IS CHANGE ON THE HORIZON FOR FEMALE HIGH SCHOOL STUDENTS WHEN IT COMES TO ICT?

A Thesis submitted by

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Abstract

This thesis explores girls' perceptions and attitudes towards ICT at high school. It asked what factors discourage or encourage participation of girls at year 11 of high school towards ICT education. The exploration involved a mixed methodology that utilised a survey and a semi structured interview to highlight findings in the survey.

It was found that girls by year 11 lose interest in ICT, this came down to many factors, such as girls perception of the industry not being diverse in people or culture, their attitude towards the subject being dull or boring, the subject not catering for creativity, innovation or imagination, the subject was just programming and was too technical. All these factors and attitudes add to the strong stereotypical image that year 11 girls had of ICT. This stereotypical image also impacted on the girls' self-confidence around ICT as they perceived the subject to be coding and technical, which gave the girls a negative perception of ICT.

It can be shown that there are many perceptions and attitudes towards ICT that have an effect on year 11 girls to a greater or lesser degree, these factors include, prior experience, self-confidence, culture and generations. Girls find themselves dismissing ICT early on in their school life because of negative perceptions and attitudes. It was found that from the results of the employees their finding aligned with what was already known regarding issues and problems within the sector. These finding helped to re-enforce those stereotypes and perceptions. However, an interesting finding that emerged from the results showed that role models for girls has a very limited life span, as girls became employees within companies they look less towards role models personally and from a career perspective.

It was clear from the results that girls at year 11 of high school were discouraged more than encouraged by perceptions and attitudes towards ICT. Girls had already made their minds up by year 11 that ICT was not the right option or career choice to follow. To make a difference for girls in ICT, schools need to start looking at promoting ICT as being creative, imaginative and getting students working on projects that they are passionate about in the first few years of high school.

Certification of Thesis

This thesis is entirely the work of *Scott Morton* except where otherwise acknowledged. The work is original and has not previously been submitted for any other award, except where acknowledged.

Principal Supervisor: Associate Professor Petrea Redmond 26/07/2019

Associate Supervisor: Professor Peter Albion 26/07/2019

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

List of Publications

Morton, S., Redmond, P., & Vos, M. (2018). Is change on the horizon for Māori and Pacific female high school students' when it comes to ICT. In E. Eturk (Ed.). Proceedings of the 9th Annual Conference of Computing and Information Technology Education and Research in New Zealand (46-54). Retrieved from https://www.citrenz.ac.nz/conferences/2018/pdf/2018CITRENZ_1_Morton_Māori.pdf. This presentation won the best collaborative paper award at the conference.

Morton, S., Redmond, P., & Albion, P. (2018, 3rd to 5th December). *Factors discouraging participation of girls in ICT education.* Paper presented at the 29 Australasian Conference on Information Sy STEMs Sydney, Australia.

Morton, S. & Redmond, P. (2015). The odd one out: Revisiting and investigating the gender imbalance in ICT study choices. *Journal of Applied Computing and Information Technology 19*(1), 2-3.

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If someone had told me that I would spend seven years researching into a specific subject in my spare time to fulfil the requirements of a PhD, I would have turned around and said you were mad. I am doing a full-time job and raising a small person (who did not arrive until two years in); I do not have the time. Seven years on, I have completed my biggest ever challenge with the help of some special people that I have met along the way and some who have been with me from the start.

