance accomplishments. Successful accomplishments result in more positive or stronger domain-specific, self-efficacy beliefs, and failures lead to more negative or weaker domain-specific beliefs. Self-efficacy has been identified to be a strong predictor of academic achievement, course selection, and career decisions across domains and age levels.

The research from Compeau and Higgins (2015) of the role of individuals' beliefs about their Information Technology (IT) self-efficacy in the determination of Information Technology use was explored. They found that IT self-efficacy was found to exert a significant influence on individuals' expectations of the outcomes of using IT, their emotional reactions to IT (affect and anxiety), as well as their actual IT use. An individual's self-efficacy and outcome expectations were found to be positively influenced by two factors, the encouragement of others and others' use of IT in their work group. Their research found that self-efficacy represents an important individual trait, which moderates organizational influences (such as encouragement and support) on an individual's decision to use IT.

Lent et al. (1996) expanded on Bandura's (1986) Social Cognitive Theory (SCT) through the exploration of the relation of self-efficacy to educational choice and performance, by assessing the extent to which self-efficacy, in conjunction with other relevant variables, predicted academic grades, persistence, and perceived career options within science and engineering fields. They found that self-efficacy contributed to the prediction of grades, persistence, and range of perceived career options in technical and scientific fields.

The relationship that gender plays in students' self-efficacy towards Information Technology was examined. Numerous researchers identified gender as a factor in the limited number of females studying and choosing IT careers. Parental support, teacher expectation and social support for using IT were also identified as factors that influence students' self-efficacy towards IT.

> **Outcome from the findings of the Literature:** From the literature review into Bandura's Social Cognitive Theory (SCT), students' self-efficacy beliefs were found to play a significant role in career decision-making. Providing students with opportunities to undertake information technology learning activities aimed at improving their self-efficacy will in turn improve their career decision-making choices towards IT careers.

Lent, Brown, and Hackett's Social Cognitive Career Theory (SCCT)

Lent, Brown, and Hackett's Social cognitive career theory (SCCT) (Brown and Lent 1996; Lent 2005, 2013; Lent and Brown 2002, 2006; Lent et al. 1996; Lent, Brown and Hackett 2002; Brown and Lent 2019; Lent and Brown 2019; Lent and Brown 2020) was explored. They identified that problems in career development emerge when individuals prematurely foreclose on occupational options due to inaccurate self-efficacy, outcome expectations, or both, and when individuals forego further consideration of occupational options due to barriers they perceive as insurmountable (Lent 2013).

They found that students can be helped to modify their self-efficacy beliefs in several ways. When ability is sufficient but self-efficacy is low due to factors such as racism and gender-role stereotyping, students can be exposed to personally relevant, vicarious learning opportunities. Students with sufficient ability but low self-efficacy can also be encouraged to gather ability-related data from friends, teachers, and others to counteract faulty self-efficacy. Educators can also work collaboratively with these students to construct success experiences to strengthen weak self-efficacy. In processing these success experiences, educators can challenge students when they identify external attributions for their successes and disregard internal, stable causes for their successes.

The role of personality, social supports, and the SCCT variables of self-efficacy, outcome expectations and goals in explaining the career readiness of students' in their career planning and exploration was tested by Rogers et al. (2007). Career exploration was found to be associated with goals and social supports; career planning was associated with self-efficacy. Rogers and Creed (2011); Rogers et al. (2007) indicated that students' career planning results from having high self-efficacy in their chosen career area and a student's career exploration results from having clear goals and good social support.

Social Cognitive Career Theory (SCCT) highlights the importance that self-efficacy, as well as outcomes expectations and other personal and environment factors (gender, culture, barriers, and supports) play in shaping a student's self-image. SCCT examines the conditions that can limit or strengthen the ability to influence student's self-image. Personal, environmental and learning experience variables are seen to influence a student's interests and career choice goals.

> **Outcome from the findings of the Literature:** Lent, Brown, and Hackett's Social Cognitive Career Theory (SCCT) supported the findings from Bandura's Social Cognitive Theory (SCT), that the type of activity that will improve students' careers decision making towards information technology was found to be a IT careers intervention that focuses on building students' self-efficacy and outcomes expectations.

Adya and Kaiser's Social and Structural Factors

Adya and Kaiser's (2005) social factors (family, peer group, and media), and structural factors (teachers and curriculum) were explored. The social factors of family and peer groups were found to play an important role in developing role models for students to assist their career exploration but were found to be difficult to influence in a career intervention strategy. The structural factors teachers and curriculum were also found to be important and linked to students' perceptions. Teachers were found to be an important role model for students, but often in junior high school, they have a disparate range of IT skills and lack of time, training and experience with IT to be able to effectively use IT in the classroom and deliver an inspiring IT curriculum (Adya and Kaiser 2005). Many students reported negative opinions of IT-specific subjects and general dissatisfaction with IT curriculum. The Australian National Curriculum was also examined and found to lack any IT Careers Curriculum from foundation to year ten level schooling.

The literature on career development theories identified that learning experiences through teachers and the curriculum can have an important effect on both the student's self-efficacy and their outcome expectations (Brown and Lent 2012; Adya and Kaiser 2005).

> **Outcome from the findings of the Literature:** From literature review into Adya and Kaiser's (2005) social and structural factors, the type of careers invention that would have an impact on student perceptions towards IT careers was identified as an IT careers focussed curriculum; implemented in year nine; and with a focus on improving students' self-efficacy and outcomes expectations towards information technology.

Learning Activities suited to the "Millennial Generation".

The literature on the teaching tools that would improve the current "millennial" generations' self-efficacy and outcomes expectations was explored. The current generation of students are confident and competent users of computers, mobile phones, the Internet, email, and instant messaging. They have become accustomed to the connected, graphics-oriented, random-access, quick payoff, twitch-speed world of computer games, the Internet and music videos (Prensky 2001b). They are also anecdotally just-in-time consumers of information, who find theoretical knowledge irrelevant (Langridge 2003) and are often bored by traditional educational methods (Prensky 2001b). The literature research examined the various types of tech-savvy web-based learning tools such as wikis, blogs, and multimedia podcasting and identified these types of tools as being best suited to the teaching of the current generation of students.

> **Outcome from the findings of the Literature:** From literature review into the learning styles of the current "millennial" generation, a learning intervention that uses tech-savvy web-based learning tools as the learning activities in a IT Careers Curriculum, would improve their self-efficacy towards information technology and in turn would improve their career decision-making choices towards IT careers.

These findings from the literature were used in the development of the two-week Information Technology Careers Curriculum outlined in Chapter 4. The findings were also instrumental in the refining of the overarching research question and the development of the seven research sub-questions, the findings of which are discussed in section 8.3.

8.3 Discussion on the Overaching Research Question and Sub-Questions

8.3.1 Research Question

The overarching research question was developed to meet the aim of the research which was to investigate whether providing students with IT careers knowledge had an impact in their subject selection and career decisions, which in turn may have had an impact on IT enrolments for tertiary education.

To meet the aim of the research, the overarching research question was developed:

Research Question: How does an information technology career focused curriculum, using tech-savvy teaching tools, impact on year nine students' perceptions toward information technology careers?

To fully address this research question, seven research sub-questions were developed from the literature in chapter 2. They have been addressed throughout the research from different view-points in the five stages of the mixed-methods research approach. Combined these research sub-questions answer the overarching research question.

Discussion on Findings Related to the Research Question

From the overarching findings of the study from both the quantitative and qualitative analysis undertaken after the implementation of the two-week Information Technology Careers Curriculum intervention, the findings of the impact on students' perceptions were mixed.

The quantitative analysis did not find any significant change in the students' perceptions towards IT careers. These findings are further discussed in section 8.3.3 where research sub-question 1c specifically addressed the quantitative analysis of the study, including discussion on potential issues arising from the use of a survey instrument with the age group of the student participants in the study.

The qualitative analysis findings revealed a different set of results from the quantitative analysis. The student focus groups analysis found that the students felt that the two-week IT Careers Curriculum had had a positive impact on their perceptions towards IT careers. The analysis also supported the positive opinions students had to the use of the tech-savvy learning activities used in the curriculum. These findings are further discussed in section 8.3.4 where research sub-question 1d and research sub-question 1f specifically addressed the qualitative analysis undertaken through the student focus groups.

The teacher interview analysis supported the findings from the student focus groups. The teachers observed that the two-week IT Careers Curriculum had had a positive impact on their students' perceptions towards IT careers. They also observed that the learning activities used in the curriculum were positively received by their students. These findings are further discussed in section 8.3.5 where research sub-question 1e and research sub-question 1g specifically addressed the qualitative analysis undertaken through the teacher interviews.

The research findings from each of the research sub-questions are discussed in the following sections. They have been addressed throughout the research from different view-points in the five stages of the mixed-methods research approach. Combined these research sub-questions answer the overarching research question.

8.3.2 Research Sub-Question 1a

Chapter 6, section 6.2 discussed stage one of the research. This involved the analysis of the data collection used in the development of the Information Technology Careers Instrument (ITCI). This quantitative analysis addressed Research Sub-Question 1a:

> **Research Question 1a: What factors contribute to an information technology career survey instrument to test changes in student perceptions towards information technology careers?**

The objective of research sub-question 1a was to identify the factors that contribute to the measurement of students' perceptions of IT careers and then to develop a testing instrument that will measure students' perceptions of IT careers. This first stage of the research involved the following steps in the development of the IT Career Interest (ITCI) Survey instrument:

1. Identify through a literature analysis the factors that contribute to the measurement of the students' perceptions of IT careers.
2. Develop ITCI scale items to be used in the IT Career Interest (ITCI) Survey instrument to measure students' perceptions of IT careers.
3. Perform data collection and factor analysis on the original set of ITCI scale items to refine the items to a concise, unambiguous, and easy set of items for a respondent to complete.

A literature analysis for the ITCI scale items was undertaken. As discussed in Chapter 2, research suggested that interest in careers was often related to self-efficacy, outcome expectations, and previous learning experiences identified in Lent, Brown, and Hackett's (2002) Social Cognitive Career Theory (SCCT). The literature review for ITCI scale items consisted of a search for studies addressing students' interest in STEM and STEM careers, students' perceptions of STEM professionals, and social cognitive career theory applied in science, technology, engineering and mathematics. Instruments used in the investigation all had a high reliability and were grounded in Social Cognitive Career Theory (SCCT). The three studies selected from the literature analysis are summarised in Table 26.

Keir et al. (2014)	Tyler-Wood, Knezek and Christensen (2010)	Mahoney (2010)
The STEM Career Interest Survey (STEM-CIS) was designed to measure the factors related to [junior high] school students' interest in and goals related to STEM subjects and potential careers. The STEM-CIS was designed using a five-point Likert scale with forty-four items, eleven items in each of the Science, Technology, Engineering and Mathematics (STEM) areas (Appendix 6.1). The STEM-CIS was found to have a Cronbach's Alpha = 0.89 for the Technology area.	The STEM Semantics Survey was designed to measure the STEM career interest of students. The STEM Semantics Survey was designed as a semantic differential scale, with students asked to select how they feel on a seven-point scale between two adjective pairs. The survey was comprised of twenty-five paired adjective items, five items in each of the Science, Technology, Engineering and Mathematics (STEM) areas and five further items about students' general feeling towards careers in science, technology, engineering, or mathematics (Appendix 6.2). The STEM Semantics Survey was found to have a Cronbach's Alpha = 0.91 for the Technology area and a Cronbach's Alpha = 0.93 for STEM careers.	The Student Attitude toward STEM Questionnaire was designed to measure the attitudes students' exhibit towards STEM education. The Student Attitude toward STEM Questionnaire was designed as a variation of a four-level semantic differential scale, with students being asked to select between most, more, less and least for each item. The survey comprised of twenty-four items and students were asked to repeat their selection for each of the four STEM areas. In total students were asked to rate nine-six items (twenty-four science, twenty-four technology, twenty-four engineering, and twenty-four mathematics) (Appendix 6.3). The Student Attitude toward STEM Questionnaire was found to have a Cronbach's Alpha = 0.95 for the Technology area.

Table 26:Summary of the three studies selected from the literature analysis

The three STEM instruments had a total of one hundred and sixty-five items dealing with science, technology, engineering and mathematics. Only the forty-five items pertaining to technology and technology careers were utilised to develop the initial version of the ITCI survey (Information Technology Interest & Careers Survey) as the other three areas of STEM were outside of the focus of this study. The term technology was amended to the more specific term, "information technology" to avoid confusion in the resulting ITCI survey.

A convenience sample of eighty first year USQ business students, who recently undertook high school IT classes, were involved in answering the original fifty-five information technology items and their responses were analysed using factor analysis. The factor analysis was conducted to reduce the number of items to a small sub-set of the original set of identified instruments.

Discussion on Findings Related to Research Sub-Question 1a

The factors that were identified through the literature analysis that contribute to the measurement of the students' perceptions of IT careers were self-efficacy, outcome expectations, and previous learning experiences. The ITCI survey instrument was developed to investigate these factors as a measure of students' perceptions of IT careers. The final bank of thirteen items (Table 27) was identified as the appropriate number of items to measure changes in students' perceptions of IT careers.

ITCI Instrument Items	
Item 1	I enjoy learning about information technology.
Item 2	I will continue to enjoy information technology.
Item 3	Information technology is important to me.
Item 4	To me, information technology is fascinating.
Item 5	I am curious about information technology.
Item 6	I would like to learn more about information technology.
Item 7	I am interested in alternative programs in information technology.
Item 8	I like to use information technology for class work.
Item 9	I am curious about careers in information technology.
Item 10	I would like to learn more about careers in information technology.
Item 11	A career in information technology would be fascinating.
Item 12	I plan to use information technology in my future career.
Item 13	I feel comfortable talking to people who work in information technology careers.

Table 27: Final bank of thirteen items

8.3.3 Research Sub-Question 1b

Chapter 4 discussed stage two of the research. This involved the design and development of an Information Technology Careers intervention activity. This design and development of the Information Technology Careers Curriculum addressed Research Sub-Question 1b:

> **Research Question 1b: What content and teaching approach contributes to an information technology career curriculum, using tech-savvy teaching tools, that could be developed to influence student perceptions towards information technology careers?**

The IT Careers Curriculum was developed based on the findings from the literature as outlined in Chapter 2. The literature explored a range of academic literature regarding students in junior high school education and the factors that influence their decision to participate in IT courses in senior secondary school and tertiary studies, and ultimately IT careers. Student perceptions of IT subjects were found to be impacted upon by limitations in junior high school IT curricula, the lack of understanding of what is taught in senior and tertiary IT courses, and poor stereotypes depicted in the media.

From the literature review, the theoretical research from Gottfredson's (2002, 2005) Theory of Circumscription, Compromise, and Self-creation; Lent and Brown's (2006) Social Cognitive Career Theory (SCCT) framework for understanding how people develop career-related interests; and Adya and Kaiser's (2005) Social and Structural Factors that were linked to students' perceptions. Learning activities that would improve self-efficacy and outcomes expectations were found to be tech-savvy web-based learning tools such as wikis, blogs, and multimedia podcasting.

There are three key areas of the literature that inform the design and development of the IT Careers Curriculum intervention.

- Age group selection that an IT Careers intervention will have the most impact based on Gottfredson's (2002, 2005) theory of Circumscription, Compromise, and Self-creation;
- The social or structural factor or factors that an IT Careers intervention will have the most impact based on Lent and Brown's (2006) Social Cognitive Career Theory (SCCT) framework for understanding how people develop career-related interests and Adya and Kaiser's (2005) Social and Structural Factors; and
- The Tech-Savvy Web-based Learning Activities that will meet the learning styles of the current "Millennial Generation" of students.

The two-week curriculum was developed with a careers focused content, based around tech-savvy learning activities. The two-week curriculum drew the tech-savvy tools most closely aligned to the current National Curriculum. Lesson Plans and resources were developed for each lesson and provided to the teachers involved prior to the start of the curriculum unit. Each week was comprised of four, 60-minute lessons. Schools with varying timetables were able to modify these lessons to suit their own structures. Video and phone conferences were held with each teacher to ensure their understanding and comfort in using the curriculum unit.

These resources were refined throughout the two-week curriculum, based on the observations of the researcher, and communicated to each teacher. The first week focused on providing students with an understanding of the breadth of careers within the Information Technology domain and the second week consolidated this knowledge with further tech-savvy learning activities. The careers content and learning activities for the two-week IT Careers Curriculum has been discussed in chapter 4. A reflective journal was undertaken by the researcher while teaching the two-week IT Careers Curriculum at one of the four schools involved in the research, Downlands College – this has been included in chapter 5.

Discussion on Findings Related to Research Sub-Question 1b

The two-week IT Careers Curriculum was developed to influence students' perceptions towards information technology careers. The literature posited that to fix the problem of student perceptions towards IT careers, solutions need to be formulated in the early years of schooling – primary and lower secondary school, and that the school curriculum and the way in which it is taught and assessed was identified as a factor influencing student perceptions. The research identified that the careers invention that would have an impact on student perceptions towards IT careers was an IT careers focussed curriculum, using tech-savvy web-based learning tools, implemented in year nine, with a focus on improving students' self-efficacy and outcomes expectations towards IT.

The Interactive ICT Career Wheel (https://www.careersfoundation.com.au/) was identified as the key source of careers content for this research. Developed by the Queensland Government Chief Information Office, based on the Skills Framework for the Information Age (SFIA) version 6, it is a tool for IT career decision making. The ICT Interactive Career Wheel breaks IT careers into four streams (Figure 15).

Figure 15: ICT Interactive Career Wheel Career Streams

The literature on the teaching tools identified that tech-savvy web-based learning tools such as wikis, blogs, and multimedia podcasting would improve the current "millennial" generations' self-efficacy and outcomes expectations, and therefore improve their perceptions towards IT careers. These tech-savvy web-based learning tools were used in the design and development of the learning activities in the IT Careers Curriculum intervention to test the overarching research question of this study.

Chapter 5 provided an alternative validation of the IT careers curriculum, through the researcher's own reflective journal recorded while teaching the two-week IT Careers

Curriculum at Downlands College (one of the four Toowoomba region schools). The use of the Interactive ICT Career Wheel was found to be a curriculum teaching instrument that was well suited to these students, providing them with comprehensive information about the many different types of IT careers. Topics drawn from the ICT Career Wheel information such as the anticipated growth in IT qualified positions and the future direction of the IT industry resonated well with the students, instigating robust discussion in the class.

The reception pitch concept was well received by the year nine students and they were able to complete their research into their given IT career and present their findings within the week one timeframe. The reception pitch allowed for groups to present their findings from the careers research, rather than having students present individually, and this was found to work well with this student level.

The only concern identified by the researcher was that while the year nine students were able to complete all the wiki tasks within the timeframe of week two, upon reflection the researcher felt that more time would have been beneficial. Future lessons using Wikis should be given more time for the students to learn the platform before embarking on developing Wikis themselves. As only one student can edit the Wiki at a time, a systematic approach will need to be developed in the lesson plans to have the other students in the group working offline on their own content while the Wiki page is being developed.

8.3.4 Research Sub-Question 1c

Chapter 6, sections 6.3 to 6.5 discussed stage three of the research. This involved the analysis of the data collection from the ITCI pre-test and ITCI post-test. This quantitative analysis addressed Research Sub-Question 1c:

> **Sub-Question 1c: Focussing on quantitative measures, how does the implementation of an information technology career curriculum, using tech-savvy teaching tools, impact student perceptions towards information technology careers?**

The objective of research sub-question 1c was to quantitatively measure the improvement of students' perceptions of IT careers through the implementation of the IT Careers Curriculum. Stage three of the research involved students being surveyed using an information technology career interest (ITCI) survey instrument developed in stage one of the research. The ITCI survey instrument was made up of a set of thirteen questions. The survey was conducted twice with students in year nine IT classes at four high schools in the Toowoomba region, firstly before the start of the two-week IT careers curriculum (Pre-Test); and then immediately after the conclusion of the final class (Post-Test). The data collected from the Pre-Test and Post-Test surveys for each student were paired, each ITCI survey contained a coded unique identifier that was used in the pairing. Respondents identified in the matching process who had only been involved in one of the surveys were discarded as they could not be used in subsequent analysis.

The data was recoded and imported into SPSS where a Descriptive Statistics Frequency Analysis was undertaken to understand the breakdown of the respondents from the IT Careers Curriculum group. Outliers were removed using Standard Deviation (Std. Dev.) Analysis, Analysis of Univariate, and Analysis of Multivariate Outliers. The remaining matched survey data was analysed using Repeated Measures Analysis of Variance (ANOVA) to investigate whether there was a significant ($p<.05$) change in student interests due to the IT Careers Curriculum.

Discussion on Findings Related to Research Sub-Question 1c

The analysis of the ITCI survey results did not show a significant change in the students' interest in an information technology career. From this data the quantitative data did not show any significant impact from the implementation of the information technology career curriculum, using tech-savvy teaching tools, on the students' perceptions towards information technology careers.

From the one hundred and eighteen students surveyed in the pre-survey, only one hundred and two completed the ITCI survey successfully, of which eighty-two undertook the two-week curriculum and twenty were in alternative classes as a control group. From the one hundred and three students surveyed in the post-survey, only ninety-eight completed the ITCI survey successfully, of which eighty-four were in the curriculum class and fourteen were in the control group. Once the pre-survey and post-survey students were matched, only seventy-nine surveys were found to be usable for the analysis, of which seventy were in the curriculum group and nine in the control group.

The control group was considered too small to analyse, and the students in the control group were removed from the analysis. All four schools were invited to participate in both the curriculum group and control group, but only two of the schools provided a control group. These teachers in these two schools taught more than one year nine class in the term, which allowed them easy access to students. School A used a mathematics class and School B used a religion class as the control group. Only School D had two concurrent year nine IT classes but requested that both take part simultaneously in the curriculum unit, all other schools only had one class running in the term. The teachers in the other School C had difficulties getting buy-in to the research project from their colleagues, which resulted in no control groups being obtained.

The remaining seventy matched survey responses were then further analysed for removal of outliers and only forty-nine matched surveys were found to be suitable for analysis. Fifteen students were found to have selected all the same agreement level for all items in one or both surveys and further six matched student responses were removed through univariate and multivariate analysis. Further discussion is covered on the appropriateness of surveying this cohort in the implications of these findings (Section 8.4).

The Paired T-Test Analysis on the individual Survey Questions (Table 28) was undertaken to examine if there was any significant change between the first ITCI survey and the second ITCI survey for any individual survey question.

Paired Samples Test									
		Paired Differences					t	Df	Sig. (2-tailed)
		Mean	Std. Dev.	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 6	PreITCI06 - PostITCI06	.204	.539	.077	.049	.359	2.649	48	.011
Pair 10	PreITCI10 - PostITCI10	.204	.645	.092	.019	.389	2.215	48	.032

Table 28: Paired T-Test Analysis on the individual Survey Questions

Of the thirteen ITCI survey items, two individual questions did show significance. Both items involved the students indicating they had an interest in learning more about information technology and information technology careers. ITCI Item 6 and ITCI Item 10 both showed a significant change ($p<.05$) in the forty-nine respondents' responses to the survey questions.

- ITCI Item 6: "I would like to learn more about information technology".
- ITCI Item 10: "I would like to learn more about careers in information technology".

8.3.5 Research Sub-Question 1d and 1f

Chapter 7, section 7.2 discussed stage four of the research. This involved the analysis of the data collected from student focus groups conducted immediately after the conclusion of the Information Technology Careers intervention activity. Research sub-question 1d qualitatively tested the students change in perceptions towards IT careers:

Sub-Question 1d: Focussing on qualitative measures, how does the implementation of an information technology career curriculum, using tech-savvy teaching tools, change student perceptions towards information technology careers?

Research sub-question 1f qualitatively tested the effectiveness of the learning experience of the Information Technology Careers intervention activity from the students' perspective:

Sub-Question 1f: What was the effect of the information technology career curriculum, using tech-savvy teaching tools, on the students' learning experience?