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Abbreviations

ACC - Auckland Chamber of Commerce

ACS – Australian Computer Society

AI – Artificial Intelligence

CBD – Central Business District

CSGF - Chi-Square Goodness of Fit

CS – Computer Science

GIS – Geographical Information Systems

HCI – Human Computer Interaction

ICT – Information Communication Technology

IS – Information Systems

IT – Information Technology

ITP – Institute of IT Professionals

KMO - Kaiser-Meyer-Olkin

ML – Machine Learning

MMR – Mixed Method Research

MP3 – MPEG-2 Audio Layer III (Moving Picture Experts Group (MPEG))

PCA - Principle Component Analysis

SCCT - Social Cognitive Career Theory

SPSS - Statistical Package for the Social Sciences

STEM – Science, Technology, Engineering and Mathematics

TTYA - Technology Takes You Anywhere

TV - Television

URL – Uniform Resource Locator

VR – Virtual Reality

WIFI – Wireless Fidelity

1 INTRODUCTION

1.1 Introduction

The information, communication and technology industry (ICT) today offers wide and varied employment opportunities for all school leavers. However, for many years the ICT industry has had a problem in recruiting diverse cultures and women to work in these environments (Mansour, 2018); Redmond and Gutke (2019) writes about the number of women earning bachelor's degrees in science, technology, engineering and math (STEM) fields being low. Their interest in ICT declines over time, starting at primary school then on to secondary school and finally higher education. From these three areas of educational study, this study endeavours to examine factors affecting girls' decisions about ICT in secondary school at year 11.

1.2 Research Problem

Western countries are seeing a shortfall of graduates from university to fill the ever-increasing ICT job market (Kirlidog, van Der Vyver, Zeeman, & Coetzee, 2018; Premack, 2018; Starr, 2018; Uhomoibhi & Ross, 2019; van den Hurk, Meelissen, & van Langen, 2019). In an investigation carried out by the Auckland Chamber of Commerce (ACC), 61,000 students across Auckland high-schools were surveyed regarding ICT qualifications. Ryan (2015) interviewed Michael Barnett from the ACC, who raised a concern that only 6% of students in Auckland would gain the ICT skills necessary to get a job in the ICT industry immediately after high-school. The finding confirms a lack of ICT understanding within schools, and that the majority of school leavers do not have the necessary ICT knowledge required by industry to get full-time employment. According to New Zealand Immigration the Information Technology industry (IT) grew by more than 12% last year and IT businesses topped 11,000 with over 100,000 people employed in the sector. New Zealand immigration have fifteen jobs on the ICT long term skills shortage list and that list keeps on growing each year as demand for ICT jobs keeps rising (New Zealand Immigration, 2019).

To date, there has not been sufficient research that examines the connection between generation Z and the other generations, millennials/Y, X and baby boomers have on the

perception and attitude towards ICT. It is also important to understand what the ICT industry requires from generation Z when it comes to ICT. In summary, being able to find out what generation Z (year 11 high school girls) think about the generational effect and the factors that cause rejection of ICT would be interesting. Also, the industry perceptions and attitudes towards ICT may provide new evidence for generation Z about ICT.

1.3 Aim and scope of the study

Students at high-school in year 11 have been using ICT at home before they started school and have been at the forefront of the disruptive era and have seen first-hand how quickly this industry evolves. However, the increase in ICT related jobs has not translated into more students wanting to study ICT and progress into an ICT career. The low numbers of students wanting to study ICT equate to a significant shortfall for qualified ICT people in New Zealand and around the globe. The New Zealand government has recognised this issue and developed a reformed curriculum, being introduced in high-schools by 2020 ("Te Kete Ipurangi", 2019). The new digital technology programme will be taught in year 1 and progress through consecutive years. This will weave ICT into the fabric of many subjects. However, the problem for industry is that they have a problem now that needs addressing.

There are many reasons that girls reject ICT at high-school and focus on other areas. Hatlevik, Throndsen, Loi, and Gudmundsdottir (2018) believed that self-efficacy has a part to play in girls rejecting ICT at school, as girls' confidence when using technology is shallow, and the girls are not willing to take risks in case they break something and cannot find the solution to the problem. Another reason girls are rejecting ICT is that they cannot see people like themselves in the industry (Stern, Frensley, Powell, & Ardoin, 2018). Girls cannot see young females of different nationalities or colour doing ICT jobs. Stern et al. (2018) go on to suggest that this stereotype promotes the lack of interest from girls to work in the ICT sector because the industry shows no diversity.