Stage four of the research used focus groups to qualitatively measure the impact of the two-week IT Careers Curriculum on students in the year nine IT classes. The focus group questions were developed as open-ended questions to address research sub-question 1d and research sub-question 1f. These questions were developed from analysis of the literature and observations by the researcher while conducting the two-week IT Careers Curriculum at one of the Schools (Downlands College). The focus groups were conducted immediately after the conclusion of the final IT careers curriculum class using the Nominal Group Technique (NGT). The data and analysis from focus group questions one to three addressed research sub-question 1d and question four addressed research sub-question 1f.

Focus Group Question One (Research Sub-Question 1d)

Focus group question one focused on exploring the students' understanding of Information Technology Careers prior to undertaking the two-week IT Careers classes. This question was broken into two parts:

- ***Before doing the two-week careers class, what did you think a computing career was?***
- ***Describe one of the careers in computing that you knew about before doing the class*.**

Focus Group Question Two (Research Sub-Question 1d)

Focus group question two explored the student's year nine IT class subject selection:

- ***Why did you selected to do the year nine Information Technology class?***

Focus Group Question Three (Research Sub-Question 1d)

Focus group question three focused on exploring the students' understanding of Information Technology Careers after undertaking the two-week IT Careers classes. This information was used to corroborate the findings of the IT Career Interest Instrument (ITCI) Analysis. This question was broken into two parts:

- ***Has your understanding of a computing career changed?***
- ***Discuss one of the interesting things you discovered during the class.***

Focus Group Question Four (Research Sub-Question 1f)

Focus group question four focused on the content and activities involved in the two-week IT Careers Curriculum. This question was also broken into two parts:

- ***What did you enjoy about the careers class?***
- ***What do you think could be improved about the careers class?***

The predictive findings were developed prior to the focus group discussions to answer research sub-question 1d and research sub-question 1f, based on an analysis of the literature, and observations by the researcher while conducting the two-week IT Careers Curriculum at one of the Schools (Downlands College). Predictive findings one to three addressed research sub-question 1d and predictive findings 4 addressed research question 1f.

- ***Predictive Finding One (Research Sub-Question 1d):*** *Students believe that a career in information technology is programming/coding centric.*
- ***Predictive Finding Two (Research Sub-Question 1d):*** *Students select junior high school information technology classes without any clear understanding of what the classes will cover.*
- ***Predictive Finding Three (Research Sub-Question 1d):*** *The two-week IT Careers Curriculum would have a positive impact on students' interest in an information technology career.*
- ***Predictive Finding Four (Research Sub-Question 1d):*** *The two-week IT Careers Curriculum utilising two different tech-savvy learning activities would be enjoyable to the students.*

The transcripts were uploaded into NVivo 12 Professional, and the student statements were coded into five nodes that were identified as the key themes for qualitative analysis. Once the student focus group discussion transcripts where coded, Yin's (2014) congruence method (pattern matching) technique for case study analysis was used to match empirically-based patterns with the predicted findings.

Discussion on Findings Related to Research Sub-Question 1d

The analysis of the qualitative focus group data reported a positive impact from the implementation of the information technology career curriculum, using tech-savvy teaching tools, on the students' perceptions towards information technology careers. These results provided a count-point to the results from the quantitative analysis. Section 8.4 provides further discussion on potential reasons why the quantitative and qualitative results were not aligned.

The findings from the focus group question one, that the students in the two focus groups had of information technology careers, matched the research's predicted finding one - students in both focus groups overwhelmingly thought that an information technology career entails a job focused on programming/coding.

For some time, the educational discussion around teaching Information Technology in Australian schools has focused on coding as the curriculum element that will instil the necessary knowledge for students to deal with the evolving information technology-dependent careers of the future. This rhetoric has been put forward by both federal and state governments throughout Australia.

This research investigated how this widely promoted, in the media, discussion has impacted on a junior high school student's understanding of information technology careers. The results as reported in the qualitative analysis of the two student focus groups found that students' initial perception of an information technology career was, overwhelmingly, that an information technology career entails a job focused on programming/coding.

With students' coding centric impression of an information technology career, their decision to select junior high school information technology subjects was investigated in the qualitative analysis of the two student focus groups. The findings from focus group question two, that the students had selected their year nine IT classes without any clear understanding of what the classes covered, matched the researcher's predicted finding two. Table 30 shows the percentage breakdown of the combined focus groups justification for their current subject selection.

Subject Selection Justification	Percentage
Previous year eight Information Technology class	14.28%
Perceived requirements in future careers	14.28%
Interest in programming / coding.	14.28%
General interest in computers.	35.74%
Interest gained through a family member.	7.14%
Perceived future hobby	7.14%
Interest in robotics	7.14%

Table 29: Percentage Breakdown of students' justification for subject selection

Only one student (School B Male Student 1) indicated that the subject information was part of their decision making, the rest of the students based their decision on perceived future usage or general interest in IT and/or programming.

Gottfredson's (2005) Circumscription, Compromise and Self-creation Theory identified four career developmental stages in a students' life. It is during the junior high schooling years (seven to ten) that students eliminate from further consideration any career path that they see as too low in prestige, irrelevant, mundane or that seems to be out of reach in terms of ability or effort required (Gottfredson 2006). Lent, Brown, and Hackett's (2002) Social Cognitive Career Theory (SCCT) together with the research from Adya and Kaiser's (2005) research identified structural factors (e.g. teachers and curriculum) as playing a role in either strengthening or limiting a student's expectations of IT careers.

With students' currently having a coding centric impression of an information technology career and limited understanding of what is covered in junior high school information technology subjects, it is likely that the majority of students are eliminating information technology from consideration as a career through circumscription, making it very challenging to reverse and causing the information technology industry considerable staffing issues currently and into the future.

Students were asked to indicate if their interest in IT careers had changed after the two-week IT Careers Curriculum. The findings from focus group question three identified that both focus groups indicated that all students felt that their awareness/interest in IT careers had increased after undertaking the two-week curriculum. All students in the focus groups indicated that their awareness of the scope of information technology careers had been raised and that this new awareness had opened them to increased interest in information technology careers.

This strong qualitative finding supports the key research question, matched the researcher's predicted finding three, and provides a counterbalance to the quantitative findings.

The qualitative finding from the focus groups that there has been an improvement in students' interest in IT careers during the two-week curriculum supported the overarching research question and research sub-question 1d and provided a counterbalance to the quantitative findings. This shows the importance of providing students with a good understanding of the breadth of the information technology industry, as opposed to the current coding centric model that forms the Australian National Curriculum. The Interactive ICT Career Wheel provides a broad range of careers information as well as detailed facts about each career. This type of information is important to be included within the junior high school information technology curriculum, rather than left to students to find on their own through web search or careers fairs. This was further confirmed in the teacher interviews in section 8.3.5.

Discussion on Findings Related to Research Sub-Question 1f

The analysis of the qualitative focus group data reported a positive effect of the information technology career curriculum, using tech-savvy teaching tools, on the students' learning experience. Based on the focus group findings, both focus groups indicated that all students felt that their experience was positive towards learning about IT careers through the two-week curriculum, this matched the researcher's predicted finding four.

School A indicated a positive experience towards the tech-savvy learning activities. Two students in School C also indicated a positive experience, the other students did not comment.

A final open-ended question was asked to students in both focus groups, encouraging the students to provide constructive feedback on possible improvements that could be made to the two-week IT Careers Curriculum. No student in either focus group indicated that they had any negative sentiments towards the IT careers content of the two-week curriculum.

The main improvement identified through this question was that students liked the group work aspect of the tech-savvy learning activities in the two-week curriculum but would have liked the groups to be changed between each week.

No student indicated that they had any negative sentiments towards the IT careers content of the two-week curriculum. The only negative sentiments were towards the learning activities used. Some of the students felt that more time investigating the different careers would have been beneficial. Upon further investigation with that school, it was noted that the teacher had allowed the students to focus on a small number of careers from the Interactive ICT Career Wheel, rather than exploring it deeper. Future teacher instructions should be more specific about requiring the students to investigate the careers in each quadrant rather than hand-picking a smaller selection to give the students as broad an understanding of the whole of the information technology careers as possible.

The students also indicated that more instructions would have been helpful is developing the Wiki. The demise of Wikispaces in July 2018, just prior to the commencement of the curriculum classes, resulted in a switch to the less well supported Wikidot platform and adjustment to the teacher training. The new platform was not as easy to use, and there were a few teething issues that needed to be worked out as discussed in the principal researcher's teaching reflections.

8.3.6 Research Sub-Question 1e and 1g

Chapter 7, section 7.3 discussed stage five of the research. This involved the analysis of the data collected from teacher interviews conducted immediately after the conclusion of the Information Technology Careers intervention activity. Stage five was also analysed through the data collected from the researcher's person journal reflections (Chapter 5) that were recorded while personally teaching one of the year nine IT classes at Downlands College. These two areas of research qualitatively compare the teachers' views to their students' views towards information technology careers after the implementation of an information technology career curriculum. Research sub-question 1e qualitatively tested the differences between these two views:

> **Sub-Question 1e: How do the views of the class teachers differ from their students' perceptions towards information technology careers after the implementation of an information technology career curriculum, using tech-savvy teaching tools?**

Research sub-question 1g qualitatively tested the effectiveness of the learning experience from the teachers' observations as they taught the IT Careers Curriculum:

> **Sub-Question 1g: What was the effect of the information technology career curriculum, using tech-savvy teaching tools, from teachers' observations, on their students' learning experience?**

Stage five of the research used interviews to qualitative measure the observed impact from the teachers' perspective of the two-week IT Careers Curriculum on their students in the year nine IT classes. The semi-structured interview questions were developed to address research sub-question 1e and research sub-question 1g. These questions were developed from analysis of the literature and observations by the researcher while conducting the two-week IT Careers Curriculum at one of the Schools (Downlands College). The interviews were conducted immediately after the conclusion of the final IT careers curriculum class. The data and analysis from interview question one addressed research sub-question 1e and question two addressed research question 1g. The third question was added as a result of the quantitative findings as outlined in Chapter 6, the implications of the findings from this question are addressed in Section 8.4.

Teacher Interview Question One (Research Sub-Question 1e)

- ***What was the impact the two-week curriculum had on their students' interest in IT careers?***

Teacher Interview Question Two (Research Sub-Question 1g)

- ***What improvement did they have for the two-week curriculum, to further increase student interest in IT careers?***

Teacher Interview Question Three

- ***What could have been the cause of the large number of issues with year nines answering the survey.***

The predictive findings were developed prior to the interview discussions to answer research sub-question 1e and research sub-question 1g, based on an analysis of the literature, and observations by the researcher while conducting the two-week IT Careers Curriculum at one of the Schools (Downlands College). Predictive findings one addressed research sub-question 1e and predictive findings two addressed research question 1g. The third predictive finding was added as a result of the quantitative findings as outlined in Chapter 6, the implications of the findings from this question are be addressed in Section 8.4.

- ***Predictive Finding 1 (Research Sub-Question 1e):*** *The two-week IT Careers Curriculum had a positive impact on students' interest in an information technology career.*
- ***Predictive Finding 2 (Research Sub-Question 1g):*** *The tech-savvy activities provided good learning opportunities for the students to increase their interest in IT careers.*
- ***Predictive Finding 3:*** *Likert scale survey questions are not reliable as data collection tools when collecting data from junior high school level students.*

The transcripts were uploaded into NVivo 12 Professional, and the teacher statements were coded into three nodes that were identified as the key themes for qualitative analysis. Once the teacher interview discussion transcripts where coded, Yin's (2014) congruence method (pattern matching) technique for case study analysis was used to match empirically-based patterns with the predicted findings.

Discussion on Findings Related to Research Sub-Question 1e

The analysis of the qualitative interview data reported that the teachers had observed a positive impact from the implementation of the information technology career curriculum, using tech-savvy teaching tools, on their students' perceptions towards information technology careers.

The four teachers acknowledged that they witnessed an improvement in their students' interest in IT careers during the two-week curriculum, which matched the research's predicted finding one and also supported the findings from the student focus groups. Teachers also acknowledged that they had changed their own perceptions of their student's knowledge of IT careers.

Discussion on Findings Related to Research Sub-Question 1g

The analysis of the qualitative interview data reported that the teachers had observed a positive effect of the information technology career curriculum, using tech-savvy teaching tools, on their students' learning experience.

Based on the teacher interviews, their suggestions include an increase in the duration of the careers exploration and elevator/reception pitch presentations activity; short duration follow up IT careers activities at the start of each new IT topic throughout their junior high school IT subjects; and an exploration as to whether the curriculum unit would be more beneficial in years seven or eight.

The third stage of Gottfredson's (2005) Circumscription, Compromise and Self-creation theory focuses on students in the range from year seven to ten, as such moving the IT Careers Curriculum to an earlier year level would still be in keeping with Gottfredson stage of development and would have the possibility of a wider audience. The only issue that would need to be considered is that not all schools currently run a year seven or eight information technology class, so alternative STEM classes may need to also be investigated for those schools.

The placement in junior high school in terms of when to run the IT Careers Curriculum was a point of discussion in the interviews. As year nine students self-select the information technology classes, it was felt that running the IT Careers Curriculum earlier, either in year seven or eight where all students in the school would undertake the curriculum, would be better allowing the students to use this information as part of their subject selection. This would allow all students in the school to undertake the IT Careers Curriculum, rather than those that had already selected the junior high school IT course.

One teacher suggested selectively discussing the relevant careers at the start of each new topic throughout their junior high school IT subjects. This may be beneficial to the classroom teacher as it would remove the two-week IT Careers Curriculum block but may result in the current situation of a skewed view of the types of information technology careers simply due to the coding centric nature of the current junior high school IT courses.

The teachers supported the student focus group suggestion to increase the duration of the careers exploration. They felt that the elevator/reception pitch presentations activity was a good learning tool for the class to explore the different types of information technology careers. It was suggested that a scaffolded approach might be beneficial where the students gave a small presentation with feedback then worked on a larger group presentation over the two weeks. There was some indication from the teachers that the wiki activity should be removed to allow for more time to the presentations.

8.4 Implications of the Findings

Why IT Needs Careers Interventions?

The Australian Academy of Science (2019) acknowledges the "critically important role of the education system in starting a healthy pipeline of STEM (Science, Technology, Engineering and Mathematics) students" and a lack of understanding of STEM career options as key barriers for participation in STEM careers.

There have been many STEM intervention programs developed for Australian schools that focus on increasing students' enjoyment of STEM subjects. The aim of these interventions is to demonstrate to students that STEM subjects are interesting and achievable. These interventions aim to build on students' self-efficacy and outcomes expectations to increase the number of students enrolling in STEM courses in senior high school and university.

Currently, there has been limited research that targets secondary schooling with a view of improving awareness of career opportunities that arise from studying STEM (Australian Academy of Science 2019), and even less that specifically focuses on the subset of STEM, information technology.

Science and mathematics are STEM subjects that students have a long-term awareness of, they start learning about both subjects in early primary school. By the time they are making decisions about senior school subject selection, they have a significant experience and understand their own self-efficacy towards both. The same cannot be said for information technology and engineering. While students are immersed in technology in their daily lives, the findings of this study has identified that they do not understand what career options IT gives them. Engineering is at even further a disadvantage, as it is not included at any level of curriculum within schooling in Australia.

The findings in this research identify that improving students' awareness of information technology careers can have a significant impact on their future career awareness. Providing students with a clear understanding of IT careers at an early stage in their schooling can affect student perceptions prior to their discounting of it as a potential career path.

Discrepancy Between Quantitative and Qualitative Findings

While the survey data resulted in no findings of any significant increase in student interest in information technology careers, the student focus group and teacher interviews provided a different account. The qualitative data from both the students' and teachers' discussions found that the two-week IT Careers Curriculum had a positive impact on students' interest in information technology careers. The teacher interviews included a qualitative investigation into the reasons why there is a difference in findings between the survey-based quantitative findings and the focus group based qualitative findings.

The large number of students whose data were considered outliers during the data analysis phase of the study also limited the quantitative analysis. Many students were found to have selected all the same agreement level for all items and the results of data analysis indicated a lack of any significance between the two ITCI surveys. Further investigation was undertaken with the teachers in their interviews as to possible causes for these data analysis issues. The three STEM careers instruments from which the IT Career Interest (ITCI) Instrument was drawn (Keir et al 2014, Tyler-Wood 2010; and Mahoney 2010) all utilised Likert scale surveys. None of these research projects indicated any issues of poor student engagement with the survey instruments. Keir et al (2014) reported removing five out of 1,061 junior high school student respondents as outliers from the data. Tyler-Wood (2010) reported surveying sixty 6th to 8th grade students with no outliers being discussed. Mahoney (2010) investigated both 9th and 11th grade students. From the 9th grade students reported in the project, eighty-three of eighty-nine students completed the survey, whereas sixty-one of sixty-two 11th grade students completed the survey. No further outliers were discussed in this research. It was from these findings of these three research projects, which formed the foundation for the IT Career Interest (ITCI) Instrument, that the decision to use a Likert scale survey with the year nine information technology school students was chosen.

Further literature investigation into the high level of outliers in the ITCI surveys lead to research by Leeuw (2011), who outlines how the cognitive level of students undertaking questionnaires can play an important role in how well they understand and answer the questions provided. They identify three age groups of students: middle childhood (ages seven – twelve); early adolescence (twelve – sixteen); and late adolescence (sixteen onwards) where different styles of questionnaires should be undertaken. The year nine students in this research would be considered to be in Leeuw's (2011) middle childhood. Questionnaires to these students should consider the complexity of questions and number of responses. The five-point Likert scale may have been too complex, whereas a semantic differential scale may have been more suitable.

The four teachers acknowledged that in their past experiences, Likert scale surveys were unreliably filled in by students in junior high schooling. Other data collection tools such as focus groups and interviews where the students were asked to give their opinions were more likely to result in more useful data.

8.5 Summary of Chapter 8

This chapter discussed the research findings in relation to existing literature and theory. It then discussed the research findings in relation to the overarching research question and seven research sub-questions developed through the five stages of the mixed-methods research approach undertaken in this study. The chapter concludes with a discussion of the implications of the findings from the study.

The next chapter will summarise and conclude this research. The chapter will show how the research has achieved its principal aim and establishes the significant contribution it has made to research. Finally, the limitations of this research are described and recommendations for future research made.

Chapter 9 Conclusions

9.1 Chapter Introduction

This final chapter provides a summary of the key research findings to demonstrate how the research has met its objectives. The chapter offers a future perspective on research in this area by highlighting the contributions to knowledge, recommendations for educational authorities, schools and teachers, limitations of the study and suggestions for further research.

This chapter is organised into nine sections. Section 9.1 presents an introduction; a summary of the thesis is provided in Section 9.2; the answer to thesis research question is in Section 9.3; the significance of the research is presented in Section 9.4; the contribution to theory and practice is provided in Section 9.5; Section 9.6 presents recommendations to educational authorities, schools and teachers and Section 9.7 presents researchers thoughts about personal development; limitations of the research and suggestions on further research are provided in Section 9.8; The final concluding remarks from the researcher are provided in Section 9.9.

9.2 Summary of the Thesis

This research has identified that there is a growing shortage in students undertaking a information technology careers pathway in Australia given the workforce needs. The research developed a IT Careers Curriculum for use in junior high school information technology classes to improve the perceptions of students towards information technology careers in order to find a solution to mitigate this shortage. A mix-methods research approach has been used in this research to evaluate the effectiveness of the IT Careers Curriculum from both a quantitiative and qualitative perspective.

Many intervention studies have been conducted into improving the shortages in students studying STEM (Science, Technology, Engineering and Mathematics) and more specifically information technology. Most of these studies has focused on the issue of gender, rather than looking at the issue in a broader context. Moreover, existing studies do not take into account the specific age group where career compromise occurs, the point in a student's education best suited for a target of IT careers intervention strategy. This creates a gap that needs to be filled.

This research was structured in nine chapters including this concluding chapter.

Chapter 1 highlighted the need and rationale for the development of a IT careers intervention strategy to to find a solution to mitigate the IT skills shortage in Australia. The chapter provided the background of the research, motivation and the role of the research in the Australian and

Queensland educational setting. The research problem, research question and justification of the research along with expected research contributions were highlighted in Chapter 1. Chapter 1 also covered the methodology adopted for the research, definition of key terms, scope delimitations and key assumptions of this research.

In **Chapter 2**, the literature review was introduced. Literature regarding the current research into the limited enrolments and career selection was covered, including the role student perceptions of IT careers plays in their career decisions. Literature about career development theories that focus on careers choice development of school-age students were explored, with a focus on Gottfredson's theory of Circumscription, Compromise, and Self-creation; Lent, Brown, and Hackett's Social Cognitive Career Theory (SCCT); and Adya and Kaiser's Social and Structural Factors. The literature on the teaching tools that would improve the current "millennial" generations' self-efficacy and outcomes expectations were also explored. These literature findings were the catalyst for the design and development of the IT Careers Curriculum. The research question identified in chapter 1 was refined through the literature and seven research sub-questions were further identified.

Chapter 3 defined the methodological approaches used for data collection and outlined the pragmatism philosophical assumption underpinning this research study. The ethical considerations of the study were presented, including discussion about the methods used for informed consent for schools, teachers and students involved in the study. Since the main aim of this research was to develop a IT Careers Curriculum for use in junior high school information technology classes, and then to test whether the curriculum had improved the perceptions of students towards information technology careers, five separate stages were developed in the research. All stages were conducted using a mixed-methods research approach to provide academic rigor. The research design and activities to answer the research question and the seven research sub-questions was also presented in Chapter 3.

Chapter 4 discussed **stage two of the research**, the design and development of the Information Technology Careers Curriculum. The theoretical research from Gottfredson's (2002, 2005) theory of Circumscription, Compromise, and Self-creation; Lent and Brown's (2006) Social Cognitive Career Theory (SCCT) framework; and Adya and Kaiser's (2005) Social and Structural Factors were discussed as to how they informed the design and development of the curriculum. This chapter addressed the research question and specifically, ***research sub-question 1b*** which was identified from the literature in chapter 2. The chapter presented the lesson plans, including careers content and learning activities, for the IT Careers Curriculum that were then implemented in the four schools in the Toowoomba region.

Chapter 5 presented an alternative validation of the curriculum, through the researcher's own reflections of teaching the Information Technology Careers Curriculum at one of the four schools in the study, Downlands College. This chapter provided further insight into answering the research question and specifically, ***research sub-question 1b*** which was identified from the literature in chapter 2. The researcher's reflections on teaching the IT Careers Curriculum focused on the observations of the impact on the students towards the careers curriculum content and the web-based tech-savvy learning activities.

Chapter 6 outlined the quantitative analysis steps undertaken in **stage one of the research** to determine the items for inclusion in the Information Technology Careers Instrument (ITCI) survey using reliability analysis to reduce the survey items from forty-eight to thirteen. The analysis of the data collection used in the development of the Information Technology Careers Instrument (ITCI) addressed the research question and specifically, ***research sub-question 1a*** identified from the literature in chapter 2.

This Chapter also analysed the quantitative data, in **stage three of the research**, collected from the two surveys (developed in stage one of the research), before and after the students had undertaken the IT Careers Curriculum using Repeated Measures Analysis of Variance (ANOVA) of the Pre and Post Test ITCI Means. The results of this analysis were that statistically there was no significant improvement in student perceptions towards IT careers as a result of the two-week IT Careers Curriculum. The analysis of the data collection from the ITCI pre-test and ITCI post-test addressed the Reseach Question and specifically, ***research sub-question 1c*** identified from the literature in chapter 2:

Chapter 7 analysed the qualitative data collected through focus groups of students and interviews with the teachers involved in the two-week IT Careers Curriculum to explore whether the qualitative data indicates a different result.

The **fourth stage of the research** qualitatively analysed the data collected from the Student Focus Groups about the students' perceptions towards IT Careers. It addressed the Reseach Question and specifically, ***research sub-question 1d*** identified from the literature in chapter 2. The qualitative analysis of the data collected from the Student Focus Groups also investigated the effect of the two-week IT curriculum learning activities on the students' learning experience, this addressed the Reseach Question and specifically, ***research sub-question 1f***.

The **fifth stage of the research** qualitatively analysed the data collected from the Teacher Interviews about their observations of their students' perceptions towards IT Careers. It addressed the Reseach Question and specifically, ***research sub-question 1e*** identified from the literature in chapter 2. The qualitative analysis of the data collected from the Teacher Interviews also investigated the teachers' observations of the effect of the two-week IT curriculum learning activities on their students' learning experience, this addressed the Reseach Question and specifically, ***research sub-question 1g***.

Chapter 8 provided a discussion on the interpretation of the results from the research within the context of the reviewed literature. Chapter 8 discussed the research findings regarding the mixed-methods research undertaken in the five stages of the research, to identify how each stage answered the research question and the seven research sub-questions about changing student perceptions towards IT careers through the use of an IT Careers Curriculum intervention activity.

9.3 Answer to the Research Question

Through literature review, the research confirmed the lack of non-gender specific information technology careers intervention strategies. The literature also identified students in years seven to ten as the age group where students compromise their future career options.

To answer the research question, the study developed an Information Technology Careers Curriculum intervention activity that would positively impact on a students' perceptions of information technology careers, prior to their reaching the compromised point of discounting it as a future career path. A mixed-methods research approach was used in the research to quantitatively and qualitatively analyse the impact of the implementation of the Information Technology Careers Curriculum intervention activity in answer to the research question.

The results were contradictory, the quantitative analysis undertaken in stage three of the reseach did not show any significance impact on students' perceptions towards information technology careers. The qualitiative analysis undertaken in stage four through student focus groups and stage five through teacher interviews found that the implementation of the Information Technology Careers Curriculum intervention activity had resulted in a positive impact on students' perceptions towards information technology careers.

9.4 Signifance of the Study

This study makes the following contributions to theory and practice from the results and findings:

The research was conducted in the context of the Australian educational context. The study contributes to academic scholars, educational practitioners, and the information technology professional bodies (ACPHIS, ACDICT, ACS etc.) by enhancing their understanding of factors that impact on school age students' perceptions towards information technology careers. The study provided a information technology careers curriculum that can be implemented in junior secondary schools in parallel with the current National Curriculum Digital Technologies curriculum.

Previous studies identified gender issues as the factor that has impacted low IT enrolments and career pathways – why girls / women opt out of pursuing a career in IT. Non-gender factors attributed in the research to low enrolments in IT programs were found to include economic conditions (such as the Global Financial Crisis), and curriculum quality and lack of relevance to industry in secondary school IT courses. Individual factors, such as students' self-efficacy, attitudes, outcome expectations, social support, and social norms, have also been identified as affecting student perceptions of IT courses and careers. Prospective students were found to hold highly negative misperceptions about IT studies, related professions, and job availability.

9.4.1 Implications for theory

The study contributes to theory and the IT community by first presenting a systematic literature review on student career decision making and the role student perceptions of IT careers play in their career decisions, including literature about career development theories that focus on careers choice development of school-age students, and on the teaching tools that would improve the current "millennial" generations' self-efficacy and outcomes expectations. The study further extends on the findings of Gottfredson's (2005) Circumscription, Compromise and Self-creation theory, Lent, Brown, and Hackett's (2002) Social Cognitive Career Theory (SCCT) together with the research from Adya and Kaiser's (2005) structural factors, to clarify the perceptions that influence student information technology study and career choices in the Australian context.

9.4.2 Implications for practice

Although this research has shown that there has been many information technology careers focused interventions activities implemented in many educational context world-wise, their focus has not been on the age group identified through the literature where students compromise their future career options. Educational practitioners may use the findings of the study to better understand the factors that influence junior high school students' information technology career choices.

This study provides educational practitioners with an alternative focus for future information technology careers interventions, outside of the factors related to gender, which have been the primary focus of most current research (Hunter and Boersen 2017; Hunter and Boersen 2016; Gorbacheva et al. 2014; Ashcraft et al. 2012; Clayton, Beekhuyzen and Nielsen, 2012; Craig, Lang and Fisher 2008; Craig, Fisher and Lang, 2007; Lang, 2010; Bain and Rice, 2006).

9.5 Contribution to Theory and Practice

This section outlines the contribution to theory and practice made by this study. The main contributions of this study are as follows:

The identification of the age group where a information technology careers intervention activity would have a significant impact on their career decision making before they discount all information technology careers for future consideration.

The clarification within the Australian context of the factors of self-efficacy and outcomes expectation as having influence on students' perceptions towards information technology careers, and the strategies best suited to improving these perceptions.

The identification of the best practice for web-based tech-savvy learning activities designed for the current "millennial" generation that can be used to inform information technology curricula development throughout the Australian educational environment.

It has been highlighted in chapter 2 that the current literature focus has been on gender factors, rather than focused on careers choice development of school-age students, and on the teaching tools that would improve the current "millennial" generations' self-efficacy and outcomes expectations. The primary contribution of this research is the development of an information technology careers curriculum for use with junior high school student that will have a positive impact on these students's perceptions of information technology careers.

It is also believed that this research will assist researchers and policymakers to better understand the factors that influence students' information technology study and career choices, and inform educational practitioners when developing programs aimed at increasing students' involvement in information technology education and vocational pathways, by providing better awareness of the range of information technology careers available beyond programming and technical support. It is further believed that this study provides evidence for the importance of future research in student STEM study and career choices. This is significant, due to the decline in interest in information technology study and career options.

This research is unique. To date, there is no known research into junior high school information technology careers curriculum of Queensland students and the influence of these careers curriculum experiences on their perceptions in the information technology field.

9.6 Recommendation to Educational Authorities and Teachers

Interest in an area is a key factor in choosing to enter and continue in the educational and career pathway associated with that field. This research has shown that interest in information technology wanes in junior high school and into students' senior high schooling. In this research, there were many reasons identified through the literature to account for this wanng of interest, including the students' self-efficacy towards information technology and the current information technology curriculum being taught in junior high school IT classes.

In light of these findings, a number of recommendations are suggested.

1. Provide a state-wide information technology focused careers curriculum unit that is embedded within the National Curriculum – Digital Technolgies, for junior school students, to provide these students with a detailed understanding of the breadth of the information technology industry and careers.
2. Provide teachers involved in junior school information technology class teaching with detailed literature and resources to assist these teachers' awareness of the breadth of the information technology industry and careers.

9.7 Researcher's Thoughts About Personal Development

During this study, I have attempted to remain as objective as possible. I believe that the discussions and findings of this research will provide further researchers considering investigating career development with adolescent students with better insights than I had when I started this journey. I discovered during this research that when involving high schools, the importance of ensuring that all levels of administration within each school, from principal, through head of department, to classroom teacher, have agreed to undertake the curriculum well before the start of the commencement of the research. When I started the research, I had verbal agreement from several teachers at various schools in the Toowoomba region who had agreed to work with me on the project. When I approached these teachers prior to the implementation of the IT Careers Curriculum, some had moved schools and others were no longer teaching year nine IT. It took me nearly twelve months of unanticipated hurdles to gain agreement with the four schools that finally took part in the study. This included getting approvals from the school principals, then working with their heads of department, and finally getting their teaching staff to agree to participate.

Another outcome of this study is my own personal growth. I have learnt the step-by-step approaches to conducting both quantitative and qualitative research methodologies. I have a significantly better understanding of the process of conducting both forms of research. I understand now the research process and the rigour that must be maintained in conducting research projects. This will help me to further my academic research career, leading to future conference and journal publications.

I have learnt to persevere, remain calm and always attempt to be optimistic in difficult situations. I have experienced several personal setbacks during the study, including the passing of my father. The goal of completing this research at times became hard to picture but I persevered, I took strength from friends and family, and worked through the process, rather than getting distracted with the big picture. These characteristics have become an integral part of my personality, I simply keep going irrespective of the challenges. In my role as a university academic at the University of Southern Queensland, I am now able to guide other research students through the process of a research thesis, and I look forward to be a future supervisor to numerous students.

9.8 Limitations of the Study and Further Research

There are a number of different limitations within the methodological development of this research, which will be sufficiently discussed in this sub-section. Apart from the limitations, this sub-section will also provide valuable guidelines for future researchers, which will benefit them towards making valuable research contributions in the field of student information technology career decision making in the context of Australian educational systems.

This study has progressed the research on the influence of information technology careers curriculum on junior high school students' perceptions of information technology study and careers. However, the context of the study also acted to limit the study. Firstly, the study size reflected the limited access available to the researcher. While there are many secondary schools in the Toowoomba region, only four schools were available and utilised in this study. Although attempts were made to include other schools, significant problems were encountered in engaging other schools willing to participate in the study. The limited number of schools also resulted in only two control group classes which when their ITCI pre and post surveys were paired provided a very small pool of useful respondents and the decision was made not to use this data. Having control groups to compare the ITCI data collected from the curriculum groups may have resulted in further quantitative analysis findings into students' perceptions of information technology study and careers.

Secondly, the original duration of the IT Careers Curriculum was to be four weeks, providing students with four distinct tech-savvy activities and allowing the students to engage in-depth with various information technology careers. Early feedback from the four schools involved in the research highlighted that this would have a significant impact on the schools' ability to complete their current year nine information technology curriculum. Negotiations with the schools resulted in the IT Careers Curriculum being shortened to two weeks and focusing on only two distinct tech-savvy activities (reception pitches presentations and wiki development). More time spent engaging with information technology careers and other tech-savvy curriculum activities may have provided the students with more opportunities to improve their perceptions of information technology study and careers. Further investigation into integrating IT careers study into the current year nine curriculum have have also extended the reach of career education.

The final question investigated in the teacher interviews was also focused on getting feedback from the teachers as to their impressions of why the survey results were not significant and the large number of outliers. Each of the four teachers acknowledged that in their past experience Likert scale surveys were unreliably filled in by students at a junior high school level. Student attitudes towards such survey instruments were apathetic and often resulted in limited data collection. All four teachers suggested that they had found other data collection tools, such as focus groups and one-on-one interviews to be much more successful, especially where the students were asked to give their opinions, as they were more likely to result in meaningful data. This may be an issue specific to the Australian or even the Queensland educational context, and future research conducted with these year levels should take this into account.

A dual-action research cycle with the redevelopment of the curriculum based on quantitative and qualitative data would have been informative and helped build a more robust final IT Careers Curriculum. However, the difficulty experienced with engaging with schools that were willing to participate in the study did not allow for this to be enacted. The schools' willingness to be involved for longer than the agreed two-weeks curriculum would have resulted in less to no schools being involved, so the action research option was not undertaken.

Finally, the longitudinal monitoring of the evolution of the participating students' study and career choices would be informative. However, time constraints imposed by the nature of the research project did not allow for this. Furthermore, tracking students over the years may have been difficult or even impossible due to the high mobility of students in some schools, and the privacy and consent issues this would raise.

Several future areas for research have emerged during and as a result of the research. Firstly, while the outcomes of this research of this research are specific to the contexts of the participating schools and cannot be widely generalised, the research has provided discussion and insights that may be used to guide future research into information technology careers decisions. As such, a State-wide study using the IT Careers Curriculum with student focus groups and interviews featuring qualitative analysis could confirm, refine or broaden the applicability of the findings to other contexts. The research could also be extended to interstate or international schools if the curriculum is shown to improve student perceptions in a state-wide context.

Further investigation of the social factors such as the influence of parents, sibling and other family members on students' information technology perceptions would be useful within regional Australia through interviews of students' family. Furthermore, a review of the changing nature of student's perceptions to information technology careers could be carried out involving primary school years (foundation to six), junior high school years (seven and eight), middle-school years (nine and ten), and senior-school years (eleven and twelve) students. The results at these four levels could be compared to determine the nature and extent of the changes of perceptions across Gottfredson's four stages of Circumscription, Compromise, and Self-Creation.

9.9 Concluding Remarks

This Chapter concludes the thesis by summarising the key research findings of the study, addresses the contributions of the research to theory and practice, examines the limitations of this research, and proposes directions for future research. This Chapter has shown that the research objectives have been met and describes the contribution to knowledge.

Gottfredson's (2005) Circumscription, Compromise and Self-creation theory, Lent, Brown, and Hackett's (2002) Social Cognitive Career Theory (SCCT) together with the research from Adya and Kaiser's (2005) structural factors highlight the importance of providing students with the IT careers knowledge to help them make well-grounded future subject selection and careers. The findings of this study have confirmed these career development theories and demonstrated that student perceptions can be influenced by providing students with the right IT careers knowledge through a tech-savvy curriculum.

This chapter concludes the dissertation by summarizing the key findings, addressing the research contributions, making some recommendations, directing research limitations, and highlighting areas for future research..

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Appendixes

Appendix 2.1: Impacting IT Enrolments: What Factors Most Influence Student Career Decisions

(25th Australasian Conference on Information Systems)

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Abstract

This paper reports preliminary data on factors influencing student perceptions affecting their decision to study information technology in later years of high school and at university. Factors from the literature mainly align as social or structural. This research has found that structural factors (curriculum and teachers) have the most influence on student decision making about course selection related to IT subjects. Subsequent research will experimentally examine curriculum changes and teacher preparation for improvements of student perception about IT subject selection and IT careers.

Keywords

IS Curriculum, Educators, IS Careers, Student Perceptions, Circumscription.

Appendix 2.2: Australian Curriculum, Assessment and Reporting Authority - Digital Technologies Sequence of content F-10

acara AUSTRALIAN CURRICULUM, ASSESSMENT AND REPORTING AUTHORITY

Australian CURRICULUM

Digital Technologies: Sequence of content F-10 *Strand: Knowledge and understanding*

	F-2	3-4	5-6	7-8	9-10 (Elective subject)
Digital systems	Recognise and explore digital systems (hardware and software components) for a purpose (ACTDIK001)	Identify and explore a range of digital systems with peripheral devices for different purposes, and transmit different types of data (ACTDIK007)	Examine the main components of common digital systems and how they may connect together to form networks to transmit data (ACTDIK014)	Investigate how data is transmitted and secured in wired, wireless and mobile networks, and how the specifications affect performance (ACTDIK023)	Investigate the role of hardware and software in managing, controlling and securing the movement of and access to data in networked digital systems (ACTDIK034)
Representation of data	Recognise and explore patterns in data and represent data as pictures, symbols and diagrams (ACTDIK002)	Recognise different types of data and explore how the same data can be represented in different ways (ACTDIK008)	Examine how whole numbers are used to represent all data in digital systems (ACTDIK015)	Investigate how digital systems represent text, image and audio data in binary (ACTDIK024)	Analyse simple compression of data and how content data are separated from presentation (ACTDIK035)

Digital Technologies: Sequence of content F-10 *Strand: Processes and production skills*

	F-2	3-4	5-6	7-8	9-10 (Elective subject)
Collecting, managing and analysing data	Collect, explore and sort data, and use digital systems to present the data creatively (ACTDIP003)	Collect, access and present different types of data using simple software to create information and solve problems (ACTDIP009)	Acquire, store and validate different types of data, and use a range of software to interpret and visualise data to create information (ACTDIP016)	Acquire data from a range of sources and evaluate authenticity, accuracy and timeliness (ACTDIP025) Analyse and visualise data using a range of software to create information, and use structured data to model objects or events (ACTDIP026)	Develop techniques for acquiring, storing and validating quantitative and qualitative data from a range of sources, considering privacy and security requirements (ACTDIP036) Analyse and visualise data to create information and address complex problems, and model processes, entities and their relationships using structured data (ACTDIP037)
Creating digital solutions by:					
Investigating and defining	Follow, describe and represent a sequence of steps and decisions (algorithms) needed to solve simple problems (ACTDIP004)	Define simple problems, and describe and follow a sequence of steps and decisions (algorithms) needed to solve them (ACTDIP010)	Define problems in terms of data and functional requirements drawing on previously solved problems (ACTDIP017)	Define and decompose real-world problems taking into account functional requirements and economic, environmental, social, technical and usability constraints (ACTDIP027)	Define and decompose real-world problems precisely, taking into account functional and non-functional requirements and including interviewing stakeholders to identify needs (ACTDIP038)

ACARA AUSTRALIAN CURRICULUM, ASSESSMENT AND REPORTING AUTHORITY

Australian CURRICULUM

Digital Technologies: Sequence of content F-10 *Strand: Processes and production skills*

	F-2	3-4	5-6	7-8	9-10 (Elective subject)
Generating and designing			Design a user interface for a digital system (ACTDIP018) Design, modify and follow simple algorithms involving sequences of steps, branching, and iteration (repetition) (ACTDIP019)	Design the user experience of a digital system, generating, evaluating and communicating alternative designs (ACTDIP028) Design algorithms represented diagrammatically and in English, and trace algorithms to predict output for a given input and to identify errors (ACTDIP029)	Design the user experience of a digital system by evaluating alternative designs against criteria including functionality, accessibility, usability, and aesthetics (ACTDIP039) Design algorithms represented diagrammatically and in structured English and validate algorithms and programs through tracing and test cases (ACTDIP040)
Producing and implementing		Implement simple digital solutions as visual programs with algorithms involving branching (decisions) and user input (ACTDIP011)	Implement digital solutions as simple visual programs involving branching, iteration (repetition), and user input (ACTDIP020)	Implement and modify programs with user interfaces involving branching, iteration and functions in a general-purpose programming language (ACTDIP030)	Implement modular programs, applying selected algorithms and data structures including using an object-oriented programming language (ACTDIP041)
Evaluating	Explore how people safely use common information systems to meet information, communication and recreation needs (ACTDIP005)	Explain how student solutions and existing information systems meet common personal, school or community needs (ACTDIP012)	Explain how student solutions and existing information systems are sustainable and meet current and future local community needs (ACTDIP021)	Evaluate how student solutions and existing information systems meet needs, are innovative, and take account of future risks and sustainability (ACTDIP031)	Evaluate critically how student solutions and existing information systems and policies, take account of future risks and sustainability and provide opportunities for innovation and enterprise (ACTDIP042)
Collaborating and managing	Create and organise ideas and information using information systems independently and with others, and share these with known people in safe online environments (ACTDIP006)	Plan, create and communicate ideas and information independently and with others, applying agreed ethical and social protocols (ACTDIP013)	Plan, create and communicate ideas and information, including collaboratively online, applying agreed ethical, social and technical protocols (ACTDIP022)	Plan and manage projects that create and communicate ideas and information collaboratively online, taking safety and social contexts into account (ACTDIP032)	Create interactive solutions for sharing ideas and information online, taking into account safety, social contexts and legal responsibilities (ACTDIP043) Plan and manage projects using an iterative and collaborative approach, identifying risks and considering safety and sustainability (ACTDIP044)

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Appendix 3.1: Human Ethics Approval

OFFICE OF RESEARCH
Human Research Ethics Committee
PHONE +61 7 4631 2690| FAX +61 7 4631 5555
EMAIL human.ethics@usq.edu.au

UNIVERSITY OF SOUTHERN QUEENSLAND

24 October 2017

Mr Rohan Genrich

Dear Rohan

The USQ Human Research Ethics Committee has recently reviewed your responses to the conditions placed upon the ethical approval for the project outlined below. Your proposal is now deemed to meet the requirements of the *National Statement on Ethical Conduct in Human Research (2007)* and full ethical approval has been granted.

Approval No.	H17REA187
Project Title	Action research into changing student perceptions of the information technology discipline and careers in junior secondary education students through the use of tech savvy curriculum unit with career focused content
Approval date	24 October 2017
Expiry date	24 October 2020
HREC Decision	**Approved**

The standard conditions of this approval are:
(a) Conduct the project strictly in accordance with the proposal submitted and granted ethics approval, including any amendments made to the proposal required by the HREC
(b) Advise (email: human.ethics@usq.edu.au) immediately of any complaints or other issues in relation to the project which may warrant review of the ethical approval of the project
(c) Make submission for approval of amendments to the approved project before implementing such changes
(d) Provide a 'progress report' for every year of approval
(e) Provide a 'final report' when the project is complete
(f) Advise in writing if the project has been discontinued, using a 'final report'

For (c) to (f) forms are available on the USQ ethics website:
http://www.usq.edu.au/research/support-development/research-services/research-integrity-ethics/human/forms

Yours sincerely,

Dr Mark Emmerson
Ethics Officer

Appendix 3.2: Application for conducting research in Department of Education and Training

Department of Education and Training

Application for conducting research in Queensland

*All mandatory fields are identified with an *.*

Please read the Terms and Conditions of Approval to Conduct Research and Research Guidelines before beginning the application process.

The term 'researcher' is used to describe persons seeking to undertake research within Department of Education and Training (DET) sites, including research involving departmental personnel, data and/or records. In the case of team research a representative who is actively engaged in the research and readily contactable should be the research applicant. This may not be the most senior person on the research team.

The Research Services unit of the Department of Education and Training is collecting the personal information set out in this research application form in accordance with the Information Privacy Act 2009 (QLD) in order to assess your application to conduct research within a school or other Departmental site. The information will only be accessed by authorised officers of the Department of Education and Training. Some of this information may be given to other areas of the Department of Education and Training and other government agencies for the purpose of confirming and reviewing the information you have set out in this form.

- ☒ I have read and will comply with the Terms and Conditions of Approval to Conduct Research *
- ☒ I have read and will comply with the Research Guidelines *
- ☒ I have read and understand the Privacy Statement *

For any questions regarding the Research Application please contact:
Email: Research.Stratpol@dete.qld.gov.au

Section 1 Applicant information — Help #1

Researcher		**Supervisor** (Help #2)	
First Name:*	Rohan	First Name:*	Mark
Surname:*	Genrich	Surname:*	Toleman
Title:*	Mr	Title:*	Professor
Position:*	Lecturer	Position:*	Professor

Organisation:*	University of Southern Queensland	Organisation:*	University of Southern Queensland
Researcher's Street/PO Box:*	PO Box 566	Street / PO Box:*	West Street
Suburb:*	Darling Heights	Suburb:*	Darling Heights
Postcode:*	4350	Postcode:*	4350
State:*	QLD	State:*	QLD
Telephone / Day:*	0746311258	Telephone / Day:*	0746315593
Telephone / Other:	0746356824	Telephone / Other:	
Mobile:	0402233637	Mobile:	0422772069
Fax:		Fax:	
Email 1:*	genrichr@usq.edu.au	Email 1:*	Mark.Toleman@usq.edu.au
Email 2:		Email 2:	

Previous research

Have you previously received approval to conduct research in Queensland state schools or other departmental sites?*

- ◯ Yes
- ◉ No

Section 2 Proposed research study

Title of research study (max 25 words)*

Investigating student perceptions of the IT careers in Junior Secondary Education through the use of Tech Savvy Curriculum with Career Focused content.

Identify the research problem (max 125 words)*

What is the research problem the study is addressing?

The number of students enrolling in Information Technology courses in senior secondary schooling in years 11 and 12, TAFE and Universities has shown significant decline over the last ten years, with only a marginal increase in the last few years in the University sector partly due to initiatives such as local University interaction with schools in their regional catchments. The aim of this research is to propose methods to increase the size of the future cohort of students taking senior Information Technology courses, and Tertiary Information Technology degrees (TAFE and University) by improving student perceptions.

Key to increasing the enrollments in IT is the role that student perceptions plays in students' subject selection, and the experiences of junior secondary IT subjects. The challenge that this places on IT education and the IT industry is that students' perceptions of IT is that it is seen as mundane and repetitive, and many are eliminating it from consideration as a career during these junior secondary years through circumscription and once this occurs it is very challenging to reverse. This research will investigate more appropriate tech savvy curriculum for Information Technology for students and teaching methods that have the highest potential to positively impact the perceptions of the IT discipline and IT careers in secondary education students.

This research advances the understanding within the Information Technology discipline into the poor perceptions that junior secondary education students (years 7 to 9) have of the Information Technology discipline and careers. It investigates what type of Information Technology content is being taught in junior secondary, the teaching methods being employed to deliver this content, and the impact that this content and delivery has on the perceptions that junior secondary students have of the Information Technology discipline and careers.