Research conducted internationally has identified many social and educational factors, such as learning environments, which can affect high-school students' choices. However, over the past decade in New Zealand, there have been relatively few studies

that have investigated this subject matter (Abbiss, 2005; Hamilton-Pearce, 2009). This study is significant as most New Zealand studies have not explored the social media, generational effects or the disruptive era that society now works with. Moreover, it explores the understanding of what employees in the industry think regarding ICT and the perceptions and attitudes that need to be addressed to make more attractive to high-school students, especially girls.

In order to understand the rejection of ICT study or as a career choice for year 11 girls, the research aimed to investigate what perceptions and attitudes discourage or encourage year 11 high-school students from studying ICT at school. The problem is summarised in the primary research question for this study:

What factors discourage or encourage the participation of year 11 girls' in ICT education?

To understand the factors that discourage and encourage the participation of girls in ICT, four sub-questions were developed:

a) Has the disruptive era changed girls' perceptions and attitudes about ICT?
b) How do girls' perceptions differ compared to those of boys when it comes to ICT?
c) What impact does technology have on attitudes and perceptions of girls towards ICT?
d) What generational effects discourage or encourage the participation of girls in ICT?

To accomplish this objective and to provide a context for the study and identify themes and gaps, a review of the literature relating to the factors that have an impact on students, especially girls, and their interest and involvement in ICT was carried out (see chapter 2). Where possible, the focus of the literature was based on high-schools and research in a New Zealand and Australian context. However, a large portion of the literature was completed outside of New Zealand and Australia. This required the literature review to look towards countries that had similarities in population and culture, such as many westernised countries, like the United States of America and Europe. The literature used within the thesis comes from a variety of disciplines including Information Science, Computer Science, Psychology, Gender and Sociology.

1.4 **Definitions**

ICT refers to information and communication technologies. For the purpose of this study this is taken to mean a wide range of technology and tools. These technologies and tools move quickly and at the time of undertaking this study ICT included computers (desktop, laptop, notebook, tablet and portable device), computer networks, mobile phones, digital cameras, web cams, peripherals such as audio recording devices, printers as well as infrastructure that supports connection of these devices. ICT can also refer to the internet and all online tools that can be associated with the internet and software.

Popular culture as defined by Kidd (2017) states that "Popular culture is the set of practices, beliefs, and objects that embody the most broadly shared meanings of a social system" (p. 1).

Disruptive era refers to technology and society evolving much quicker than businesses can adapt. This can disrupt traditional market platforms in a short period of time. Globalisation has also changed the way customer shop and their needs to receive goods. Online shopping can be described as being disruptive to the old fashion bricks and mortar store (Noordin, Othman, & Rassa, 2018).

STEMcell is defined as 'STEM' combining Information Technology (IT) in the broader STEM field (Science, Technology, Engineering and Mathematics) and the 'Cell' looks at the individual (Bernhardt, 2014)

Generational effects refers to experiences shared by a group of people who came of age together, such as generation Z, millennials/Y, X and baby boomers. These shared experiences will affect their political views, popular culture and ideology(Jones, Jo, & Martin, 2007).

Generation is a term used to describe a group of people born between a specific time span. (Howe & Strauss, 2000); Jones et al. (2007); (Lancaster & Stillman, 2003; Martin & Tulgan, 2002; Oblinger, Oblinger, & Lippincott, 2005; Strauss & Howe, 1997; Tapscott, 1998; Zemke, Raines, & Filipczak, 1999) state "In each cohort, individuals share a group identity with a common social history" (p. 2). Those people that grow up within these cohorts seems to share similar attitudes and traits. Strauss and Howe (1997)

suggested that each generation or cohort span around 20 years for each cohort based on work carried out on generational similarities and differences over the last 550 years.