Description of proposed study (max 200 words)*
Aim/purpose and brief explanation of proposed study - do not describe the detailed methodology here as it will be addressed later in the application

This research will investigate the use of technology savvy curriculum for Information Technology for students and teaching methods that have the highest potential to positively impact the perceptions of the IT discipline and IT careers in secondary education students. This curriculum will be trialled in a number of Queensland junior secondary classes, where student's perceptions will be tested to ascertain the impact such a curriculum has on their interest in IT careers.

For this research the term Tech Savvy is used to refer to the technology focus that will be given to the curriculum intervention in the Action Research. It will involve the teaching about the different types of Information Technology Careers through the use of Elevator Speeches (short 2 minute presentations); Wikis where each student will contribute to and edit other's posts (in a private closed Wiki environment); Audio Recorded Podcasts (developed but not released on the Internet); and YouTube video (developed but not released on the Internet).

Why is it necessary for this research to occur in state schools or Departmental site? (max 200 words)*
For example, expected benefits to participants, DET, schools, community, etc

This research advances the understanding within the Information Technology discipline into the poor perceptions that junior secondary education students (years 7 to 9) have of the Information Technology discipline and careers. It investigates what type of Information Technology content is being taught in junior secondary, the teaching methods being employed to deliver this content, and the impact that this content and delivery has on the perceptions that junior secondary students have of the Information Technology discipline and careers.

The outcomes of this research will be a technological savvy careers focused curriculum unit that can be integrated into junior secondary Information Technology classes, providing students with a better understanding of careers in the IT discipline. Through this intervention, students will gain better understanding of IT careers and this will result in more students opting to consider further studies in the IT discipline and future careers.

What sites will be approached for the research study?* **Help #3**

- (●) Schools
- ( ) Education Centres / Other Centres / Organisational Units
- ( ) Schools AND Education Centres / Other Centres / Organisational Units

Please list all the Queensland schools to be approached and indicate whether they are state or non-state.*

School Name*	**School Type***	
Harristown State High School	state (government)	x
Centenary Heights State High School	state (government)	x
St. Joseph's College Toowoomba	non-state (private)	x
Downlands College Toowoomba	non-state (private)	x
Add School		

See the Schools Directory for a comprehensive list of Queensland state schools. Refer to the Regional Office Contact Page for the regional offices.

Has this research received any significant (more than $1,000) funding support?*

- ( ) Yes
- (●) No

Has this research been funded or partially funded by DET?*

- ◯ Yes
- ◉ No

Estimated start date:*	22 January 2018	Please note: applicants must allow at least eight weeks for the approvals process
Estimated finish date:*	29 March 2018	Please note: the department will expect to receive a summary of findings after this date

Please note: All applications regardless of anticipated timelines will expire after three years from the approval date and a new application will need to be submitted.

Section 3 Research method

Research design: data collection, analysis and reporting:*

How will the research be conducted? How will the participants be recruited? How will the data be collected, by whom and when? How will the data be analysed? How will the study findings be reported and disseminated?

This research will use a two phase Action Research methodology to implement and test a tech-savvy careers focused curriculum into the junior secondary school curriculum of a sample number of schools. Each phase of the Action Research cycle includes an experiment designed as a 2x2 factorial design. The factors are School type (Public, Private) and Curriculum type (Existing – control, new). The effect of the curriculum will be assessed using the participants' responses with an instrument which will answer the proposed hypothesis. Once approval has been given, the teachers involved from the trial schools will be provided with training and resources for them to be able to dynamically teach the new curriculum unit.

The test instrument is called the Information Technology Career Interest Instrument (ITCI), it will be used for pre- and post- testing conducted as a self-administered online survey by the participants throughout term 1 2018. It investigates what type of Information Technology content is being taught in junior secondary, the teaching methods being employed to deliver this content, and the impact that this content and delivery has on the perceptions that junior secondary students have of the Information Technology discipline and careers.

Only year 9 students are being recruited as this has been identified in the literature as the key year group where students rule out many career paths based on Gottfredson's (1981) Circumscription and Compromise Theory.

The Information Technology Career Interest Instrument (ITCI) has been derived from three existing STEM Career Interest Instruments. including Social Cognitive Career Theory Instruments (SCCT) and Science, Technology, Engineering and Mathematics Instruments (STEM). Instruments currently under investigation all have high reliability (Cronbach's Alpha > 0.8) and are grounded in SCCT.

After the post test of the Information Technology Career Interest Instrument (ITCI) has been completed, a randomly selected focus group of 7 to 10 students will be undertaken for approximately 30 minutes by the lead investigator at each school. No debriefing process will be undertaken.

The participants will be recruited from the Term 1 2018 year 9 IT curriculum classes with parental consent, from the schools listed above (the aim being for 2 State and 2 non-State schools).

The Pre- and Post- testing for each student of the ITCI Instrument will be paired for each phase of the Action Research, each ITCI will contain a coded unique identifier. Multivariate Analysis of Variance (MANOVA) will be performed with SPSS to determine whether any difference within and between the groups' scores on the ITCI are significant. After the surveys have been analyzed, interviews and/or focus groups will also be conducted with students from the sample, to investigate key findings from the survey in more depth.

This final stage will involve the final review of the curriculum unit, including all teaching materials and lesson plans, based on the findings from the study and the release of the curriculum V2.1 to the schools in the region.

The findings of the study will be included within my Doctoral Thesis, within a published educational journal, and will be disseminated to each school in the study.

Participants and sample sizes:*

Please list all categories of participants and anticipated numbers within each category (e.g. principals x 3, teachers x 6, parents/ caregivers x 60, students x 60 and curriculum branch staff x 5) and the time and task commitments sought from each category of participant.

The participants will be drawn from four Schools (State Schools x 2; Non-State Schools x2).
Each School will involve teachers x 1, students x 25 (dependent on the size of the year 9 IT classes).

Group 1
Will be comprised of year 9 high school students studying information technology in term 1 2018 from up to 2 private and 2 state schools in the Toowoomba region - this will be the student control group. The Tasks involved with this group will be:
1. At the start of the semester, students invited through their Information Technology teachers to participate in the research.
2. Once student assent and parental permission has been received, students will be asked to participate in completing the Information Technology Career Interest Instrument (ITCI) survey (pre-test).
3. Students in this group will then undertake their normal year 9 information technology classes for a period of 4 weeks.
4. Students will then be asked to again participate in completing the Information Technology Career Interest Instrument (ITCI) survey (post-test).
5. A random selection of 7 to 10 students from the class will be invited to participate in a 30 minute focus group - the questions of which will be open ended, based on the findings from the Multivariate Analysis of Variance (MANOVA) conducted on and between the pre- and post- tests.
Total Time per participant: 30 minutes to 1 hour
1a. Non-focus group participants will undertake up to 30 minutes (15 minutes pre-test and 15 minutes post-test) in class.
1b. Focus group participants will undertake a further 30 minutes (60 minutes in total) in class.

Group 2
Will be comprised of year 9 high school teachers teaching information technology in term 1 2018 from up to 2 private and 2 state schools in the Toowoomba region - this will be the teacher control group. The Tasks involved with this group will be:
1. Teachers in this group will administer the pre-test and post-test Information Technology Career Interest Instrument (ITCI) via an online Survey tool.
2. After the post test of the Information Technology Career Interest Instrument (ITCI) has been completed by the teacher's class after 4 weeks, a one -on-one interview will be undertaken for approximately 30 minutes by the lead investigator with teach school's year 9 Information Technology teacher.

Teachers will be given training via ZOOM session on the implementation of the survey instrument. The researcher will endeavour to provide the teachers with a good working knowledge of the 13 likert scale questions and will be available via phone to assist.

Total Time per participant: 1.5 hours
1. 30 minutes for pre-test Information Technology Career Interest Instrument (ITCI) via an online Survey tool.
2. 30 minutes for post-test Information Technology Career Interest Instrument (ITCI) via an online Survey tool.
3. 30 minutes after class for Focus Group

Group 3
Will be comprised of year 9 high school students studying information technology in term 1 2018 from up to 2 private and 2 state schools in the Toowoomba region - this will be the student curriculum group. The Tasks involved with this group will be:
1. At the start of the semester, students invited through their Information Technology teachers to participate in the research.
2. Once student assent and parental permission has been received, students will be asked to participate in completing the Information Technology Career Interest Instrument (ITCI) survey (pre-test).
3. Students in this group will then undertake the Tech-savvy Careers Curriculum within their year 9 information technology classes for a period of 4 weeks.
4. Students will then be asked to again participate in completing the Information Technology Career Interest Instrument (ITCI) survey (post-test).
5. A random selection of 7 to 10 students from the class will be invited to participate in a 30 minute focus group - the questions of which will be open ended, based on the findings from the Multivariate Analysis of Variance (MANOVA) conducted on and between the pre- and post- tests.

Total Time per participant: 9 to 9.5 hours
1. All participants in this group will undertake twelve (12) forty minute Tech-savvy Careers Curriculum lessons within their normal year 9 Information Technology classes (8 hours in total) PLUS
2a. Non-focus group participants will undertake up to 30 minutes (15 minutes pre-test and 15 minutes post-test) in class.
2b. Focus group participants will undertake a further 30 minutes (60 minutes in total) in class.

Group 4
Will be comprised of year 9 high school teachers teaching information technology in term 1 2018 from up to 2 private and 2 state schools in the Toowoomba region - this will be the teacher curriculum group. The Tasks involved with this group will be:
1. Teachers in this group will administer the pre-test and post-test Information Technology Career Interest Instrument (ITCI) via an online Survey tool.
2. After the post test of the Information Technology Career Interest Instrument (ITCI) has been completed by the teacher's class after 4 weeks, a one -on-one interview will be undertaken for approximately 30 minutes by the lead investigator with teach school's year 9 Information Technology teacher.
Total Time per participant: 13.5 hours
The curriculum unit will be used in place of the existing curriculum, therefore the teachers non-teaching commitment will be 5 1/2 hours over 4 to 5 weeks.

Materials and instruments:*
Please describe the type of measurement instruments to be used (e.g. 25 item questionnaire, interviews with open ended questions, focus group discussion) and identify steps taken to ensure their reliability and validity.

The ITCI Instrument will be a 13 item Questionnaire.
The follow-up Student and Teacher interviews will be through open ended questions which will be determined based on the findings of the Questionnaire.

Attach a copy of all data collection instruments*
(include all instruments and/or proposed questions/themes)
Where possible please keep file sizes to a minimum

Attach an instrument   File attached: **SurveyMonkey_119760750.pdf**   x

Add attachment

Does your research require participants access an online survey or internet site?* Help #4

(•) Yes
( ) No

Please list the URL address for this site*

https://www.surveymonkey.com/r/F7YY2VM

Is the research study to be conducted in more than one stage?*

( ) Yes
(•) No

Section 4 Research of a sensitive nature and risk management

Help #5

Does the proposed research cover the following in any way?*

Y	N	
( )	(•)	Criminal or anti-social behaviour?
( )	(•)	Depression and/or anxiety?
( )	(•)	Bullying?
( )	(•)	Grief, trauma and/or death?
( )	(•)	Sexuality?
( )	(•)	Drug or alcohol usage?
( )	(•)	Eating disorders and/or body image material?
( )	(•)	Race or ethnic relations?

Does the proposed research include any of the following methods?*

Y	N	
( )	(•)	Psychological testing, assessment or intervention?

(●) Y	( ) N	Reporting of comparative data which compares individuals, state vs non-state systems or jurisdictions?
( ) Y	(●) N	Possible identification of participants, classes or schools in reports?
( ) Y	(●) N	Deception?
( ) Y	(●) N	Use of procedures, activities or equipment, other than those in everyday use, which may involve physical risk or emotional distress?
( ) Y	(●) N	Passive rather than active consent?
( ) Y	(●) N	Visual recording (photographs and video recording)?
( ) Y	(●) N	Interaction with children individually or outside the classroom environment?

Are any of the following groups the focus or used as an analytical category in the research?*

( ) Y	(●) N	People of Aboriginal or Torres Strait Islander origin?
( ) Y	(●) N	People with social, emotional or physical difficulties?
( ) Y	(●) N	People with other difficulties (e.g. visual, hearing, intellectual or multiple disabilities)?
( ) Y	(●) N	Minority cultural or ethnic groups?
( ) Y	(●) N	Children whose parents/caregivers are unable to give informed consent because of language or other difficulties in understanding information?

Describe the specific risk mitigation strategies which will be employed to address each of the risks you have identified in Section 4:*

The participants will be drawn from four (4) Schools (State Schools x 2; Non-State Schools x 2).
Each School will involve teachers x 1, students x 20 (dependent on the size of the year 9 IT classes) and there will be a short term time inconvenience for the participants during the research.

- For the two control groups schools, the time commitment will be the time seek parental permission and run the pre- / post- online survey.
- For the two curriculum trial schools, the time commitment will be 4 weeks of the teaching in year 9 IT classes for Term 1 2018 (to replace the curriculum that would normally be covered during this time).

Risk to the Student in the Control group will in time as per above
Risk to the Studnet in the Curriculum group will be in time and their curriculum being different from the other classes undertaking year 9 IT.

Risk to the Teacher in the Control group will be in time as per above.
Risk to the Teacher in the Curriculum group will be in time and their need to learn new technical education tools.

Risk of coercion will be managed - The information letters and parental consent forms will clearly outline that participation is optional in the pre- / post- test survey and the student focus groups. This information will also outline that students can chose to withdraw any time during the study. Teachers involved in the study will be actively counseled that this is optional for the students, and that only those students who have received parental consent will be involved. Involving the parents will mitigate any teacher coercion.

Justification of teacher time - outlined in detail for Group 2 and 4, dependent on level of involvement for each group.
The control groups will be asked to conduct the pre- / post- surveys via web-based data collection to minimise the time outlay.

The curriculum groups will run for four weeks, including data collection, this will be arranged to run at the start of semester 1, 2018 to minimise time impact on these year 9 students.

The year 9 IT teachers will be involved in teaching the curriculum and conducting the pre- / post- surveys. Their experience will be utilised to mitigate any adverse events during the running of the research.

Teachers will be given mobile phone access to the leader researchers to call in the event of any unexpected events.

The principle researcher is a qualified teacher, with membership of the Queensland College of Teachers and holds a Blue Card.

Do you anticipate any media interest in the proposed research study?*

- ○ Yes
- ◉ No

Section 5 Information statement and informed consent forms

All applications seeking approval to conduct research in state schools or DET sites must include an information statement and informed consent form for principals or managers regardless of participant category.

Please refer to the Terms and Conditions to ensure that all essential information is provided in information statements and consent forms. Please consider the literacy levels of your target participants and tailor statements and forms accordingly.

View examples of information statements and consent forms for each participant category.

Please indicate each category of participant you intend to include in your research and attach an information statement and consent form appropriate to each participant category.*

Participant Category	Informed Consent Form	Information Statement
☒ Principal	Add Attachment File attached: **Consent Form (All Groups**	Add Attachment File attached: **Participant Information S**
☒ Teacher	Add Attachment File attached: **Consent Form (All Groups**	Add Attachment File attached: **Participant Information S**
☒ Parent/Caregiver	Add Attachment File attached: **Consent Form (All Groups**	Add Attachment File attached: **Participant Information S**
☐ Student		
☐ Director/Manager		
☐ Departmental staff excluding school-based staff		
☐ Other		

Section 6 Key attachments

Blue Card (for all researchers involved in data collection)

The *Working with Children (Risk Management and Screening) Act 2000 (Qld)* requires all persons working with children to undergo the Working with Children Check. All researchers wishing to work with children and young people (aged less than 18 years of age) at DET sites will more than likely be required to hold a Blue Card. Although some specific exemptions do apply, DET regulations require that all persons working with children seek guidance and/or verification from Blue Card Services regarding a Working with Children Check (Blue Card).

Will your research activities involve contact with children in order to undertake your research as proposed?*

- (●) Yes - you must supply evidence of either having a Blue Card, an Exemption Card or that you are in the process of obtaining an appropriate card. If you believe you are exempt from requiring a Blue Card then you must apply for an Exemption Card or provide DET with written verification from the Commission that you do not require a Blue Card or an Exemption Card.
- ( ) No - this indicates that you will not be undertaking research that involves children, for example there are no children participating and the research will not be conducted on school sites.

I have a Blue Card (attach a copy of the Card)

Attach a copy of the Blue Card — File attached: **eCertificate of Queensland Teacher Registration.pd**

OR

I have an Exemption Card (attach a copy of the Card)

Attach a copy of the Exemption Card — File attached: **None.**

OR

I am seeking a Blue Card (please attach evidence)

Attach evidence — File attached: **None.**

OR

I am seeking an Exemption Card (please attach evidence)

Attach evidence — File attached: **None.**

OR

I have written verification from Blue Card Services that neither a Blue Card nor an Exemption Card is required for this research. *(If you believe your research activities do not require a Blue Card, please email Blue Card Services with a small summary of your research project focusing on the proposed interaction with children to allow Blue Card Servcies to ascertain whether or not you require a Blue Card. The written response from Blue Card Services can be attached below. Blue Card Servcies can be emailed at* **enquiries@bluecard.qld.gov.au***)*

Attach evidence — File attached: **None.**

Ethics Clearance Help #6

Research conducted on Department sites must comply with the National Health and Medical Research Council: National Statement on Ethical Conduct in Research Involving Humans. Research involving Indigenous participants will need to comply with the Guidelines for Ethical Conduct in Aboriginal and Torres Strait Islander Health Research.

We expect that your university/organisation requires you to obtain clearance for the research from a Human Research Ethics Committee. You may submit your research application to DET while still awaiting that ethical clearance.

Please attach evidence of either having obtained or to be seeking this ethical clearance*

Attach evidence File attached: **1. USQ HREC 17REA187 - Approval Letter.pdf**

If you are not required to obtain clearance for the research from a Human Research Ethics Committee please attach a statement outlining your ethical approach to your research study: (max 500 words)*

How will you address the issues of informed and voluntary consent; confidentiality and privacy; management, storage and disposal of data; risks and benefits of the research; publication, reports and/or dissemination of results?

Attach evidence File attached: **None.**

The Research Services unit of the Department of Education and Training is collecting the personal information set out in this research application form in accordance with the Information Privacy Act 2009 (QLD) in order to assess your application to conduct research within a school or other Departmental site. The information will only be accessed by authorised officers of the Department of Education and Training. Some of this information may be given to other areas of the Department of Education and Training and other government agencies for the purpose of confirming and reviewing the information you have set out in this form.

Section 7 Researcher's declaration

Departmental approval to approach school principals or managers to invite their students' and/or staff's participation in research is granted conditionally upon the Department's terms and conditions being met. By signing and submitting your research application, you agree to abide by these terms and conditions.

If at any time these conditions are contravened the researcher may, in the first instance, receive a warning from the Department. If such behaviour continues the Department will immediately withdraw approval for the research project and all research activity will cease pending an investigation of the contravention. Legal action may be taken in line with the relevant acts and policies.

☒ * I, Rohan Genrich accept the terms and conditions for conducting research on Department of Education and Training sites.

11/12/2019

Signature of Researcher: ____________________________
(for hard-copy submission)

Signature of Supervisor/Colleague: ____________________________
(please see Help #2 to determine which is required)

Section 8 Submission Help #7

Both an electronic copy of your application and a scanned copy of the signature page is required by the relevant approval authority (see Research Guidelines).

If the proposed research is of a **sensitive nature** (i.e. one or more risks identified in Section 4 'Research of a sensitive nature and risk management'), the application will need to be processed by central office.

Submit by Email Print Form

Section	Help

HELP 1
Regarding the privacy of applicants the Department adheres to Right to Information Act , the Information Privacy Act and the Queensland Public Sector Intellectual Property Guidelines. Applications may be circulated within the Department for appraisal and confidentiality cannot be guaranteed.

Jump back to Section 1

HELP 2
It is mandatory for all applicants to provide details of a supervisor or colleague, who is a senior research associate with knowledge of the research and who can act as a referee for the research applicant. In the case of student researchers or research assistants, supervisors are required to authorise the submission of an application to conduct research at Section 7: Researcher's declaration of the application form. Applications will not be processed without the verification of a supervisor (for students or research assistants) or a colleague (for senior academics).

Jump back to Section 1: Supervisor

HELP 3
List the schools or other sites you would like to include in your research study. The researcher must notify the Department in writing if there is any change to the schools or other sites to be subject to the research. If unsure of the schools to be included, type "TBC".

Jump back to Section 2: Research sites

HELP 4
If using an overseas-based web survey tool (e.g. Survey Monkey), please see the web survey tools and information privacy information sheet for a statement to comply with Section 33 of the IP Act.

If your research requires participants to access an internet site from school or departmental computers (for example to complete a web-based survey), then the URL for the website must be provided so that it can be checked for compatibility with the Department's allowed internet sites and policy of usage.

Jump back to Section 3: Access to an internet site

HELP 5
This section seeks information on whether the proposed research is of a sensitive or controversial nature, and how you plan to manage risks associated with the research. If your research includes any of the listed topics, methods or analytic categories your application must be submitted to central office.

Please assess the potential risks of your research, including consideration of the implications for students and departmental personnel who participate in the research project. Please provide a comprehensive description of the risk mitigation strategies that will be employed for each of the risks you have identified in order to minimise and manage the potential risks of your research.

Jump back to Section 4

HELP 6
The Department does not have an Ethics Committee and will not provide ethics clearance for research.

Jump back to Section 6: Ethics Clearance

HELP 7
To ensure the application is processed in a timely manner, applicants must ensure that:

- sufficient information is provided for the Department to process the application.
- supplementary information and documentation is provided with the application.
- you and your research supervisor have read and understood the Terms and Conditions of Approval to Conduct Research in Departmental Sites, the Research Guidelines and the Researcher's declaration (Section 7 of this form) prior to submitting your application.

Jump back to Section 8

Appendix 3.3: School Principal Content Form

Consent Form

[School Name] (Principal)

Project Title: Action Research into changing student perceptions of the Information Technology discipline and careers in Junior Secondary Education Students through the use of a Tech-savvy Curriculum Unit with Career Focused content.

Research Organisation: University of Southern Queensland

Contact Details: Mr Rohan Genrich | University of Southern Queensland

P: 07 4631 1258 | E: rohan.genrich@usq.edu.au

- I have read the Information Statement and understand the aims, procedures, and risks of this project, as described to me in the information statement.
- I have had the opportunity to ask questions about the study, and I am satisfied with the answers I received.
- I am willing for this my school to be involved in the research project, as described.
- I understand that participation in the project is entirely voluntarily.
- I understand that I am free to withdraw participation at any time, without affecting the relationship with the research team/organisation.
- I understand that the results of this research may be presented in a Doctoral Dissertation as part of PhD research and that the participants and the school will not be identified in publications resulting from the study.
- I understand that the school will be provided with a copy of the findings from this research upon its completion.

For Principal, **Name of School:**	**[School Name]**	
Principal's Name:	**[Principal's Name]**	
Signature		**Date**

Please return this form to the Research Mr Rohan Genrich.

Appendix 3.4: School Teacher Consent Form

Consent Form

[School Name] (Class Teacher/s)

Project Title: Action Research into changing student perceptions of the Information Technology discipline and careers in Junior Secondary Education Students through the use of a Tech-savvy Curriculum Unit with Career Focused content.

Research Organisation: University of Southern Queensland

Contact Details: Mr Rohan Genrich | University of Southern Queensland

P: 07 4631 1258 | E: rohan.genrich@usq.edu.au

- I have read the Information Statement and understand the aims, procedures, and risks of this project, as described to me in the information statement.
- I have had the opportunity to ask questions about the study, and I am satisfied with the answers I received.
- I am willing for this my school to be involved in the research project, as described.
- I understand that participation in the project is entirely voluntarily.
- I understand that I am free to withdraw participation at any time, without affecting the relationship with the research team/organisation.
- I understand that the results of this research may be presented in a Doctoral Dissertation as part of PhD research and that the participants and the school will not be identified in publications resulting from the study.
- I understand that the school will be provided with a copy of the findings from this research upon its completion.

For Principal, Name of School:	**[School Name]**	
Year nine IT Class Teacher's Name:		
Signature		**Date**

Please return this form to the Research Mr Rohan Genrich.

Appendix 3.5: Parent / Caregiver Consent Form

Consent Form

[School Name] (Parent / Caregiver/s)

Project Title: *Action Research into changing student perceptions of the Information Technology discipline and careers in Junior Secondary Education Students through the use of a Tech-savvy Curriculum Unit with Career Focused content.*

Research Organisation: *University of Southern Queensland*

Contact Details: *Mr Rohan Genrich | University of Southern Queensland*

P: 07 4631 1258 | E: rohan.genrich@usq.edu.au

- I have read the Information Statement and understand the aims, procedures, and risks of this project, as described to me in the information statement.
- I have had the opportunity to ask questions about the study, and I am satisfied with the answers I received.
- I am willing for this my child to be involved in the research project, as described.
- I understand that participation in the project is entirely voluntarily.
- I understand that my child is free to withdraw participation at any time, without affecting the relationship with the research team/organisation.
- I understand that the results of this research may be presented in a Doctoral Dissertation as part of PhD research and that the participants and the school will not be identified in publications resulting from the study.
- I understand that the school will be provided with a copy of the findings from this research upon its completion.

For Principal, **Name of School:**	**[School Name]**	
Name: **Parent/caregiver**		
Signature		**Date**

I have discussed the study with my child, they understand the research, and consent to participate.

Name of child:	
Signature:	

Please return this form to the School's Year nine Information Technology Teacher.

Appendix 3.6: Parents / Guardians Information Letter

INFORMATION LETTER

TITLE OF PROJECT: Action Research into changing student perceptions of the Information Technology discipline and careers in Junior Secondary Education Students through the use of Tech-savvy Curriculum Unit with Career Focused content.

PRINCIPAL SUPERVISOR: Professor Mark Toleman | University of Southern Queensland
P: 07 4631 5593 | E: mark.toleman@usq.edu.au

STUDENT RESEARCHER: Mr Rohan Genrich | University of Southern Queensland
P: 07 4631 1258 | E: rohan.genrich@usq.edu.au

Dear Nicola O'Neil,

We are inviting your school to participate in a research project that will look at enriching the teaching about the different types of Information Technology Careers. As a control group, your school's commitment to the project would involve your Year nine IT students being asked to participate in two 10 minute online surveys (a pre- and post- survey) two week apart. The data collected would form part of our control group data to compare against the data collected from the schools involved in teaching a IT Careers Curriculum that we have developed. Upon completion of the 2nd survey, your school will also be given a copy of the year nine IT Careers Curriculum should you wish to use it.

Why is this research being done?

The number of students enrolling in Information Technology courses in senior secondary schooling in years 11 and 12, TAFE and Universities has shown significant decline over the last ten years, with only a marginal increase in the last few years in the University sector partly due to initiatives such as local University interaction with schools in their regional catchments. The aim of this research is to propose methods to increase the size of the future cohort of students taking senior Information Technology courses, and Tertiary Information Technology degrees (TAFE and University) by improving student perceptions.

Currently Australia is facing a significant shortage of IT skilled professionals, with 12,000 plus jobs currently being listed on online employment sites such as SEEK.COM and only about 4,000 students currently undertaking IT studies within TAFE and universities across Australia.

This research aims to better understand the poor perceptions that junior secondary education students (years 7 to 9) have of the Information Technology discipline and careers. It investigates what type of Information Technology content is being taught in junior secondary, the teaching methods being employed to deliver this content, and the impact that this content and delivery has on the perceptions that junior secondary students have of the Information Technology discipline and careers.

Are there any benefits/ risks involved in this research?

This research will provide a technological savvy careers focused curriculum unit integrated into the year nine junior secondary Information Technology classes, providing students with a better understanding of careers in the IT discipline. Through this curriculum unit, the students will gain better understanding of IT careers and allow them to be better informed when considering further studies in the IT discipline and future careers.

There will be two groups of schools involved in the project drawn from both State and Private Schools in the Darling Downs region:

- Schools in the control group will participate in the pre- and post- survey instrument , and upon completion of the 2nd survey, be given a copy of the year nine IT Careers Curriculum to undertake at their own discretion.

- Schools in the curriculum group will complete the two week IT Careers Curriculum, as well as, participating in the pre- and post- survey instrument.

Each School will involve teachers x 1, students x 20 (dependent on the size of the year nine IT classes) and there will be a short-term time inconvenience for the participants during the research.

What will teachers be required to do?

Teachers in the control classes will undertake the following activities:

Your teacher will be asked to deliver a survey at the start of the term and again after week 2. The time commitment will be the time taken to seek students' parental permission and run the two online surveys.

Your teacher will be provided with 1 hour weekly training over two weeks on the Tech-savvy Curriculum if they choose to run it in their class after the research period to give the students the same experience as other participants in this project, this will be conducted via Video Conference.

Teachers in the classes undertaking the IT Careers Curriculum will undertake the following activities:

Your teacher will be asked to be involved in a two-week class which will focus on enriching their understanding of IT Careers. This will be conducted in the first two weeks the term in place of the normal curriculum. They will also supervise their students taking a survey at the start of the term and again after week 2. The time commitment will be 2 weeks of the teaching in year nine IT classes for Term 3 2018 and the time taken to supervise parental permission and run the two online surveys.

The IT careers classes will be run by the school's normal Information Technology teacher and all School-base risk management policies and procedures in place.

What will students be required to do?

Students in the control classes will undertake the following activities:

1. At the start of the semester, students invited through their Information Technology teachers to participate in the research.

2. Once student assent and parental permission has been received, students will be asked to participate in completing the Information Technology Career Interest Instrument (ITCI) survey (pre-test).

3. Students in this group will then undertake their normal year nine information technology classes for a period of 2 weeks.

4. Students will then be asked to again participate in completing the Information Technology Career Interest Instrument (ITCI) survey (post-test).

5. A random selection of 7 to 10 students from the class will be invited to participate in a 30 minute focus group - the questions of which will be open ended, based on the findings from the analysis conducted on and between the pre- and post- tests.

Students in the classes undertaking the IT Careers Curriculum will undertake the following activities:

1. At the start of the semester, students invited through their Information Technology teachers to participate in the research.

2. Once student assent and parental permission has been received, students will be asked to participate in completing the Information Technology Career Interest Instrument (ITCI) survey (pre-test).

3. Students in this group will then undertake the Tech-savvy Careers Curriculum within their year nine information technology classes for a period of 2 weeks (including a 1 hour a week video conference training for the teacher involved).
4. Students will then be asked to again participate in completing the Information Technology Career Interest Instrument (ITCI) survey (post-test).
5. A random selection of 7 to 10 students from the class will be invited to participate in a 30 minute focus group - the questions of which will be open ended, based on the findings from the analysis conducted on and between the pre- and post- tests.

What would you have to do?

If you wish your school to participate in this research, you will need to sign and return the Principal's consent form to the principle researcher prior to the start of the research. This will give permission for your teacher to be involved in the pre-test survey and the post-test survey, to teach the two week IT careers class in place of the normal IT curriculum, and be involved in an interview during the research.

What are the benefits of the research to you/ your school/ your child/ school community?

The outcomes of this research will be a technological savvy careers focused curriculum unit that can be integrated into junior secondary Information Technology classes, providing students with a better understanding of careers in the IT discipline. Through this curriculum, students will gain better understanding of IT careers and this will result in more students opting to consider further studies in the IT discipline and future careers.

How will your teachers and students' confidentiality be protected?

An Online Survey instrument is called the Information Technology Career Interest Instrument (ITCI), it will be used for pre- and post- testing conducted as a self-administered online survey by the participants throughout Term 3 2018. All data collected will be anonymous, no identifiable information will be collected about the students. The survey data will be kept stored on USQ storage.

A random selection of students and their classroom teachers will also be asked to participate in focus groups after the post-test survey. The lead investigator will transpose the audio transcript. No identifiable information of the focus group participants will be collected. The participants will not be involved in reviewing or editing the transcript document. The audio file and transcript will be kept stored on USQ storage.

Your consent

By signing the consent form you are indicating your willingness for your school to participate in the research project as it is explained in this letter. Participation is completely voluntary, and you are free to refuse consent altogether without having to justify that decision, or to withdraw your consent after first giving it and discontinue participation in the study at any time without giving a reason.

More questions?

Any questions regarding this project should be directed to Mr Rohan Genrich | University of Southern Queensland | P: 07 4631 1258 | E: rohan.genrich@usq.edu.au.

Ethics

This study has been approved by the Human Research Ethics Committee of the University of Southern Queensland.

Complaints about the research

If you have a complaint or concern about the conduct of this research, or if you have any query that the Investigator has not been able to satisfy, you may write to, or contact the Chair of the Human Research

Ethics Committee at: USQ Ethic Committee | University of Southern Queensland | E: ethics@usq.edu.au
.

Any complaint or concern will be treated in confidence and fully investigated.

What do you have to do?

Please read this Information Statement and be sure you understand it. If you would like to participate, please complete the attached consent form and return to the researcher. Keep the Information Statement for your records.

Thank you for considering this invitation and we look forward to hearing from you.

Signatures

Principal Researcher ______________________ Student Researcher:

Please keep this document for your records

Appendix 3.7: Education Queensland Research Approval

Queensland Government

Department of
Education and Training

5 January 2018

Mr Rohan Genrich
University of Southern Queensland
PO Box 566
Darling Heights QLD 4350

Dear Mr Genrich,

Thank you for your application seeking approval to conduct research in Queensland state schools titled *Investigating student perceptions of the IT careers in Junior Secondary Education through the use of Tech Savvy Curriculum with Career Focused content*. I wish to advise that your application to invite research participants to be involved in your study has been approved. This letter gives you approval to approach potential research participants only.

You may approach principals of the schools as described in your application and invite them to participate in your research project. In the first instance, please provide principals of these schools with the attached letter which provides important information to help inform their decision about whether they wish to participate in this study. Your approval is conditional upon provision of this letter to each of the school principals you have nominated (you may need to photocopy the attached letter to provide sufficient copies for all principals).

As detailed in the Department's research guidelines the following applies to the study:

- You need to obtain consent from the relevant principals before your research project can commence.
- Principals have the right to decline participation if they consider that the research will cause undue disruption to educational programs in their schools.
- Principals have the right to monitor any research activities conducted in their facilities and can withdraw their support at any time.

This approval has been granted on the basis of the information you have provided in your research proposal and is subject to the conditions detailed below.

- Adherence to the Department's *Terms and Conditions of Approval to Conduct Research* in Departmental sites is required as outlined in the document at: http://education.qld.gov.au/corporate/research/terms_conditions.pdf
- Any changes required by your institution's ethics committee must be submitted to the Department of Education and Training for consideration before you proceed. Conversely, any changes required by the Department must be submitted to your institution's ethics committee to ensure you are not in breach of your ethics approval.
- Any variations to the research proposal as originally submitted, including changes to the research team, changes to data collection, additional research undertaken

Education House
30 Mary Street Brisbane 4000
PO Box 15033 City East
Queensland 4002 Australia
Telephone 07 3034 5929
Website www.dete.qld.gov.au
ABN 76 337 613 647

Appendix 3.8: Education Queensland Research Letter to School Principals

Queensland Government

Department of
Education and Training

5 January 2018

Dear Colleague,

Mr Rohan Genrich of the University of Southern Queensland has the Department's approval to approach your school inviting participation in the research project titled *Investigating student perceptions of the IT careers in Junior Secondary Education through the use of Tech Savvy Curriculum with Career Focused content.*

The acceptance of the invitation to participate is entirely voluntary and at your discretion.

This letter provides you with information about the Department's terms and conditions for research conducted on state school sites to inform your decision as to whether or not your school will participate in this research. The Department supports the conduct of quality research in State schools and values the potential contribution of good research in informing educational policy and professional practice. Participation in research, however, may impact on the daily operations of schools, and it is therefore imperative that discretion is used when deciding whether to agree to research involving your school.

As a minimum, the researcher should provide you with the following documentation to inform your decision regarding school research participation:

- an information statement which describes the research, identifies who will be involved (e.g. students, teachers, parents/caregivers) and explains what will be required of these participants;
- the informed consent form for you to sign to indicate your agreement that school staff, students and/or parents/caregivers can be invited to participate in the research;
- a copy of the approval to approach letter from central office or a regional office (where applicable);
- a copy of the final ethical clearance from their institution's Human Research Ethics Committee;
- full copies of any data collection instruments such as surveys, questionnaires, and interview schedules to be used in the study;
- a copy of all current Blue Cards and/or exemption notices from Blue Card Services at www.bluecard.qld.gov.au for any researcher(s) seeking access to children on school sites.

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Queensland 4002 Australia
Telephone 07 3034 5929
Website www.dete.qld.gov.au
ABN 76 337 613 647

Appendix 3.9: University of Southern Queensland - The Future of Information Technology Report

THE FUTURE OF INFORMATION TECHNOLOGY REPORT

CAREER PROSPECTS AND TRENDS

DECEMBER 2017

usq.edu.au

PREPARE FOR THE IT JOBS OF THE FUTURE

We live in a digital revolution. What's new in 2017, will be old by 2027.

46% of the world's population is now connected to the internet and the demand for skilled ICT workers in Australia will increase from 638,000 in 2017 to 695,000 by 2022 *(ASC, 2017)*.

Digital technologies are driving economic growth and experts are predicting mass adoption of emerging technologies including the Internet of Things (IoT), Artificial Intelligence (AI), data analytics and cloud computing.

Higher connectivity will result in more cybercrime, with the US Bureau of Labor Statistics anticipating a 37% growth in information security analyst positions between 2012 and 2022 to keep people, organisations and countries safe *(Pratt, 2015)*.

Employers hiring ICT workers want technical skills – such as IT infrastructure, web programming and cloud computing – as well as broader business skills including project management, customer service, business analysis and strategic planning *(Deloitte, 2017)*. ICT graduates will also be challenged to maintain contemporary skills and knowledge, while also preparing for career roles that may not yet exist *(ACS, 2017)*.

"IT is the future – join the digital revolution."

AUSTRALIAN IT MILESTONES

1949

Australia's first computer, the fourth in the world, was developed by the Council for Scientific and Industrial Research (later CSIRO). The computer filled a room the size of a double garage and had only a fraction of the brainpower of the cheapest electronic organiser.

(ABC, 2017)

1953

Melbourne Aeronautical Research Laboratory scientist David Warren brought a 'game changer' to the aviation industry, when he invented the world's first-ever 'black box'.

(Australian Geographic, 2017)

1982

IBM sold its first personal computer in Australia. A starter system cost $4273 and featured 64K memory, a 160KB disk drive, ran on Microsoft's Disk Operating System (DOS) and included a keyboard and monitor.

(Hearn, 2016)

1992

John O'Sullivan and the CSIRO developed Wi-Fi technology.

(CSIRO, 2017)

2000

Graeme Wood revolutionised the travel industry in Australia when he created the concept for, and cofounded, Wotif.com

(Saxton, 2017)

Early 2000s

Google Maps was developed in Sydney by Danish brothers Lars and Jens Rasmussen and Australians Neil Gordon and Stephen Ma.

2019

The average Australian household will have 24 devices connected online.

(Deloitte, 2017)

SKILLS FOR SUCCESS IN IT

Knowledge for Solving Computing Problems

Apply knowledge of computing fundamentals, knowledge of a computing specialisation, and mathematics, science, and domain knowledge appropriate for the computing specialisation to the abstraction and conceptualisation of computing models from defined problems and requirements.

Problem Analysis

Identify, formulate, research literature, and solve complex computing problems reaching substantiated conclusions using fundamental principles of mathematics, computing sciences, and relevant domain disciplines.

Communications

Communicate effectively with the computing community and with society at large about complex computing activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clear instructions.

Design / Development of Solutions

Design and evaluate solutions for complex computing problems, and design and evaluate systems, components, or processes that meet specified needs.

Modern Tool Usage

Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.

Individual and Team Work

Function effectively as an individual and as a member or leader in diverse teams and in multi-disciplinary settings.

Computing Professionalism and Society

Understand and assess societal, health, safety, legal, and cultural issues within local and global contexts, and therefore the responsibilities relevant to professional computing practice.

Ethics

Understand and commit to professional ethics, responsibilities, and norms of professional computing practice.

Life-long Learning

Recognise the need, and have the ability, to engage in independent learning for continual development as a computing professional.

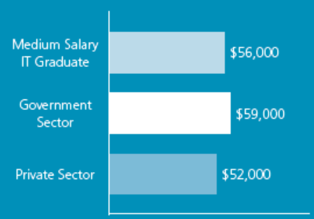
(ACS, 2017)

Professional Accreditation

IT graduates seek professional recognition with the Australian Computer Society (ACS) – the regulatory body for IT professionals. IT professionals and students may also undertake professional accreditation, depending on the career path including Cisco Certified Network Associate (CCNA) training, CompTIA certification and Microsoft Certified Solutions Associate (MCSA) certification.

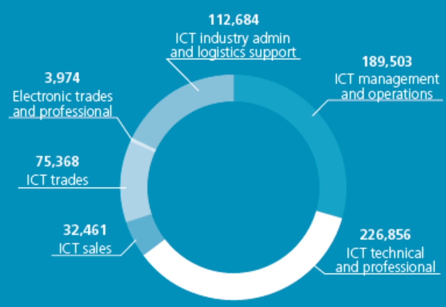
JOB PROSPECTS

Graduate salaries in IT 2015



(GradAustralia, 2017)

ICT workers by industry 2016



(Deloitte, 2017)

75%
of the fastest growing occupations require STEM knowledge
(Deloitte, 2017)

ICT workers in Australia

2016	640,846
2022	721,886

(ACS, 2017)

> "There has been a noticeable focus on recruiting candidates with the right soft skills, rather than purely the technical."
> (Hays, 2017)

6 | UNIVERSITY OF SOUTHERN QUEENSLAND

FUTURE TRENDS IN IT

The Internet of Things (IoT)

- According to network supplier Cisco, the number of intelligent objects connected to the internet exceeded the number of people on the planet five years ago. By 2020, it predicts there will be 50 billion devices connected to the internet as smart sensors become more present *(Goodwin, 2013)*.
- IoT could create the need for a new specialist who can combine skills in hardware, engineering, programming, analytics, privacy and security *(Pratt, 2015)*.

Cloud Computing

- More than 90% of US companies are using some form of cloud computing, according to CompTIA.
- IT leaders predict companies in the future will operate in a hybrid environment with a mix of private and public cloud.
- Cloud-centric jobs will increase, including cloud security.

(Pratt, 2015)

Artificial Intelligence / Robotics

- Artificial Intelligence (AI) and robotics have already moved from science fiction to reality.
- By 2025, these technologies will permeate wide segments of daily life including healthcare, transportation, logistics, customer service and home maintenance.
- IT professionals will have roles to play in programming, integrating and building out the infrastructure for organisational applications of AI and robotics.

(Pratt, 2015)

Virtual Reality

- 2.8 million Garner VR headsets were sold in 2016 and VR headset shipments are expected to double each year.
- By 2025, the majority of VR revenue will be from social experiences including television shows, dance games, feature films and 'hardcore' video games *(Patterson, 2016)*.

***"At all levels in education, augmented reality lectures will be popular by 2025. The teacher and students strap on VR goggles and all go to the same microscopic or telescopic place together"** - Jesse Schell, Professor at the Carnegie Mellon University Entertainment Technology Center*

(Patterson, 2016)

Cybersecurity

- As technology brings ever greater benefits, it also brings ever greater threats including:
  - attack vectors such as botnets, autonomous cars and ransomware
  - data manipulation, identity theft and cyberwarfare
  - data sovereignty, digital trails and leveraging technology talent.
- Cybersecurity is a growth industry, projected to be worth $US639 billion from 2017 – 2024.

(ACS, 2017)

Big Data

- Internet data is growing exponentially in Australia. Roughly 2.5 exabytes were generated on any given day in 2015. By 2035, 15 billion terabytes will be downloaded twice-yearly *(CSIRO, 2017)*.
- Roles expected to emerge include:
  - data architects – who design the structure to support emerging needs
  - data integration engineers – who ensure data solutions and analytics from any number of sources can be integrated
  - IT planning analysts – who aggregate and analyse data and predict future needs.

(Pratt, 2015)

CAREERS IN TECHNOLOGY

BUSINESS SERVICES
Sales / Marketing
Use IT and business knowledge to market solutions to clients and industry.

TECHNOLOGY SERVICES
Technical
Use deep technical skills to securely manage and interpret clients data.

CONTENT & DESIGN
Creative / Artistic
Use artistic skills to design engaging and user friendly digital content and apps.

PRODUCT DEVELOPMENT
Logical
Use coding and engineering skills to create software and hardware products.

Tip

Explore this interactive ICT Career Wheel online at:
www.careersfoundation.com.au

(Careers Foundation, 2017)

IT CAREERS ... A SNAPSHOT

Database and Systems Administrators, and ICT Security Specialists

Plan, develop, maintain, manage and administer organisations' database management systems, operating systems and security policies and procedures to ensure optimal database and system integrity, security, backup, reliability and performance.

Average Salary – $1,693 per week
Job Forecast – Grow Strongly

(Job Outlook , 2017)

ICT Trainers

ICT Trainers analyse and evaluate information-based system training needs and objectives, and develop, schedule and conduct ICT-based system training programs and courses.

Average Salary – Unavailable
Job Forecast – Grow Moderately

(Job Outlook , 2017)

ICT Managers

ICT Managers plan, organise, direct, control and coordinate the acquisition, development, maintenance and use of computer and telecommunication systems within organisations.

Average Salary – $2,105 per week
Job Forecast – Grow Very Strongly

(Job Outlook , 2017)

Business Analyst

Business analysts, also known as business systems analysts/planners, analyse and manage the information systems requirements within an organisation. They use their specialist problem-solving skills to identify and solve technological issues to achieve maximum efficiency of an organisation's business systems including database design and implementation, security and network management, service management and resource systems.

Average Salary – $1,819 per week
Job Forecast — Grow Moderately

(Job Outlook , 2017)

ICT Support Technicians

ICT Support Technicians provide support for the deployment and maintenance of computer infrastructure and web technology and the diagnosis and resolution of technical problems.

Average Salary – $1,200 per week
Job Forecast – Grow Strongly

(Job Outlook , 2017)

Software Developer

Software developers are involved with the development of computer software through the translation of written specifications into specific program units, and convert these into computer programs. They carry out a range of testing to ensure correct functionality of the programs.

Average Salary – $1,801 per week
Job Forecast – Grow Moderately

(Job Outlook , 2017)

Job Forecast is the likely change in the number of jobs over the next 5 years, based on the Department of Employment projections.

FUTURE-PROOF YOUR CAREER

Employability skills you will need to succeed

Having the right mix of skills is crucial to the success of individuals, businesses and societies. For individuals, better skills and qualifications lead to higher incomes and improved health.

Formal academic qualifications and technical skills are only part of the requirements for modern employees. Employability skills and personal attributes are just as important to success *(Deloitte, 2016)*.

A recent report by Deloitte Access Economics revealed that technology enhancements and globalisation will intensify the need for the following skills by 2030 *(Deloitte, 2016)*.