Based on Reeves and Oh (2008) the following Figure 1.2 depicts the different cohorts from the latter of the 20th century into the 21st century.:

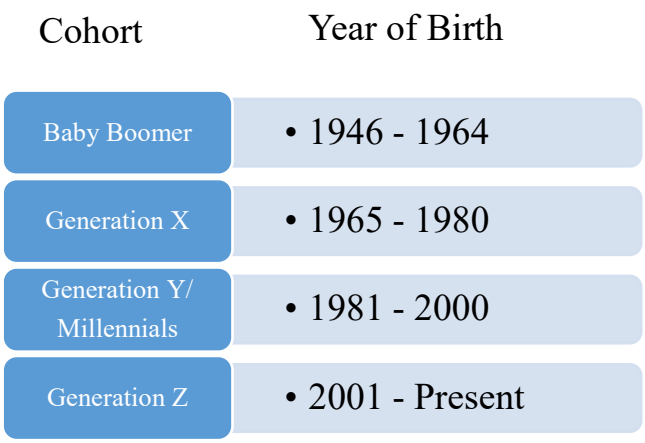


Figure 1-2. Reeves and Oh (2008) Cohort and year of birth Created for this study

In the context of this study 'girl' is intended to mean a female studying at high-school and the term 'female' when not referring to a specific age. The same is applicable for the term 'boy', signifying a male studying at high-school and the term 'male' when not referring to a specific age.

Career and career choice is an occupation that is undertaken for a significant amount of time in one's person life that has the possibility of progression. Most people have an interest in a certain career and career path, a choice implies some action or steps taken to achieve the outcome, that being the career chosen. A job has very little impact on your future work life, however a career can provide you with experience and learning along that career pathway.

Western or Westernised is intended to mean cultures that identify with western ideology this includes people that are born in New Zealand and have European heritage.

1.5 Methodology

The researcher wanted to carry out an online survey followed by semi-structured interviews, so a mixed approach seem the best course of action. Multiple schools and businesses across Wellington's central business district (CBD) were contacted. The study looked at year 11 students, both female and male from high schools and for ICT employees, both female and male from the industry. Each set of participants would fill in the online survey for phase one. From the information gathered, phase two would use the data from phase one to create questions for the semi-structured interview. A selection of participants were then picked for the interview phase,

The limitation for the study was imposed by the researcher to include high-schools and companies that were in a 5-kilometre radius of the CBD in an attempt to make the selection of schools manageable and create a boundary for the study. Only coeducational high-schools were involved in this study to allow both boys' and girls' influences and attitudes to be examined within the study. All year 11 students and employees were invited to participate in both the survey phase and the interview phase.

1.6 Significance of the study

One intended outcome of the study on a theoretical level is to identify a set of factors that can be used in a framework. These factors will signify major themes, such as school, industry, home and government. A second intended theoretical outcome of the study is to find out if the generational effect has any influence on perceptions and attitudes of year 11 girls when it comes to ICT. Further, a third intended outcome will contribute to the knowledge space by advancing understanding of factors associated to perceptions and attitudes that discourage or encourage year 11 girls when it comes to ICT

1.7 Overview of the study

The thesis consists of seven further chapters which has three sections. Section I (chapter 2 & 3) place the current study within the related literature and establishes the research methodology. In chapter 2, it begins with a look at theoretical underpinning

of different theories used within the study, which has helped guide the enquiry. This chapter includes a critical review of the historical and current theories based on the literature, leading to using a framework approach to answering the main question based on the gaps in the literature identified. The publications were sought through an open ended search using multiple databases to include as many areas as possible. Chapter 3 outlines the methodology and the research method design, providing an ontology and epistemology that matches the researcher's beliefs. It also describes the instrument and protocol design and outlines the nature of data collection through surveys and interviews. The chapter also outlines the role of the researcher through the data collection phase. The chapter also describes how the data was analysed and identified ethical considerations that came up within the context of the study.