- Self-management
- Communication
- Teamwork
- Problem solving
- Digital literacy
- Critical thinking
- Innovation
- Emotional judgement
- Global citizenship
- Professional ethics

Soft-skill-intensive jobs will grow **2x faster** than other jobs

2/3 of jobs will be soft-skill-intensive by 2030

43% of businesses need leadership skill development for the digital future

> **Digital disruption, globalisation and demographic shifts are shaping Australia's future skill needs. Soft-skill-intensive occupations are expected to account for two-thirds (63%) of all jobs in Australia by 2030, according to the report by Deloitte Access Economics.**

(Deloitte, 2016)

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Further Reading

Australian Computer Society – www.acs.org.au

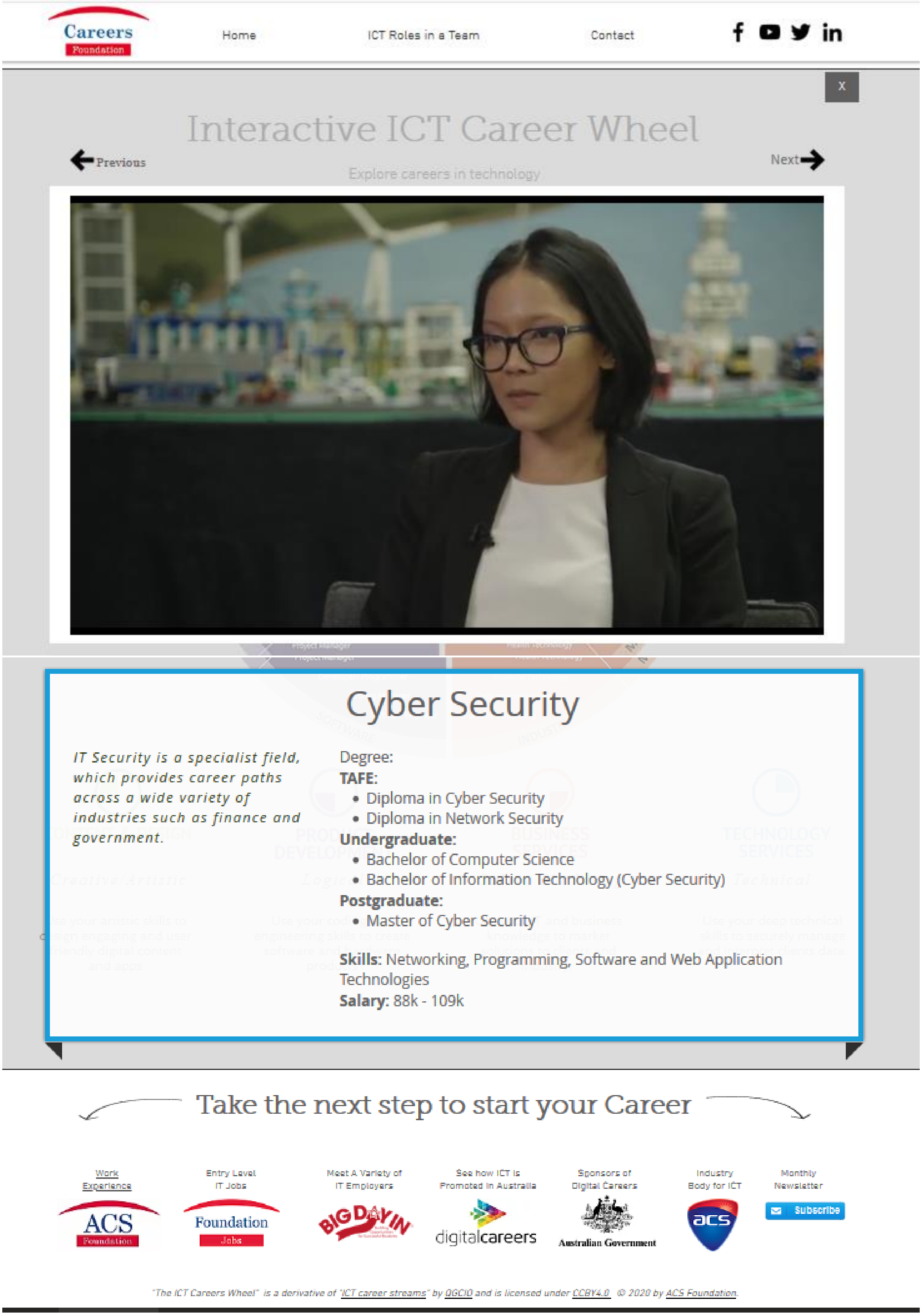
Digital Careers – www.digitalcareers.edu.au

Careers Foundation – www.careersfoundation.com.au

I Choose Technology – www.ichoosetechnology.com.au

Appendix 3.10: Interactive ICT Career Wheel

With Cyber Security ICT Careers Example


Careers Foundation
Home
ICT Roles in a Team
Contact
X
Interactive ICT Career Wheel
Previous
Next
Explore careers in technology
Cyber Security
IT Security is a specialist field, which provides career paths across a wide variety of industries such as finance and government.
Degree:
TAFE:
Diploma in Cyber Security
Diploma in Network Security
Undergraduate:
Bachelor of Computer Science
Bachelor of Information Technology (Cyber Security)
Postgraduate:
Master of Cyber Security
Skills: Networking, Programming, Software and Web Application Technologies
Salary: 88k - 109k
Take the next step to start your Career
Work Experience
Entry Level IT Jobs
Meet A Variety of IT Employers
See how ICT is Promoted in Australia
Sponsors of Digital Careers
Industry Body for ICT
Monthly Newsletter
ACS Foundation
Foundation Jobs
BIG DAY IN
digitalcareers
Australian Government
acs
Subscribe
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Appendix 3.11: Student Focus Group Questions

Student Understanding of Information Technology Careers prior to undertaking the two-week IT Careers classes:

- Before doing the two-week careers class, what did you think a computing career was?
- Describe one of the careers in computing that you knew about before doing the class.

Student understanding of Information Technology Careers after undertaking the two-week IT Careers classes:

- Has your understanding of a computing career changed?
- Discuss one of the interesting things you discovered during the class.

Student perceptions of the learning activities involved in the two-week IT Careers Curriculum:

- What did you enjoy about the careers class?
- What do you think could be improved about the careers class?

Appendix 3.12: Pre-Focus Group worksheet

USQ Information Technology Careers Research Focus Group

Write down at least 3 careers in computing that you knew about before doing the two-week class:

1.
2.
3.
4.
5.

Write down at least 3 interesting things you discovered <u>during</u> the two-week class:

1.

2.

3.

4.

5.

Appendix 3.13: Teacher Interview Questions

Teacher's view of their students' change in perceptions of Information Technology Careers based on undertaking the two-week IT Careers classes:

- In your opinion, what was the impact the two-week curriculum on your students' interest in IT careers?

Teacher's observations of the effect of the the two-week IT Careers classes on their students' learning experience:

- Can you suggest improvement for the two-week curriculum, to further increase student interest in IT careers?

Follow up question from the issues discovered with data collected from the pre- and post- ITCI survey instrument:

- From the data we received in the first and second surveys, across all four schools, there was no statistical evidence of the students' interest in IT improving. What could have been the cause of the large number of issues with year nines answering the survey?

Appendix 4.1: "High 5" Elevator Pitch worksheet

9-12-2011

The "High 5" Elevator Pitch Worksheet

Connie I. Reimers-Hild
University of Nebraska-Lincoln, creimers2@unl.edu

Nebraska Lincoln EXTENSION 1

The "High 5" Elevator Pitch

By: Connie Reimers-Hild, Ph.D.
(creimers2@unl.edu)

Great elevator pitches are created to sell something in 30 seconds or less (the time it takes to go from the first floor to the top of the building in an elevator). Think broadly about how a great pitch can help you. Great pitches can be used to market or sell anything from yourself as an individual to your business or community. Great pitches are clear and compelling. They make memorable impressions of whatever you are pitching and create a foundation for building relationships, clients, sales and investments!

It's important to develop and practice an effective pitch so you are ready to use it under fire. This worksheet will help you create an amazing pitch by using the "High Five" method of developing a great elevator pitch. The High Five is:

1) What?
2) Who?
3) Wow!
4) Why ?
5) When?

Note: As you develop your pitch, use words and pictures to engage both your right- and left-brain functions while stimulating your creative juices!

Step One: What are you Pitching?

What are you pitching? Is it an idea, a business plan or a product? Maybe you are pitching yourself for a new job or promotion. You can even use a great pitch to promote the new project you want to implement in your company. Communities can use pitches attract new families and businesses.

Decide what you want to pitch and create some detail around it. Writing the details will provide clarity and help you develop a successful pitch!

Describe your idea (be as specific as you can-clarity will create more impact!) Again, draw pictures if it helps to stimulate your creative juices or remind you of what you want to pitch!

IANR

Step Two: Who is Your Target Audience?

Who are you going to pitch? A potential client or investor? Maybe it is your boss or colleague. Effective pitches are created for specific audiences, so you should have more than one!

The Pitch I am creating is for:

Step Three: "Hook" Your Audience with a Wow Factor!

People are inundated with information. Catch the attention of your audience by colorfully describing the situation. Create a "Wow Factor" as a "Hook" and real the target audience into your pitch. *Hint: Use statistics, numbers and emotion to peak the interest of others!*

Step Four: Why You? Paint a Vivid Picture and Rescue Your Audience

Describe the situation to your target audience in a way that vividly describes how the situation impacts THEM! You are more likely to keep their attention by personalizing your pitch. How can you emotionally tie them to whatever it is you are pitching?

Further, let your audience know how you can help them resolve the situation. Tell your audience HOW your business, idea, product or service BENEFITS THEM. Make it personal, memorable and real. Do this while building credibility.

Let your audience know ***Why*** *you are the best!* Give them proof…use testimonials and numbers to build your case!

Sharing awesome financial info and/or numbers will help sell you and your big idea!!

Step Five: When? Revise and Rehearse with THE ASK!
Write your full pitch below. Say it out loud, roll it over in your mind, run it past a few people and get their feedback. Test it, revise it, perfect it and practice it. An effective pitch may be just the tool you need to land that big break!

Hint: Make sure you ASK for ACTION by firming up a when. When can you meet with them, ***When*** *can you call them, etc.*

Examples of Effective Elevator Pitches:

Pretend you just stepped on the elevator with someone and have started a conversation with them. You now have 30 seconds to "pitch" them. The examples below will provide you with some ideas on how to create a successful and impactful pitch!

Business Example:

1) What? A business coach pitching their coaching services
2) Who? To a potential client
3) Wow! The coach demonstrates their effectiveness with proof by adding numbers:

"Research shows that business coaching increases profitability by 22%...AMAZING!"

4) Why? The coach begins paints a vivid picture of how coaching can benefit the potential client…with their services:

I am currently coaching a business owner, and his profits have increased each month over the course of our coaching relationship… even in this tough economic downturn!

He is spending time working on this business and is now planning for even bigger growth. He is also having a lot of fun! Coaching has really helped him achieve both his personal and business goals. I know the current economic climate is challenging, especially for business owners. I would really enjoy the opportunity to help you increase your profits too (while having some fun in the process of course!)

5) When? The coach goes for the ask and creates action!

When are you available for a complimentary coaching session?

Professional Organization Example:

1) What? The Innovation Coaches Association (ICA)

2) Who? A potential member

3) Wow! ICA demonstrates proof of their membership benefits

We just conducted a recent survey of our membership, and 95% of our members indicated their coaching firms grew because of ICA!

4) Why? ICA paints a vivid picture of how they benefit their members in a way that makes the potential member want to join:

ICA provides its members with tools they can use to grow their businesses. One of the tools is a business essential. We help innovation coaches like yourself market themselves with our database that matches clients with coaches. We also will help you grow your business with our monthly eNewsletter. It contains information on how to land great clients while growing your practice!

5) When? Go for the ask...create immediate action! We would enjoy having you as a member. Here is an information packet. Do you have any additional questions? When can we set up a time to talk more?

Additional Success Tips:

Break the Ice!

Find any excuse you can to break the ice and introduce yourself to potential clients, investors, partners, etc. Pay people compliments and ask them questions that create a positive interaction. For example: *"Your shoes are awesome! Where did you buy them?"*

This will start a conversation and set the stage for delivering your awesome pitch while selling yourself, your business, product and/or idea. Give them your business card and ask for theirs so you can follow-up with them and begin developing a trusting relationship with your target audiences! Get out there and put your pitch to work!

Let it Flow Naturally!

Practice so you know your pitch; however, do not sound rehearsed. Let it flow naturally. It may come out a bit different every time, and that is O.K. Keep making improvements and adjustments over time. Be natural and confident. Confident pitches are effective pitches!

Prepare for Great Q&A

What a great opportunity to hit a homerun! Answer questions confidently and concisely. Listen to the questions and take time to formulate powerful answers. Create a relationship with your target audience so they buy into your big idea!! Remember, you are working to develop a trusting relationship with your audience!

Consider these questions…

What are questions you may be asked?
How can you best answer them?
What are some key points you want to make after the dialogue has started?

Tools You Can Use:

Harvard Business School Elevator Pitch Builder located online at:
http://www.alumni.hbs.edu/careers/pitch/

Buzzuka.com: Another web-based tool designed to help you create an impactful pitch!

Appendix 6.1: Keir et al. (2014) – STEM Career Interest Survey

Each question is Likert scale with the following choices:
Strongly Disagree (1), Disagree (2), Neither Agree nor Disagree (3), Agree (4), Strongly Agree (5)

Optional Demographic Questions
1. Date
2. First name
3. Last name
4. Grade
5. Gender
6. Teacher
7. Race
8. Period
9. School

Directions: Students will complete the STEM-CIS online via iPod Touches or computers. Each question is Likert scale with the following choices:
Strongly Disagree (1), Disagree (2), Neither Agree nor Disagree (3), Agree (4), Strongly Agree (5)

Science
S1 I am able to get a good grade in my science class.
S2 I am able to complete my science homework.
S3 I plan to use science in my future career.
S4 I will work hard in my science classes.
S5 If I do well in science classes, it will help me in my future career.
S6 My parents would like it if I choose a science career.
S7 I am interested in careers that use science.
S8 I like my science class.
S9 I have a role model in a science career.
S10 I would feel comfortable talking to people who work in science careers.
S11 I know of someone in my family who uses science in their career.

Math
M1 I am able to get a good grade in my math class.
M2 I am able to complete my math homework.
M3 I plan to use math in my future career.
M4 I will work hard in my math classes.
M5 If I do well in math classes, it will help me in my future career.
M6 My parents would like it if I choose a math career.
M7 I am interested in careers that use math.
M8 I like my math class.
M9 I have a role model in a math career.
M10 I would feel comfortable talking to people who work in math careers.
M11 I know someone in my family who uses math in their career.

Technology
T1 I am able to do well in activities that involve technology.
T2 I am able to learn new technologies.
T3 I plan to use technology in my future career.
T4 I will learn about new technologies that will help me with school.
T5 If I learn a lot about technology, I will be able to do lots of different types of careers.
T6 My parents would like it if I choose a technology career.
T7 I like to use technology for class work.

T8 I am interested in careers that use technology.
T9 I have a role model who uses technology in their career.
T10 I would feel comfortable talking to people who work in technology careers.
T11 I know of someone in my family who uses technology in their career.

Engineering
E1 I am able to do well in activities that involve engineering.
E2 I am able to complete activities that involve engineering.
E3 I plan to use engineering in my future career.
E4 I will work hard on activities at school that involve engineering.
E5 If I learn a lot about engineering, I will be able to do lots of different types of careers.
E6 My parents would like it if I choose an engineering career.
E7 I am interested in careers that involve engineering.
E8 I like activities that involve engineering.
E9 I have a role model in an engineering career.
E10 I would feel comfortable talking to people who are engineers.
E11 I know of someone in my family who is an engineer.

Appendix 6.2: Tyler-Wood et al. (2011) – STEM Semantics Survey

STEM Semantics Survey

Gender: M / F

This five-part questionnaire is designed to assess your perceptions of scientific disciplines. It should require about 5 minutes of your time. Usually it is best to respond with your first impression, without giving a question much thought. Your answers will remain confidential.

ID: ________________ School:_____________	Use the assigned ID or the year and day of your birthday (ex: 9925 if born on the 25th day of any month in 1999.

Instructions: Choose one circle between each adjective pair to indicate how you feel about the object.

To me, SCIENCE is:

1.	fascinating	①	②	③	④	⑤	⑥	⑦	mundane
2.	appealing	①	②	③	④	⑤	⑥	⑦	unappealing
3.	exciting	①	②	③	④	⑤	⑥	⑦	unexciting
4.	means nothing	①	②	③	④	⑤	⑥	⑦	means a lot
5.	boring	①	②	③	④	⑤	⑥	⑦	interesting

To me, MATH is:

1.	boring	①	②	③	④	⑤	⑥	⑦	interesting
2.	appealing	①	②	③	④	⑤	⑥	⑦	unappealing
3.	fascinating	①	②	③	④	⑤	⑥	⑦	mundane
4.	exciting	①	②	③	④	⑤	⑥	⑦	unexciting
5.	means nothing	①	②	③	④	⑤	⑥	⑦	means a lot

To me, ENGINEERING is:

1.	appealing	①	②	③	④	⑤	⑥	⑦	unappealing
2.	fascinating	①	②	③	④	⑤	⑥	⑦	mundane
3.	means nothing	①	②	③	④	⑤	⑥	⑦	means a lot
4.	exciting	①	②	③	④	⑤	⑥	⑦	unexciting
5.	boring	①	②	③	④	⑤	⑥	⑦	interesting

To me, TECHNOLOGY is:

1.	appealing	①	②	③	④	⑤	⑥	⑦	unappealing
2.	means nothing	①	②	③	④	⑤	⑥	⑦	means a lot
3.	boring	①	②	③	④	⑤	⑥	⑦	interesting
4.	exciting	①	②	③	④	⑤	⑥	⑦	unexciting
5.	fascinating	①	②	③	④	⑤	⑥	⑦	mundane

To me, a CAREER in science, technology, engineering, or mathematics (is):

1.	means nothing	①	②	③	④	⑤	⑥	⑦	means a lot
2.	boring	①	②	③	④	⑤	⑥	⑦	interesting
3.	exciting	①	②	③	④	⑤	⑥	⑦	unexciting
4.	fascinating	①	②	③	④	⑤	⑥	⑦	mundane
5.	appealing	①	②	③	④	⑤	⑥	⑦	unappealing

Appendix 6.3: Mahoney (2010) – Student Attitude toward STEM Questionnaire

Question A	Most	More	Less	Least
I like:	S	S	S	S
	T	T	T	T
	E	E	E	E
	M	M	M	M

Category	Associated Terms:
Awareness: (Initial Interest)	1. I do not like 2. I enjoy learning about 3. I am curious about 4. I am not interested in 5. I like 6. (subject) is appealing to me
Perceived Ability:	7. (subject) is difficult for me 8. I do well in 9. I am not confident about my work in 10. I have a hard time in 11. Assigned work in (subject) is easy for me 12. I can not figure out
Value:	13. (subject) is important to me 14. I feel there is a need for 15. I do not need 16. It is valuable for me to learn 17. (subject) is good for me 18. I do not care about
Commitment: (Long-term interest)	19. I will continue to enjoy 20. I am not interested in a career involving 21. I am interested in alternative programs in 22. I would like to learn more about 23. I do not wish to continue my education in 24. I am committed to learning

Appendix 6.4: Likert scale items developed from Keir et al. (2014)

1. I am able to do well in activities that involve information technology.
2. I am able to learn new technologies.
3. I plan to use information technology in my future career.
4. I will learn about new technologies that will help me with school.
5. If I learn a lot about information technology, I will be able to do lots of different types of careers.
6. My parents would like it if I choose a information technology career.
7. I like to use information technology for class work.
8. I am interested in careers that use information technology.
9. I have a role model who uses information technology in their career.
10. I would feel comfortable talking to people who work in information technology careers.
11. I know of someone in my family who uses information technology in their career.

Appendix 6.5: Likert scale items developed from Tyler-Wood et al. (2011)

Information Technology Questions

1. To me, information technology is appealing.
2. To me, information technology is unappealing.
3. To me, information technology means nothing.
4. To me, information technology means a lot.
5. To me, information technology is boring.
6. To me, information technology is interesting.
7. To me, information technology is exciting.
8. To me, information technology is unexciting.
9. To me, information technology is fascinating.
10. To me, information technology is mundane.

General Information technology Careers Questions

1. To me, a career in information technology means nothing.
2. To me, a career in information technology means a lot.
3. To me, a career in information technology is boring.
4. To me, a career in information technology is interesting.
5. To me, a career in information technology is exciting.
6. To me, a career in information technology is unexciting.
7. To me, a career in information technology is fascinating.
8. To me, a career in information technology is mundane.
9. To me, a career in information technology is appealing.
10. To me, a career in information technology is unappealing.

Appendix 6.6: Likert scale items developed from Mahoney (2010)

1. I do not like information technology.
2. I enjoy learning about information technology.
3. I am curious about information technology.
4. I am not interested in information technology.
5. I like information technology.
6. Information technology is appealing to me.
7. Information technology is difficult for me.
8. I do well in information technology.
9. I am not confident about my work in information technology.
10. I have a hard time in information technology.
11. Assigned work in information technology is easy for me.
12. I cannot figure out information technology.
13. Information technology is important to me.
14. I feel there is a need for information technology.
15. I do not need information technology.
16. It is valuable for me to learn information technology.
17. Information technology is good for me.
18. I do not care about information technology.
19. I will continue to enjoy information technology.
20. I am not interested in a career involving information technology.
21. I am interested in alternative programs in information technology.
22. I would like to learn more about information technology.
23. I do not wish to continue my education in information technology.
24. I am committed to learning information technology.

Appendix 6.7: Likert scale items developed for the Information Technology Interest & Careers Survey

1. I do well in activities that involve information technology.
2. I easily learn new technologies.
3. I am happy to learn about new technologies that will help me with school.
4. When I use information technology in school, I am able to get better results.
5. I like to use information technology for class work.
6. To me, information technology is appealing.
7. To me, information technology means nothing.
8. To me, information technology is boring.
9. To me, information technology is exciting.
10. To me, information technology is fascinating.
11. I do not like information technology.
12. I enjoy learning about information technology.
13. I am curious about information technology.
14. I like information technology.
15. information technology is difficult for me.
16. I do well with information technology.
17. I am not confident about my work in information technology.
18. I have a hard time using information technology.
19. Assigned work in information technology is easy for me.
20. I can not figure out information technology.
21. Information technology is important to me.
22. I feel there is a need for information technology.
23. I do not need information technology.
24. It is valuable for me to learn about information technology.
25. Information technology is good for me.
26. I do not care about information technology.
27. I will continue to enjoy information technology.
28. I am interested in alternative programs in information technology.
29. I would like to learn more about information technology.
30. I do not wish to continue my education in information technology.
31. I am committed to learning about information technology.
32. I plan to use information technology in my future career.
33. If I learn about information technology, I will be able to do lots of different types of careers.
34. I am interested in careers that use information technology.
35. I have a role model who uses information technology in their career.
36. I feel comfortable talking to people who work in information technology careers.
37. I know of someone in my family who uses information technology in their career.
38. I am curious about careers in information technology.
39. I am not interested in careers in information technology.
40. I would not like a career in information technology.

41. A career in information technology is appealing to me.
42. I do not care about careers in information technology.
43. I would like to learn more about careers in information technology.
44. A career in information technology would be boring.
45. A career in information technology would be fascinating.
46. A career in information technology would be exciting.
47. A career in information technology would be too difficult for me.
48. I am not confident about having a career in information technology.

Appendix 6.8: Suggested changes to items developed for the Information Technology Interest & Careers Survey

Change:-
I am able to do well in activities that involve Information technology.
To:-
I do well in activities that involve information technology.

Change:-
I am able to learn new information technologies.
To:-
I easily learn new technologies.

Change:-
I will learn about new technologies that will help me with school.
To:-
I am happy to learn new technologies that will help me with school.

Remove the repeating item:-
I do not like information technology.

Change:-
I do well in information technology.
To:-
I do well with information technology.

Change:-
I am not confident about my work in information technology.
To:-
I am not confident about my work with information technology.

Change:-
I have a hard time in information technology.
To:-
I have a hard time using information technology.

Change:-
I am not confident about a career in information technology.
To:-
I am not confident about having a career in information technology.

Appendix 6.9: Information Technology Interest & Careers Survey

Information Technology Interest & Careers Survey

This survey investigates student interest in Information Technology and Careers in Information Technology.

Please enter your first and last names initials, and your date of birth ddmm: ________________.
Eg. John Citizen born 6th May - JC0605.

*** 1. Interest in information Technology**

Please indicate your level of agreement or disagreement with the following statements:

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
I do well in activities that involve information technology.	○	○	○	○	○
I easily learn new technologies.	○	○	○	○	○
I am happy to learn about new technologies that will help me with school.	○	○	○	○	○
When I use information technology in school, I am able to get better results.	○	○	○	○	○
I like to use information technology for class work.	○	○	○	○	○
To me, information technology is appealing.	○	○	○	○	○
To me, information technology means nothing.	○	○	○	○	○
To me, information technology is boring.	○	○	○	○	○
To me, information technology is exciting.	○	○	○	○	○
To me, information technology is fascinating.	○	○	○	○	○
I do not like information technology.	○	○	○	○	○
I enjoy learning about information technology.	○	○	○	○	○

I am curious about information technology.	○	○	○	○	○
I like information technology.	○	○	○	○	○
information technology is difficult for me.	○	○	○	○	○
I do well with information technology.	○	○	○	○	○
I am not confident about my work in information technology.	○	○	○	○	○
I have a hard time using information technology.	○	○	○	○	○
Assigned work in information technology is easy for me.	○	○	○	○	○
I can not figure out information technology.	○	○	○	○	○
Information technology is important to me.	○	○	○	○	○

I feel there is a need for information technology.	○	○	○	○	○
I do not need information technology.	○	○	○	○	○
It is valuable for me to learn about information technology.	○	○	○	○	○
Information technology is good for me.	○	○	○	○	○
I do not care about information technology.	○	○	○	○	○
I will continue to enjoy information technology.	○	○	○	○	○
I am interested in alternative programs in information technology.	○	○	○	○	○
I would like to learn more about information technology.	○	○	○	○	○
I do not wish to continue my education in	○	○	○	○	○

I am committed to learning about information technology.	◯	◯	◯	◯	◯

*** 2. Interest in Information Technology Careers**

Please indicate your level of agreement or disagreement with the following statements:

	Strongly Disagree	Disagree	Neither Agree or Disgree	Agree	Stongly Agree
I plan to use information technology in my future career.	◯	◯	◯	◯	◯
If I learn about information technology, I will be able to do lots of different types of careers.	◯	◯	◯	◯	◯
I am interested in careers that use information technology.	◯	◯	◯	◯	◯
I have a role model who uses information technology in their career.	◯	◯	◯	◯	◯
I feel comfortable talking to people who work in information technology careers.	◯	◯	◯	◯	◯
I know of someone in my family who uses information technology in their career.	◯	◯	◯	◯	◯
I am curious about careers in information technology.	◯	◯	◯	◯	◯
I am not interested in careers in information technology.	◯	◯	◯	◯	◯
I would not like a career in information technology.	◯	◯	◯	◯	◯
A career in information technology is appealing to me.	◯	◯	◯	◯	◯
I do not care about careers in information technology.	◯	◯	◯	◯	◯

I would like to learn more about careers in information technology.	○	○	○	○	○
A career in information technology would be boring.	○	○	○	○	○
A career in information technology would be fascinating.	○	○	○	○	○
A career in information technology would be exciting.	○	○	○	○	○
A career in information technology would be too difficult for me.	○	○	○	○	○
I am not confident about having a career in information technology.	○	○	○	○	○

Appendix 6.10: Information Technology Careers Interest (ITCI) Survey

Information Technology Interest & Careers Survey

This survey investigates student interest in Information Technology and Careers in Information Technology.

Please enter your first and last names initials, and your date of birth ddmm: _________________.

Eg. John Citizen born 6th May - JC0605.

Please indicate your level of agreement or disagreement with the following statements:

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
I enjoy learning about information technology.	○	○	○	○	○
I will continue to enjoy information technology.	○	○	○	○	○
Information technology is important to me.	○	○	○	○	○
To me, information technology is fascinating.	○	○	○	○	○
I am curious about information technology.	○	○	○	○	○
I would like to learn more about information technology.	○	○	○	○	○
I am interested in alternative programs in information technology.	○	○	○	○	○
I like to use information technology for class work.	○	○	○	○	○
I am curious about careers in information technology.	○	○	○	○	○
I would like to learn more about careers in information technology.	○	○	○	○	○
A career in information technology would be fascinating.	○	○	○	○	○
I plan to use information technology in my future career.	○	○	○	○	○
I feel comfortable talking to people who work in information technology careers.	○	○	○	○	○

Appendix 6.11: Information Technology Careers Interest (ITCI) Survey Data

Participant Num	Participant Code	School (1-4)	PreITCI 01	PreITCI 02	PreITCI 03	PreITCI 04	PreITCI 05	PreITCI 06	PreITCI 07	PreITCI 08	PreITCI 09	PreITCI 10	PreITCI 11	PreITCI 12
1	AB2701	4	4	3	4	4	4	3	3	5	4	4	4	4
2	AK0503	4	4	3	2	4	4	3	2	5	2	2	3	4
3	AL2608	3	5	3	4	5	5	5	4	3	5	5	5	5
4	AS0807	4	4	4	4	4	4	4	4	4	4	4	4	3
5	AV0502	3	4	4	4	4	4	4	4	4	3	4	4	3
6	BH1501	2	4	4	5	5	5	5	4	5	5	5	4	5
7	BT2301	2	5	5	4	4	4	5	4	4	5	5	4	4
8	BT2909	2	4	5	4	5	5	5	4	4	5	5	4	4
9	CB1301	1	5	5	5	5	5	5	4	5	5	4	5	5
10	CG0202	1	5	5	5	5	5	5	5	5	5	5	5	5
11	CK3005	2	5	4	4	5	4	5	4	5	4	5	4	4
12	CL0611	1	3	3	3	3	3	3	3	3	3	3	3	3
13	DC0611	1	4	4	3	3	3	3	4	4	2	2	1	3
14	DG0702	2	5	5	5	5	5	5	5	5	5	5	5	5
15	DG2802	2	5	5	5	5	5	5	4	5	5	5	5	5
16	DT1005	4	5	5	5	5	5	5	5	5	5	5	5	5
17	EC0810	1	4	4	3	4	4	4	3	4	4	4	4	3
18	EK0307	1	4	3	3	3	3	4	4	4	3	4	3	3
19	ER2402	2	5	5	5	5	5	5	5	5	5	5	5	5
20	FT1612	4	5	4	5	4	4	5	5	3	4	3	4	3
21	GM1205	4	5	4	4	4	5	5	5	5	5	5	4	3
22	GP2912	1	3	3	3	3	4	5	4	4	4	4	4	4
23	GS2703	4	5	5	4	5	4	4	4	4	4	4	4	4
24	HB00207	1	5	5	5	5	5	5	5	5	5	5	5	5
25	HB0912	4	4	4	4	4	4	4	4	4	4	4	3	4
26	HJ0210	4	4	5	4	5	4	5	4	5	5	4	5	4
27	HW2908	4	5	5	5	5	5	5	4	5	4	4	4	3
28	JC0303	4	4	4	4	4	4	4	4	5	3	3	4	4
29	JC3003	1	4	4	4	4	4	4	4	3	4	4	5	4

Participant Num	Participant Code	School (1-4)	PreITCI 01	PreITCI 02	PreITCI 03	PreITCI 04	PreITCI 05	PreITCI 06	PreITCI 07	PreITCI 08	PreITCI 09	PreITCI 10	PreITCI 11	PreITCI 12
30	JD0311	3	4	4	4	4	4	4	3	3	4	4	4	3
31	JF2909	3	4	4	4	4	4	4	4	4	4	4	4	4
32	JG2010	4	4	4	3	4	4	4	4	4	4	4	4	3
33	JK0307	1	3	3	3	3	3	4	4	4	4	4	3	4
34	JK2702	3	3	2	3	4	3	2	3	2	2	3	4	3
35	JL3007	4	4	4	4	3	4	4	4	4	4	4	4	3
36	JV1710	4	3	3	3	3	3	3	3	3	3	3	3	3
37	JZ2011	1	4	4	3	4	3	4	4	4	3	4	3	4
38	KD0105	2	4	4	4	4	4	4	4	4	4	3	3	3
39	LB0705	4	4	3	3	3	2	2	3	4	3	2	3	2
40	LM1805	4	1	1	1	1	1	1	1	1	1	1	1	1
41	MB1909	4	5	4	4	5	5	5	4	4	4	4	5	4
42	MC2011	4	4	4	4	3	4	4	3	4	5	5	4	4
43	MC2204	4	5	5	4	4	4	5	4	5	4	4	3	4
44	MR1401	1	5	5	4	5	5	5	4	5	4	5	4	5
45	ND1212	2	4	4	4	4	3	4	3	3	3	4	3	3
46	NF1902	1	5	5	4	5	4	4	4	4	5	4	4	5
47	NN1111	4	3	3	4	3	3	4	3	5	3	3	3	3
48	NN2711	4	4	4	4	4	4	4	4	4	4	4	4	3
49	OG0903	2	4	4	5	3	4	4	4	5	3	4	4	5
50	PM0504	2	4	5	4	4	4	4	4	4	4	4	4	4
51	RD0805	2	5	5	5	5	5	5	5	5	5	5	5	5
52	RW1003	2	5	5	5	5	5	5	5	4	5	5	5	4
53	SK1501	3	3	4	3	4	2	3	4	2	2	3	3	3
54	SL2309	1	4	4	4	4	4	5	4	4	4	4	4	4
55	SM1606	3	4	4	4	4	4	3	4	4	3	4	3	2
56	SP2804	4	5	5	5	5	5	5	4	5	5	5	5	5
57	SR1202	4	4	4	4	4	4	4	4	5	3	3	3	3
58	SW2111	4	4	4	4	4	4	4	4	4	3	2	4	2
59	TB1208	1	5	5	4	5	5	5	3	5	5	5	5	5
60	TB1701	4	4	4	4	3	5	4	5	5	3	3	2	2
61	TC1204	3	5	5	3	4	5	5	4	3	4	4	5	4

Participant Num	Participant Code	School (1-4)	PreITCI 01	PreITCI 02	PreITCI 03	PreITCI 04	PreITCI 05	PreITCI 06	PreITCI 07	PreITCI 08	PreITCI 09	PreITCI 10	PreITCI 11	PreITCI 12
62	TM1901	2	4	4	4	5	4	4	5	4	3	3	4	3
63	TR0301	4	4	5	4	5	4	5	5	5	4	4	4	4
64	TS0801	4	4	4	4	4	4	4	4	4	4	4	4	3
65	TS1411	2	5	4	4	4	4	5	4	4	4	4	3	3
66	WD1401	2	4	4	3	4	4	4	3	3	5	5	5	4
67	WT1211	1	3	3	3	3	3	4	3	4	4	4	3	3
68	ZD2501	4	5	5	4	5	5	5	4	5	4	5	4	5
69	ZH2509	4	5	5	5	5	5	5	5	4	4	4	4	5
70	ZK1807	3	4	4	3	4	4	4	4	3	5	4	4	4

Participant Num	Participant Code	PreITCI 13	PostITCI 01	PostITCI 02	PostITCI 03	PostITCI 04	PostITCI 05	PostITCI 06	PostITCI 07	PostITCI 08	PostITCI 09	PostITCI 10	PostITC I11
1	AB2701	3	4	4	4	5	4	3	4	5	4	5	4
2	AK0503	3	2	2	2	2	3	3	3	5	3	3	2
3	AL2608	4	4	4	4	5	5	5	4	3	4	5	5
4	AS0807	3	4	4	4	4	4	3	4	2	4	4	3
5	AV0502	3	4	4	3	4	4	4	3	4	3	3	3
6	BH1501	3	4	5	5	4	5	5	4	5	5	5	4
7	BT2301	5	5	4	4	4	4	5	5	4	5	5	4
8	BT2909	3	4	4	4	4	4	4	4	3	4	5	4
9	CB1301	4	5	5	5	5	5	5	4	5	4	5	5
10	CG0202	3	5	5	5	5	5	5	5	5	5	5	5
11	CK3005	4	4	4	3	3	3	4	4	4	3	3	4
12	CL0611	3	3	3	3	3	3	3	3	3	3	3	3
13	DC0611	2	3	3	2	2	2	2	3	3	3	3	2
14	DG0702	5	4	4	5	5	5	5	4	4	4	4	4
15	DG2802	5	5	5	5	4	5	5	5	5	5	5	5
16	DT1005	4	5	5	5	5	5	5	5	5	5	5	5
17	EC0810	4	4	4	3	4	4	4	4	4	4	4	4
18	EK0307	3	4	3	3	4	4	4	3	3	4	4	4
19	ER2402	4	5	5	5	5	5	5	5	5	5	5	5
20	FT1612	4	5	5	5	5	5	5	5	5	4	3	4

Participant Num	Participant Code	PreITCI 13	PostITCI 01	PostITCI 02	PostITCI 03	PostITCI 04	PostITCI 05	PostITCI 06	PostITCI 07	PostITCI 08	PostITCI 09	PostITCI 10	PostITC I11
21	GM1205	3	4	4	3	4	4	5	4	5	4	5	3
22	GP2912	4	4	4	3	4	4	4	3	4	4	4	4
23	GS2703	4	5	5	4	5	5	5	5	5	4	4	4
24	HB00207	4	5	5	5	5	5	5	5	5	5	5	5
25	HB0912	3	4	4	4	4	4	4	3	5	4	4	3
26	HJ0210	5	4	5	4	5	4	5	4	5	4	5	4
27	HW2908	4	5	5	5	5	5	4	4	5	4	4	5
28	JC0303	3	4	4	4	3	4	3	3	4	4	3	3
29	JC3003	3	4	4	4	4	3	3	4	4	3	3	4
30	JD0311	2	4	4	3	4	3	4	3	3	4	4	4
31	JF2909	4	4	4	4	4	4	4	4	4	4	4	4
32	JG2010	4	4	4	4	4	4	4	4	4	4	4	4
33	JK0307	2	3	3	3	3	3	4	4	4	4	4	3
34	JK2702	2	4	4	4	4	4	4	3	5	4	4	4
35	JL3007	4	4	4	4	4	4	4	4	4	4	4	4
36	JV1710	3	3	3	3	3	3	3	3	3	3	3	3
37	JZ2011	4	4	4	3	3	3	3	4	4	3	3	3
38	KD0105	3	4	4	3	3	4	4	3	4	4	4	3
39	LB0705	2	3	3	3	3	3	3	3	4	3	3	3
40	LM1805	1	3	4	4	4	5	5	3	5	3	3	3
41	MB1909	4	5	5	4	4	4	5	4	4	4	4	5
42	MC2011	4	5	5	5	5	5	5	1	5	5	5	5
43	MC2204	5	5	4	4	5	4	4	4	5	5	4	5
44	MR1401	5	4	4	3	4	4	4	3	4	4	4	4
45	ND1212	3	4	4	3	3	3	3	3	4	3	3	3
46	NF1902	**4**	5	5	5	5	5	5	5	5	5	5	5
47	NN1111	3	3	3	3	3	3	3	3	3	3	3	3
48	NN2711	2	4	4	4	4	4	4	4	4	3	3	3
49	OG0903	3	4	4	5	3	4	4	4	4	4	3	3
50	PM0504	4	4	4	4	5	5	4	4	5	4	4	4
51	RD0805	4	5	5	5	5	5	5	5	5	5	5	5
52	RW1003	3	5	5	5	5	5	5	5	5	5	5	5

Participant Num	Participant Code	PreITCI 13	PostITCI 01	PostITCI 02	PostITCI 03	PostITCI 04	PostITCI 05	PostITCI 06	PostITCI 07	PostITCI 08	PostITCI 09	PostITCI 10	PostITC I11
53	SK1501	3	3	3	3	3	3	3	3	2	2	2	3
54	SL2309	4	4	4	5	5	4	5	4	4	4	4	4
55	SM1606	4	4	4	4	4	4	4	4	3	4	4	4
56	SP2804	5	5	5	5	5	5	5	5	5	5	5	5
57	SR1202	3	4	4	4	3	4	3	3	4	4	3	3
58	SW2111	3	1	2	3	2	1	2	3	2	1	2	3
59	TB1208	3	5	5	5	5	5	5	5	5	5	5	5
60	TB1701	3	4	4	4	5	5	5	4	4	4	3	3
61	TC1204	3	5	5	3	5	4	5	3	5	5	4	5
62	TM1901	4	4	3	4	5	4	4	4	4	3	3	4
63	TR0301	3	4	5	4	4	5	4	5	5	5	4	5
64	TS0801	2	3	3	3	3	3	3	3	3	3	3	3
65	TS1411	3	5	4	5	4	4	5	4	5	4	4	4
66	WD1401	3	4	4	3	3	4	4	3	3	4	4	3
67	WT1211	3	4	4	4	4	3	4	4	4	3	3	3
68	ZD2501	4	5	4	5	5	5	5	5	4	4	3	3
69	ZH2509	5	5	5	4	5	5	5	4	5	4	4	3
70	ZK1807	3	4	3	4	4	4	4	3	3	4	4	4

Participant Num	Participant Code	PostITCI12	PostITCI13
1	AB2701	4	3
2	AK0503	5	3
3	AL2608	5	4
4	AS0807	2	2
5	AV0502	3	3
6	BH1501	5	4
7	BT2301	5	5
8	BT2909	4	2
9	CB1301	5	4
10	CG0202	5	3
11	CK3005	3	3

Participant Num	Participant Code	PostITCI12	PostITCI13
12	CL0611	3	3
13	DC0611	3	3
14	DG0702	5	4
15	DG2802	5	5
16	DT1005	5	5
17	EC0810	3	4
18	EK0307	3	2
19	ER2402	5	5
20	FT1612	3	4
21	GM1205	3	3
22	GP2912	4	4
23	GS2703	4	4
24	HB00207	5	4
25	HB0912	5	4
26	HJ0210	5	4
27	HW2908	4	5
28	JC0303	4	3
29	JC3003	4	4
30	JD0311	3	2
31	JF2909	4	4
32	JG2010	4	4
33	JK0307	4	3
34	JK2702	5	3
35	JL3007	3	4
36	JV1710	3	3
37	JZ2011	4	3
38	KD0105	4	3
39	LB0705	3	3
40	LM1805	3	3
41	MB1909	5	5
42	MC2011	5	4
43	MC2204	5	5

Participant Num	Participant Code	PostITCI12	PostITCI13
44	MR1401	4	4
45	ND1212	3	2
46	NF1902	5	5
47	NN1111	3	3
48	NN2711	4	3
49	OG0903	3	2
50	PM0504	4	4
51	RD0805	5	5
52	RW1003	5	5
53	SK1501	3	3
54	SL2309	4	4
55	SM1606	2	4
56	SP2804	5	5
57	SR1202	3	3
58	SW2111	4	5
59	TB1208	5	5
60	TB1701	3	3
61	TC1204	5	3
62	TM1901	4	3
63	TR0301	5	4
64	TS0801	3	3
65	TS1411	4	4
66	WD1401	3	4
67	WT1211	4	3
68	ZD2501	4	4
69	ZH2509	5	3
70	ZK1807	3	4

Appendix 7.1: School B Focus Group Transcript

Researcher: Welcome to the [School B] Focus Group for the year nine careers research project... We will go around the room and what I'd like you to do is tell me firstly "why did you decide to do year nine computing?"

Female Student 1: I did IT in year 8 and I loved it and I wanted to do it again.

Female Student 2: I didn't do IT in year 8 but I am looking into a career in environmental science and I know that technology is something that could be in my future so I wanted to broaden my knowledge on it.

Male Student 1: During subject selection, I read through all [of the courses offered] and IT caught my eye so that's really why I chose it.

Researcher: Can you tell us more about what it was in the subject selection that caught your eye?

Male Student 1: I think it was a lot of the programming stuff really, just interested me.

Male Student 2: No particular reason.

Male Student 3: I did IT in grade 8, so I thought that if I did IT in grade 9, I'd broaden my knowledge of it further.

Male Student 4: I chose it because I really had an interest in robotics and IT is an extension of robotics.

Researcher [to Female Student 1]: What did you like about the year 8 IT class?

Female Student 1: I think the way it was taught, there is like social stigmas around IT, that it is geniuses and numbers and programming that that type of thing. The way it was taught made it easy to understand, and I really liked that.

Researcher: What were some of the topics that were covered?

Female Student 1: The programs were mainly Excel, formatting and formulas and that type of thing.

Researcher [to Male Student 3]: You said you did IT in year 8 as well, what was something you took away from that class that made you think I want to do IT again?

Male Student 3: When we were doing it, it was much more interesting than just writing numbers, for instance using all the different word, excel capabilities, it was much more interesting than just using a bunch of numbers.

Male Student 2: I just enjoyed it, I had a stepbrother, I connected to him when he was doing that kind of stuff, and he taught me about that kind of stuff.

Researcher [to Male Student 5]: Was there anything in particular that he mentioned to you that made you think, "that's what I'd like to get into"?

Male Student 2: Just hardware and that type of stuff, how things work.

Researcher: That was just a general question about each of you and how you came to the class. What we will do now is get you to think back to the beginning of the semester, [before we started the careers classes], "what did you think a career in IT was [about] before we looked at them in class? – if someone had asked you during the holidays what a career in IT was about, what would you mentioned?"

Female Student 1: Programming, desk job, boring, my understanding was about numbers and how computers work.

Female Student 2: That was the same for me, in the first lesson we did coding and I found it really boring, and I thought that was what careers in IT was about.

Researcher [to Female Student 2]: So that was the very first lesson in this term?

Female Student 2: Yes, before we started looking at careers.

Researcher [to Female Student 2]: What type of coding did you do in this lesson?

Female Student 2: It was on excel, we just did formulas and stuff.

Male Student 1: Almost anything that included electronic, I though came under the IT umbrella, anything from hardware to the programming of it and the manufacturing, what goes into the hardware.

Male Student 2: I really though IT was games and stuff, programming different software and stuff.

Male Student 3: I really thought it was more website security, website design and robotics area.

Male Student 4: Making electronics stuff, you tell it to do different things, teaching it to do different things.

Researcher: What we are seeing is a bit of a theme, you thought it was going to be a lot of programming and a bit of electronics. Other than programming did you think there was any other IT careers that you though were out there?

Female Student 1: I know there is a lot of design, our mum is a designer and I know there is a lot of scope there.

Female Student 2: Same

Male Student 1: The advancement of technology. Like exploring new type of fields, like facial recognition that Apple uses that haven't come to light yet.

Male Student 2: Gaming, like testing them.

Male Student 3: Designing firewalls and security for websites, a lot of the security side of things.

Male Student 4: Those guys who are paid to go into systems and hack them, I'd really love to do that.

Researcher: We came up with this research because a lot of people do not have much of an idea of what IT careers are, from your parents to students at high School and even students at university, they don't have much of an idea of all the types of jobs that are out in the IT industry. That it is very much programming or security, hacking or electrical engineering. So we thought that having a better understanding of IT careers was an important thing for students to know. So let's see now if we had the right information in the class, did it give you a better understanding of IT than you had before the class. So the next questions are about, now after doing the two-week careers classes, "Has your understanding changed?"

Female Student 1: Absolutely, I do not think you can walk away from the activities we did and not say that, because the way it was structured, I think everyone took away that there was much more about IT, I didn't know much about it originally, I was expecting to learn different things, but what surprised me was how specific they were in each field.

Female Student 2: I thought the individual research was good and presenting it, and hearing other students presenting it was good, it helped us understand rather than hearing it from teachers.

Male Student 1: I think it did change, especially when we looked at the careers wheel, when we got to explore the whole spectrum of IT, a lot of new things where explored.

Male Student 2: When we explored, the jobs and things, it was much more than just computers, we could look at robotics and quantum computing, using more than machines.

Male Student 3: My thought on it has changed, the class was structured well, in most classes I don't listen because I already know the stuff, but this class was well structured and I listened because I was intrigued.

Male Student 4: I just enjoyed learning about how the technology and stuff is used in these jobs.

Researcher: Ok, one of the things I asked you to do at the start of lunch was to list on the paper provided was to list things that you found interesting about the classes – very open ended.

Female Student 1: The functions on a wiki, everyone uses Wikipedia, but you don't realise what actually goes into it.

Female Student 2: How many careers there were in IT was interesting, because I thought careers were just coding and it was quiet boring, but when we looked at all the careers and I thought some were quiet interesting.

Male Student 1: Branching off [Female Student 2], how many of those [careers] were unfilled, which was for the time we were talking about it, how many need staff but don't have them.