In the next section, (chapter 4, 5 & 6) present the results of the data analysis. The findings and analysis are presented in these three chapters. Chapter 4 starts with a detailed description of the schools and students and provides an insight into the context in which the schools and students are situated within Wellingtons CBD. The chapter shows the results of the survey, which are broken into section based on the survey. Chapter 5 starts with a description of the types of employees and companies which provide an insight into those participants within the Wellington CBD. This chapter follows on from chapter 4 and uses the same design for the results. Chapter 6 starts with an understanding of who was chosen for the interviews from both the students and the employees and how the interviews were conducted. The next part of the chapter focuses on the emerging themes found through the use of software tools. The last part of the chapter uses those themes found to show the results from both students and employees.

The final section, section III (chapter 7 & 8) contain the discussion, conclusions and recommendations of the current study. In chapter 7, the discussion of the key findings are expanded by using the conceptual theoretical framework created in chapter 2. The final chapter, chapter 8 concludes the current study by answering the main question and sub-questions. Recommendations are made based on the major key themes found in the framework. The chapter also identifies limitations of the study and implications for further research into perceptions and attitudes with school teachers from across New Zealand.

2 LITERATURE REVIEW

2.1 Introduction

This chapter presents the review of literature relating to factors that discourage or encourage girls at year 11 of high school in ICT education in New Zealand and internationally. This chapter also presents literature related to different theories associated to gender and what makes genders different. Literature pertaining to perceptions, technology impact and generational effects.is also utilised in the exploration and explanation of the emerging themes. As a male studying girls perceptions and attitudes towards ICT and the reason why they choose different avenues I do not plan in entering into the gender theory debate, however, in the study the research has looked at girls perceptions, attitudes and motivations that discourage or encourage girls to pursue ICT at school and onto higher education or an ICT career. The researcher has for clarity around gender theory touched upon some of those theories associated with gender theory but has not go into too much depth as this is outside the scope of this study.

2.2 Theorising ICT through gender

When it comes to gender and ICT (Wajcman, 1991) believed there are three distinct perspectives, being technology as hardware or inanimate physical objects, ICT captured in knowledge in different areas and what people do with technology. This final perspective reflects a social view of ICT as culture, where technology is seen as a valuable tool that becomes influenced through social interaction. It has been argued that gender can be a key dynamic in understanding the meaning of ICT as it relates to computing (Vitores & Gil-Juárez, 2016). Social standards have dictated this through education by associating ICT experts with masculine roles,

There have been conflicting views that surround gender and ICT. For some, ICT is socially neutral and becomes irrelevant to gender. For others, ICT it becomes socially constructed and gendered. Another distinction comes from those essentialise gender and ICT and those who taken an anti-essentialist stance. The former believe ICT can be seen

as masculine or feminine and gender dominates areas of ICT. However, anti-essentialists argue that social constructions of ICT and gender move with the changing nature of ICT, causing both gender and ICT to have problems (Keddie, 2005).

Critical reviews in the gender and ICT debate have led to the emergence of individual differences or a different way of thinking. Trauth (2006b) suggested rejecting essentialist arguments by looking at individual experiences that shape understanding. Individual females and males may have different experiences of ICT and of gender relations surrounding technology based on context and their past experiences. Those that take a critical perspective on gender and ICT do not deny there are differences between boys' and girls' perceptions and attitudes towards school and ICT, or that there can be a socio-economic difference and cultural bias causing these perceptions in some ICT related courses and careers (Quesenberry & Trauth, 2012).

2.2.1 **Is it a girl or a boy**

For individuals, gender is assigned when they are born based on their genitalia at birth. Most parents create a gendered world for their children by naming and dressing them appropriate to their gender. Once a child is able to talk those gender related differences start to take shape and by the time the child reaches puberty they are already shaped by their gender and the expectations that go along with them. Gender of children is also reinforced by their parents where there are different expectation for mother and fathers. The work that parents do also has an impact of that child as their work shapes their life experiences. These experiences produce different ways of thinking, feeling and relationship that parents have with each other and their children. All these constructs constitute the social construction of gender through feminine and masculine traits (Lorber, 1994). Children's sense of which gender they belong to usually develops around the age of three at the time they start to form bonds with other children and within their group. In childhood, children develop gendered personalities and sexual orientation through their interaction with parents, friends, media and social media which guides them into gendered work and family roles (Lorber, 1994).

Through cognitive development children learn, extract and apply their own actions applicable to their own gender as well as race, ethnicity and social class. If social categories are highly valued then children will also value themselves highly. Once these

gender constructs are ascribed to the child then social order constructs hold for the gendered norms and expectation. In social constructs of gender it does not matter that women and men do the same thing, the social institution of gender dictates that what they do is perceived different (Chodorow, 1974). Gender has many components as a social institution, but here are a few that are believed to be most appropriate, taken from Lorber (1994):

- Gender statues – the socially recognised genders in society
- Gender division in the labour market – work assigned to different genders
- Gender personalities – how different genders are supposed to feel and behave

As for an individual, gender is composed of some of the following, again taken from (Lorber, 1994):

- Gender identity – the individual sense of gendered self
- Gender personality – internal patterns of emotions through family and parenting
- Gender display – presentation of self through dress, makeup and adornments

As a process, gender creates social differences that define women and men. Through social interaction the lives of those individuals learn what is expected, act and react in expected ways which creates and maintains the gender order. Everyday interactions builds gender into family, work and school which then reinforces those gender expectations.

In a gender organised society, men are usually more valued in what they do more than women, even when their jobs are identical. The Freudian theorists claim that "boys must reject their mothers and deny the feminine in themselves in order to become a man (Chodorow, 1974, p. 165). The Marxist feminist explanation for gender inequality is that by demeaning women's abilities and keeping them from learning technology skills, bosses can keep them as cheap labour (Lorber, 1994). Even in westernised countries where boundaries are less rigorous around gender, women and men spend much of their working lives only working with their own genders. This separation in the workforce reinforces differences, identity, ways of thinking and behaviour (Coser, 1978).

2.2.2 Disruptive innovations

In business theory the current theoretical understanding of the disruptive innovation which has been taken from Bower and Christensen (1995) discussed a simplistic idea that established companies fail because they do not keep up with technology. However, this simplistic approach does not relate to modern companies and the real world. Companies are aware of innovations within their industry but their business environment does not allow them to pursue those innovations because there are not profitable for the company (Bower & Christensen, 1995). Bower and Christensen (1995) go on to and suggested that a company's existing value network places insufficient value on the disruptive innovation to allow that company to pursue that technology. It also hold true for education and the way generation Z students learn.

Disruptive technologies are defined "as an innovation in technology having a major effect on the old technologies, making them obsolete" (Noordin et al., 2018, p. 6). This disruption through technology has moved the modern business landscape into a new era. Many old business models have been abandoned because of the uptake of technology, causing companies to adopt more of an agile approach to business (Noordin et al., 2018). Creating disruptive technologies has allowed the ICT sector to create new markets by providing a different set of values which overtakes existing markets, such as 'Lime' scooters who have impacted on the public transport system across New Zealand. These changes to the old business models have also impacted employment and the types of jobs available and the type of people that businesses are seeking. The World Bank's 2019 World Development Report on the changing nature of work outlined how disruptive technologies are shaping the demand for new skills in the labour market by replacing repetitive jobs through automation and expecting employees to possess more creative and innovative skills to keep up with the rapidly changing environment (World Bank, 2019). The disruptive era can be described as an era in which technology and society are evolving faster than businesses can naturally adapt (Noordin et al., 2018). New digital platforms are disrupting traditional markets and globalisation is rapidly changing customer needs and expectations. Companies are failing to meet the challenge of this disruptive era. However, today's businesses need to move quickly using agile methods, be adaptable and innovative. Organisations are struggling to find people with the skill sets to move their companies into the new era. Companies are finding that their

internal structures are inadequate and are increasingly out of step with the external environment. The disruptive era's design is the polar opposite to the traditional learning environment that education has adopted over many decades towards the focus on individuals and how they accomplish tasks (Salam, Zeng, Pathan, Latif, & Shaheen, 2018). The disruptive era focuses on creativity, innovation, imagination and collaboration, allowing organisations to work in an agile manner, learn continuously from success and failure and to share learning collaboratively to encourage group mentality.