Male Student 2: Quantum computing, beyond computers, space / time, new physics.

Male Student 3: What the others have said basically.

Male Student 4: The new stuff, the new careers.

Researcher: Was there any other things you have listed that you thought was interesting?

Female Student 1: The importance of marketing and how to sell a product when we did the elevator pitch – the wow factor.

Female Student 2: The wiki as well.

Male Student 1: The potential for how far an IT job could take you in the future.

Male Student 2: The amount of IT jobs and how many branch off from the main ones.

Male Student 3: Everything has been said.

Male Student 4: You can take a job and just go with that.

Researcher: There are four schools involved in this research, and the research will be provided at the end to all schools in the region for them to use as part of their year nine IT classes. So the last few questions will help us make any modifications needed for the two-week classes. "So let's start off with "what did you enjoy about the classes?"

Female Student 1: I liked the group work, that was really fun. Just the way it was set up, and how you could delegate, and do your own thing but you also had to collaborate, knowing it was an important skill in any career was very interesting.

Female Student 2: I liked the discussion, we all had different ideas that we could share, within our groups and with the whole class.

Male Student 1: The opportunity of the career wheel, that we could explore each career and go into detail about each one.

Male Student 2: Go into detail about each job, how many jobs might suit different people. Some people might not like to sit at a desk, fiddling with things, working on wikis and collaborating that was fun.

Male Student 3: I enjoyed the learning part, some of the information I did not know before and it was intriguing.

Male Student 4: I liked how the teacher would discuss things then we would discuss things in the class. Everyone got to discuss things.

Female Student 1: everyone got the opportunity to share his or her ideas.

Researcher: What do you think could have been improved with the class.

Female Student 1: I do not have anything, I thought it was great and really enjoyed it.

Female Student 2: I really enjoyed it, but some students may have found some of the reading off the screen boring, but I really enjoyed it.

Male Student 1: I really liked the opportunity to learn from my peers, but there were times that some people got a little off the topic. The randomly assigned topics were good, forcing people to be fish out of water on some topics.

Male Student 2: Group work was great but changing the groups each week might have been good too, instead of the same group for elevator pitches and the wikis.

Male Student 3: More time to prepare for the elevator pitches. Some of the groups may felt a bit nervous standing up in class.

Male Student 4: Changing the groups.

Researcher: Any final comments.

Male Student 2: It was fun and we learnt quite a bit, giving us a better knowledge of what is IT.

Appendix 7.2: School D Focus Group Transcript

Researcher: Welcome to the [School D] Focus Group for the year nine careers research project... We will go around the room and what I'd like you to do is tell me firstly "why did you decide to do year nine computing?"

Male Student 1: I selected it because I'd learn some basic useful skills. Basic coding, coding is useful in a lot of different areas. If I got to know the basics of that, I'm able to know the basics for a lot of future careers.

Male Student 2: I had a like for computers and maths, and they sort of crossed over.

Male Student 3: So basically I wanted it as a hobby, for later in life. Designing websites or creating a game.

Male Student 4: I decided to do ICT because it looked interesting, before I'd go on Scratch and fiddle around making games, and I thought I'd like to do a subject that involves around coding.

Male Student 5: I've been fascinated with computers since I was young, so I thought it would very helpful to learn more about computers so I could use them for practical reasons, and I thought the subject would help with that.

Male Student 6: I chose it because I thought I'd enjoy it and I'v always been fascinated with computers.

Male Student 7: I just found ICT interesting and decided to give it a shot.

Male Student 8: Same as [Male Student 7], I thought I'd be a fun thing to do.

Researcher: That was just a general question about each of you and how you came to the class. Before we started the careers classes, "what did you think a career in IT was all about"

Male Student 1: I don't really know that many careers that are clearly have IT involved. It's all going to be about coding and creating new ideas, creative ideas using coding.

Male Student 2: At first I just believed careers in computing would have been all coding, like there would have been too much, just code pretty much. A career in coding would not be very social.

Male Student 3: So basically I thought that it'd be like in class, that you hang around computers, like come up with ideas and try to manufacture something.

Male Student 4: I thought basically coding and programming applications and a lot of maths, I didn't know much about it.

Male Student 5: I thought it would be mainly either doing programming or using certain software programs, not this diverse. I've seen my uncles developing websites and I've seen them doing work a couple of times, and it looked like a shell with code in it, and I didn't think it would be that simple, it looked like all this jargon, but when you get into learning about it, it is fairly simple.

Male Student 6: I thought it'd be a lot of programming and using excel, and stuff like that to make businesses easier with some try of coding as well.

Male Student 7: I thought it'd be quite a bit of coding and like some programming.

Male Student 8: Same as most others, some programming and coding.

Researcher: We've talked mostly coding, "was that the main career you thought a career in IT was about before we looked at the Careers Wheel?"

Male Student 1: I thought it was the main, big part of it, but I really wasn't sure what to expect.

Male Student 2: I thought it was all coding, but now when I look back I see that it is so much more.

Male Student 3: Not really, I thought it was gathering information and gathering ideas of what you are going to do. So instead of doing a job on your own, you could have a group of people working in similar tasks as you.

Male Student 4: Pretty much exactly the same, I always thought it was mainly coding and programming.

Male Student 5: I thought I'd be computer literacy, I didn't know it would be so much more indepth, simple things.

Male Student 6: The same as everyone else, a far wack of it.I didn't know too much about it saw that programming had a big part of it.

Male Student 7: I thought programming was a big chuck of it and then I realised there were many more things you could do with it.

Male Student 8: I thought programming was the main part of it and didn't look past that.

Researcher: We came up with this research because a lot of people do not have much of an idea of what IT careers are, from your parents to students at high school and even students at university, they don't have much of an idea of all the types of jobs that are out in the iT industry. So we thought that having a better understanding of IT careers was an important thing for students to know. So let's see now if we had the right information in the class, did it give you a better understanding of IT than you had before the class. So the next questions are about, now after doing the two-week careers classes, "Has your understanding changed?"

Male Student 1: A little bit, it showed me that it's not that specific, there is a lot you can do that still involves IT, and that is good. I researched electrical engineering in the class, I was interested in engineering and as well as IT, it was interesting to see that mixed together.

Male Student 2: It greatly opened my opinion to what all the careers were about and I suddenly think there is a lot more to these careers than I did before. I researched cyber security.

Male Student 3: So basically it like it kind of got interesting, I researched robotic engineering, so I found that quite fascinating and fun, learning about robots and that sort of things.

Male Student 4: So after the wiki, I researched robotic engineering as well, I thought that makes sense because you had to program robots, then looking at the other options like animating I was so surprised because I didn't know that it used IT as well.

Male Student 5: I figured out that it there is a lot more of diverse areas of IT, that it is not mainly technology and maths that you need to do, it has a lot more art to it.

Male Student 6: My understanding changed after looking at the [career wheel] and there is a lot of different jobs colliding with IT, which I never quite thought could happen, and there is a lot of other jobs than programming. I researched cyber security.

Male Student 7: My understanding changed when I looked at the wheel, there were so many other options. I just thought it would be one section. I researched games development.

Male Student 8: Same, I looked at the wheel and there was so much, I didn't realise that things like robotics and animation needed that much coding. I researched games development

Researcher: There are four schools involved in this research, and the research will be provided at the end to all schools in the region for them to use as part of their year nine IT classes. So the last few questions will help us make any modifications needed for the two-week classes. "So let's start off with "what did you enjoy about the classes?"

Male Student 1: It was good to learn about the different areas, there were a lot of interesting things.

Male Student 2: Just learning that there were a lot of opportunities out there for jobs related to IT, and you don't need to know everything about coding.

Male Student 3: So basically learning more about what my Dad does, I researched mechanical engineering after looking at electrical engineering.

Male Student 4: Pretty much the same, I was amazed at the types of jobs that involved ICT, and found the wheel great to discover this.

Male Student 5: It was interesting to know there are a lot of areas you can learn about in IT, not just one or two. Very diverse

Male Student 6: There are so many sections, and many sections had other options you could go to. Like it isn't just picking like five there's much more.

Male Student 7: There is a lot of options you didn't realise.

Male Student 8: I enjoyed learning about all the different jobs and opportunities.

Researcher: What do you think could have been improved with the class.

Male Student 1: I can't think of things.

Male Student 2: More impactful and memorable. If we recap it again later in the semester.

Male Student 3: So basically if we looked at a few other jobs, those that could link to IT careers.

Male Student 4: I encountered problems with the wiki, a bit more help on how to use the wiki.

Male Student 5: Looking at a few more careers.

Male Student 6: I thought it was well done, I recon it was the right type of thing. Not hard but some parts required having to think about it.

Male Student 7: I thought it was pretty good.

Male Student 8: Other than some more how-to for the wikis, it was good.

Appendix 7.3: Student Focus Group Predictive Findings

Predictive Finding One: Students believe that a career in information technology is programming/coding centric.

Predictive Finding Two: Students select junior high school information technology classes without any clear understanding of what the classes will cover.

Predictive Finding Three: The two-week IT Careers Curriculum would have a positive impact on students' interest in an information technology career.

Predictive Finding Four: The two-week IT Careers Curriculum utilising two different tech-savvy learning activities would be enjoyable to the students.

Appendix 7.4: School B Teacher Interview Transcript

Researcher: In your opinion, do you think that the two-week IT Careers Curriculum had an impact on the students' interest in IT and IT careers?

Teacher: I do think it helped, particularly with the girls, and particularly some boys who did not know why they took the subject but thought it would be interesting. I know that some of the students who had no knowledge of the careers beforehand were surprised at actually what is out there, and what you need IT skills for, so I certainly think it had an impact. I do think there were probably students in the class who knew many of those careers, especially those who had parents or family in the field.

Researcher: What is the gender mix in the class?

Teacher: There were five girls in this class of 20, which is a good mix, though two have now left the school and one has just joined us.

Researcher: Out of the 16 respondents at your school, four of the first or second surveys had to be discounted because either they had filled out the survey for example, by selected all strongly agree, maybe not taking the survey seriously. However, saying that 12 out of 16 was good compared to some of the other schools involved in the research. I know we spoke briefly that you have had concerns with surveys with this year level in the past, can you elaborate?

Teacher: I definitely seen the just tick all A's. Getting them to write a sentence generates probably more individualised answers, but obviously, this is harder to collate. And as long as a teacher supervising and reminding them that it must be appropriate and it will be read. That probably works better, that combination of A, B, C, D and a reason why. That is how I have seen survey work a little better with teenagers.

Researcher: Other than getting the students to add some reflection to their choice of survey responses, can you suggest any other improvements that could be made to the overall curriculum activity, to improve their level of interest?

Teacher: I feel that by the end of the two weeks, they were just itching to get started [with the next activity - robotics]. In our case it was a little bit funny because the teacher left and I hadn't started with them [as you were conducting the class for those two weeks and I was just observing]. They were a little anxious to get started. I wonder about just guiding them though the careers in IT just as you touch on subjects. For example in tomorrow's lesson, we are looking at cryptography. They had to look at cases of data breaches over the weekend, and then in Monday's lesson I will give them 15 minutes for research careers using cryptography. That way it is embedded in what we are doing. Now that we have the resources from the research project, we can go back and access them as we cover different areas of IT.

Teacher: Maybe in the future, we could give a smaller introduction to the IT careers, and then reinforce the level or diverse careers as they start each new topic. I think what we did was valid, I could see the students getting something out of it, but going forward I think I'd just use it for 15 minute here and there as you go through the topics. In theory, if they do this throughout year nine and 10, they should gain a good appreciation of the diverse types of IT careers.

Teacher: Another idea would be to bring in some professionals. What I'll probably do in a few weeks when we are looking at computer systems is get one of our IT technicians to come in with a laptop and pull it apart. I'll also encourage the students to ask the technician about his job and what he does. I think this is a good idea for teachers to do in all subjects.

Teacher: I think it was the variety of careers that they were surprised about. I think when they see the overlap between marketing, or maths and engineering, and that may be already where they are heading, then that's where you start to gain more interest.

Appendix 7.5: School C Teacher Interview Transcript

Researcher: In your opinion, do you think that the two-week IT Careers Curriculum had an impact on the students' interest in IT and IT careers?

Teacher: I think it did help with the careers stuff; they were already interested in IT. It would have been curious what it would have been like if we had used more the years 7's and year 8's when they have to be exposed to it and see how it goes there. My guys already loved IT, but it was good, I think they were like wow, there's a bit more to IT then they realised. A few of them would come in with their ideas of what IT would be and it was good for shifting that [preconceived ideas] I thought.

Researcher: At [your school], what is the structure of the years 7, 8, 9 and 10 IT classes?

Teacher: At the moment, year nine and 10 are electives, years 7 and 8 do not do anything in the digital technology space. That may well change next year, but they do not have anything to do with IT at the moment and then suddenly year nine and 10 [they select IT]. If they already enjoy it [they select it as an elective], and they probably think it is more about playing games more so then creating them. Unless they already enjoy IT and don't care about the geeky / nerdy aura around it, and they is probably why the numbers are low in these classes. It is [seen] as a little too geeky for a lot of them.

Researcher: When did they start doing the year nine elective course?

Teacher: Mine is a composite class, the majority are year nines, and there were 3 kids who did the year 10 work, so the year 10s have had a year at it and the year nines starting in semester 1.

Researcher: So by the time the students did the two-week IT careers classes, they had had 6 months of IT classes already, do you think this could have affected their level of IT careers interest?

Teacher: Yes, that could be the case, especially raising their interest levels for the first survey prior to the two-week class.

Researcher: From the data we received in the first and second surveys, across all four schools, there was no statistical evidence of the students' interest in IT improving. Other than that the students had already been involved in a semester of IT classes prior to the first survey, can you think of any other issues that might have limited the level of improvement we saw in the second survey?

Teacher: For me as a teacher, having one or two more lessons on working through the careers wheel, especially watching more of the videos, would have been great. It was good to give them a smattering of the different careers, though looking at everything may have been overkill. I did think more time on the careers themselves would have been nice. I thought the idea of them creating wikis was nice but it was a brand new concept for me too, so I may have needed more prep time myself, but it was good for the students to see how they worked. But the wikis didn't work so well in class because couldn't all be working on the wiki at the same time. Possibly a collaborative tool like Google Docs would have been a better option where all students in the group could have been working on the task at the same time. I understand the benefit of the wiki is that it can be shared online, where Google Docs is only available to the team working on it. What we ended up doing was having the students developing their notes in notepad and then copying that to the wiki when it was their turn to have wiki access.

Teacher: I know for some of the kids, any of the careers choices rocked their boat, or the group they were in [looked at careers] that it wasn't as interesting to them, they said they had wished at the time they had been in a different group. This could have been first time teething issues.

Researcher: One of the comments from the focus groups was that they wished they could have swapped groups between weeks.

Teacher: Yes that may have helped with this.

Researcher: From your perspective of a year nine teacher, do you think having a survey that asked students to choose between strongly disagree and strongly agree across a 5-point scale would be different for them to differentiate?

Teacher: I hope not, I have struggled with the work ethic with the students in this class, "come on step-up", so there may have been a little of that, but I don't think even the weakest student would have had any issues with strongly disagree to strongly agree. I do not think they misunderstood the survey, when I walked around the class there were not any questions. I did not see in their eyes that they were having issues with the questions, but I did not police it too strongly. Perhaps you could have used terms like super happy for agree and super unhappy for disagree, but heck this is year nine, they are only a year or two off senior level. There is often a lot of talk about the year nine's when it comes to NAPLAN, how they do more poorly than the year 3 and 6's, that it is possibly an issue with the work ethic of this year level in general.

Teacher: My class is also very boy heavy, I think it might have been better if there were more girls in the class, I think, just that the girls seem to have their future heads screwed on a bit better than what boys are at that age. Honestly, they [boys] have to get through 18 and driving cars fast, long before they think about settling down with families and mortgages, they are just so not on that plain at all. So it could be a little of that too. I've noticed even with the year 12s, it's not uncommon for the girls to be pushing and doing the hard work, and the boys starting to ease back, almost apathetic "ah well if the girls want to do it I'm not going to stop them" but it's not setting anyone up well for the future. Even 10 years ago in Gladstone, it was the girls in year nine that were getting the A's and the boys were getting the B's and being mightily upset about it but they didn't do the work. I think by year nine you've got hormones kicking in and they want to be treated as grown up and taken seriously but they want all the perks I had when I was four, particularly with the boys. For a lot of them, particularly if you got well set up in primary school, particular with parents helping as well, they get along well, the day of reckoning doesn't come up till parents start to pull back, "I don't know so much about high school and such" then all those little holes and gaps that you picked up on the way. And when we try to build on them, you kind of reach a crunch and I think a lot of them stick their head in the sand hoping that it goes away.

Researcher: Out of the 9 respondents at your school, two of the first or second surveys had to be discounted because either they had filled out the survey for example, by selected all strongly agree, maybe not taking the survey seriously. However, saying that 7 out of 9 was good compared to some of the other schools involved in the research. They may have been legitimate responses for those students but we have chosen to remove them because they appear to be outliers.

Teacher: I had not thought to say anything to the class; I presumed that none of the students would think to donkey vote their way through. It could be something to do with year nines "I'll just answer all strongly agree as it is easy, rather than think about my answer". I may not have given them a lot of time as well, if I hadn't given them enough time to think carefully about each question and the bell is about to ring …

Researcher: As a general question, we had constraints on how much of the term we could use for the IT Careers Curriculum, what could we have done differently in that time frame to improve the students interest in IT careers?

Teacher: I feeling I got in the class, was that because it didn't count towards grades, and I was not going to assess them standing up in front of their peers, whether that cut both ways. I understand the concern that we don't want to assess everything, you don't learn for the sake of learning. Whether there was some of that element, "it's ok, if I do a poor job, I won't get detention".

Teacher: I think they basically worked alright, I do think more time and practice in giving [presentations], for a lot of the groups they were not used to working in the groups in this sort of style, delegating the jobs and that sort of things. I don't know if at year nine they have had a lot of practice, perhaps if they had the time to have a couple of goes… Have a go, get some feedback from the teacher and the class, then let's do it again, maybe with mixed up groups, with a different career path, look more closely at the career wheel information and watch the videos more closely, getting your ducks in a row, would be better. Maybe start with a basic presentation individually and get feedback (like an elevator pitch), then move on to a more detailed group presentation (reception pitch) with well-developed PowerPoint slides etc. It would be nice to get them to look at more careers, there were so many there. Also my guys were not used to talking in front of the class, I know it is an important skill but it is something they learning as they go through school. I think it is both ways too, if you do the presentation yourself you can focus in on yourself and your presentation, but in a group you can kind of hide behind other people and learning not much. They weren't being rebellious or slackers, it was more that they didn't know how to tackle this [activity]. [I] probably didn't divide the task up well, it is something I could do differently as well. "Ok you've got 20 minutes, work out in your group your plan of attack and come to me, and I want to hear how things are going". A little bit more of a learning curve, "ok I need you to contribute a bit more, your mate is doing all the work…" sort of feedback as you go, rather than how it ran. Have a lesson to prepare, and then up and talk… Then move on to the next activity.

Teacher: I do like the idea of spending more time on it [presentations] they are great skills for the students to have. I definitely didn't have any issues of any heckling or anything like that, that I've had in years past when I've done this type of stuff. They were a good bunch of kids, so it may have been just a little awkward and not enough time to get some success with it.

Researcher: The focus groups were a different story, the feedback for the students in these groups were that they found the class interesting, that they discovered information about careers they not heard of and they found these new careers to be of interest for future careers.

Teacher: Maybe surveying year nines was not a good way of collecting the information, if the focus groups gave better information. Talking and sharing about their experiences might be a more important way of collecting information for these students.

Researcher: Other than getting the students to look at more careers, can you suggest any other improvements?

Teacher: Another thing was that I didn't work through the survey questions with the class, and none of them asked for help, but that could be seen as an uncool thing to do. Perhaps if I'd worked through each question in turn, "so what do you think this means?" that could perhaps be a way of just making sure they understand the questions.

Researcher: The one question that was shown as significant to your class was "I am interested in alternative programs in Information Technology".

Teacher: I wonder if that refers to them wanting to do more computing at high school or university?

Researcher: What is the gender mix in the class?

Teacher: There was only 1 girl in the class, but she left part way through the class so really there was none. My experience at Gladstone was similar.

Researcher: In semester 1, what IT did the class do?

Teacher: We came across Grok Learning part way through the semester. We had done a little bit of intro to HTML and CSS, then segwayed into the careers classes. We had also done the National Computer Challenge. We also looked at the hardware of a computer and developed a computer quote. We also spent a lot of time working on spreadsheets, looking at compound interest and investigating using Goal Seek.

Appendix 7.6: School D Teacher Interview Transcript

Researcher: In your opinion, do you think that the two-week IT Careers Curriculum had an impact on the students' interest in IT and IT careers?

Teacher: I was surprised how little they knew before, I guess you assume the age group they are in that technology-wise they know what careers could be done, but had very little idea, very narrow… gaming, just gaming and a little bit of coding.

Teacher: I think the ICT careers wheel was useful, it may not be immediate but for subjects in year 10 it will be in the back of their minds, when it may not have been before. It is a bit difficult because a lot of them are interested in the social media side of things, but when you look at senior there is nothing to do with it, but it is something that would be looked at after school, at least it is there.

Teacher: Doing the careers course with just year nines is only targeting a small amount of students, they had already selected IT in year 8. In our context, our school it would be better to run the careers class in year 7 or 8 before they do year nine subject selection.

Teacher: I guess it highlights a downside with the careers wheel that the vast majority of the careers wheel is not relevant to the senior IT subjects, the narrow computer science focus of IPT [year 11 and 12 Information Processing and Technology subject] or Digital Solutions courses. They are all about Data and Programming pretty much.

Teacher: We would use the careers curriculum again, we might modify it slightly but the careers wheel was good. Boys being boys, in that age group we added the task of looking at the money [income] first and how much study is involved in each career.

Teacher: With my class, we did the elevator / reception pitches but by the time we finished that, we did not move on to the wikis because they had started to lose some interest. One week would have been enough. We would then integrate or link the careers wheel into the rest of the topics covered to reinforce rather than just relying on the one two-week point in their course. We would be happy to run the course in late year 7 or early year 8 just to cover all students in the school, the content wasn't too heavy for students in those levels.

Researcher: Other than getting the students to do the curriculum in year 7 or 8, can you suggest any other improvements?

Teacher: The careers wheel could load more videos of someone who is working in that field; some of the videos were not as relevant. Videos similar to the QUT videos that are available. The boys do talk about those videos when they talk about their future careers. Videos about various kids working for various companies and what they have done, and the pathways involved.

Researcher: Out of the 29 respondents at your school, eleven of the first or second surveys had to be discounted. From the data we received in the first and second surveys, across all four schools, there was no statistical evidence of the students' interest in IT improving.

Teacher: I think that is indicative of the surveys we have seen with that age group, especially boys, do not take them seriously. It would be interesting to also not the time taken to do the survey, as that would be a good indicator of level of engagement. They do care about these things but you get that by talking to them rather than through a survey, the way or mode of a survey rubs up against them.

Teacher: We could examine more closely at the end of their presentations, getting them to discuss whether they found the careers to be of interest, and whether they are now considering IT careers for the future. Maybe as a one or two minute video, you would get a lot more from that.

Teacher: I would definitely run the careers curriculum again; it was definitely worthwhile being on board with the project. Many staff make the mistake that these guys can use technology well, which we do not, but I must admit making the mistake of assuming they understood the types of careers there were in IT, which they do not. Going forward we would use it in the lower grades and just make sure the content is pitched at the right level for them and maybe even look at using a guest speaker.

Appendix 7.7: Teacher Interview Predictive Findings

Predictive Finding One: The two-week IT Careers Curriculum had a positive impact on students' interest in an information technology career.

Predictive Finding Two: The tech-savvy activities provided good learning opportunities for the students to increase their interest in IT careers.

Predictive Finding Three: Likert scale survey questions are not reliable as data collection tools when collecting data from junior high school level students.