2.2.3 Theory of generations

When looking at ICT, education and the ICT industry the study will look at different genders, cultures, ethnicities and ages. Being able to understand those different areas different theories need to be examined. The theory of generations is a theory where people are influenced by events that happen, especially if those events include them, giving rise to a shared experience for that particular cohort, in-turn influence events that shape future generations (Pilcher, 1994). Mannheim's (1970) seminal work of the early nineteenth century about generations, identified modes of behaviour, feelings, thoughts and experiences during early periods of people's lives form social generations. However Mannheim's work lacks any guidelines on what generational consciousness should involve.

Strauss and Howe (1997) generational theory define people born over a span of roughly twenty years or the length of one phase of life, i.e. childhood, young adulthood, midlife and old age. A generation is identified by looking for cohorts that share three criteria. First criteria, age location in history where the cohort share historical events and social trends. These cohorts are shaped in a lasting way as they share these experiences through childhood and young adulthood, giving them a shared common beliefs, behaviours and perceived membership to that cohort. For the purpose of the study, cohorts or generations that were defined by Strauss and Howe (1997) have been used throughput the thesis.

Strauss and Howe (1997) described generations or cohorts as a four stage cycle of social era which they coined 'turnings', these are: the high, the awakening, the unravelling and the crisis. According to Strauss and Howe (1997) the first turning is called the high

which occurs after the crisis. During this turning institutions are strong, society is strong and know where they want to go collectively. The second turning is the awakening, this is where institutions are attacked in the name of personal and spiritual autonomy. Young adult activists look at the first turning as an era of cultural poverty. The third turning, the unravelling looks to oppose the first turning by seeing institutions as week and individualism as strong. The final turning is the crisis, the era of destruction, in which institutional life is destroyed and rebuilt in response to the perceived threat. This fourth turning mirrors traits in those from the G.I. generation (born 1901 – 1924) of coming of age during this era and a collective outlook with those of the latest generation, generation Z coming of age by collectively coming together to fight the climate crisis, giving this turning a sense of belonging.

2.2.4 The normalising effect on genders

Gender stereotyping is learnt from an early age; at home the toys that children play with, cars for boys and dolls for girls, promoting the difference in genders (Francis, 2010; Varney, 2002). Throughout school the way children are taught using masculine and feminine teaching habits and teachers playing a leading role in certain subjects, such as male teacher for technical subjects and female teacher for social subjects (Abbiss, 2011; Clayton, Hellens, & Nielsen, 2009). Today's children also have social media and the imagery portrayed by different companies in genderising the information that young adults or teenagers see (Murire & Cilliers, 2019; Noordin et al., 2018; Pangrazio & Selwyn, 2018). All of these influences start to build a gendered person, be it female or male, and the information that these children take in start to mould an image of what and who people in the ICT are and do. This promotes those stereotypical images that generation Z students have about ICT and the industry, thus promoting the normalisation of those particular stereotypes of people associate with ICT and the industry. Generation Z students use of social media has grown over the past decade exposing them to these stereotypes which again starts to make the information they are taking on become the norm for ICT, helping to cement their perceptions and beliefs about the ICT sector (Noordin et al., 2018).

These stereotypes that children see on all platforms, including social media have not changed much over many decades. These stereotypes are pasted down from one generation to the next with only slight changes for the differing landscapes used by the

latest generation (Berg, Sharpe, & Aitkin, 2018). So when girls search for information on ICT and related careers the imagery that is presented is normally stereotypical of a white male. The more girls and young females see regarding ICT and the industry the more normalised those perceptions and attitude towards ICT becomes (Berg et al., 2018). Through gender, girls then feel the need to adapt to these social norms and react to a male-dominated filed by choosing more gendered lines of work, thus meeting the social expectations (Pechtelidis, Kosma, & Chronaki, 2015).

Abbiss (2011) from her study carried out with year 12 high school students stated that "within a structural and discursive gender order that normalises differences in what male and females 'do' with computer" (p. 614), suggesting students that had been brought up and exposed to gendered things from family, school and peers would gravitate around stereotypical gender related experiences by giving into the norms of computing which can enable or restrict girls engagement in ICT. Girls also saw technical computing as a masculine domain and to participate in technical areas means going against the norm, which underpins the normalisation of gender identity within the ICT sector. It was also apparent from Abbiss's (2011) study, that normalising gender identity was shown from the discussion, stating "It does, however, recognise that gender identity is a technological site and acknowledges the potency of the social construction of gender and ICT and regulatory influence on individuals that act to sustain gendered preference and pattern engagement on ICT courses" (p.615).

2.2.5 Generational differences, traits and styles

Due to the large number and the times in which they matured, baby boomers made an impact in the societies they lived. This made them idealistic and very work driven, for them financial success came at a personal sacrifice (Glass, 2007). Generation X are the polar opposite to that of the baby boomers. Members of generation X share more of a sceptical, less loyal and highly independent. For generation X the most important value is work/life balance. Millennials/Gen Y show the other cohorts that they are the most confident of all the generations. However, Millennials/Gen Y have been given the trait of parental dependant. The last of the generations, generation Z differences have not emerged as much. What is known so far is that this generation are more socially aware than any other cohorts and are more intelligent than the previous generation. Generation Z needs instant feedback and enjoy disruptive technologies in order to achieve their

goals. This generation needs to be challenged by active learning and teachers need to support or help them evaluate resources (Wiedmer, 2015). These different traits and styles that generation Z possess will make for a very different outlook for education and companies and how they interact with other cohorts or generations.

2.2.6 Social comparison theory

Students at year 11 of high school have their own perceptions and attitudes towards many different events and circumstances including their home life, their culture that they belong to and education and schooling. These perceptions and attitudes are built over time from interaction from family/Whānau, friends and the surrounding culture. However, as these students progress on to high school those attitudes and perceptions are bombarded by many new influences.

Social comparison theory centres on the belief that with each individual there is a drive to gain accurate self-evaluations. The theory looks at how people evaluate their own opinions and abilities by comparing themselves to others (Festinger, 1954). A person's cognition about situations in which they exist and they can appraise what they are capable of will have a bearing on their behaviour. If that person hold incorrect opinions or inaccurate knowledge of their abilities it can cause that person to under or over-estimate their abilities (Festinger, 1954). From the theory, people tend to compare themselves against others, however, this comparison decreases as the difference between opinions or ability in their own opinion or ability increases.

Students tend to congregate into groups that share the same ideologies within their societal structure. People move in groups that hold the same opinions, attitudes and perceptions that are close to or near to their own. If those opinions do not match or are too far removed from the group those individuals will move out of that social group for another group more closely related to their opinions. However the attractiveness of some groups may be strong enough for some individuals to shift their own opinions closer to those of that group. Students at year 11 high school will be exposed to these types of circumstances. Acceptance for teenagers to fit in with groups may impact on their perceptions and attitudes towards certain subjects at school. Wood's (1989) review of Festinger (1954) seminal work felt that Festinger did not elaborate on self-evaluation, where people's feelings about self may change with situational variations in the context

of self-esteem. Self-evaluation may be affected when individuals assume people to be more attractive or clever than themselves. Wood (1989) suggested that self-concepts and that social environment impose comparisons that have an impact the individual. Similarly, if a person is happy with life appears to depend less on objective circumstances but on how that person stands in relation to others; if you feel you are better off than others then you feel happy. Woods also found that Festinger overemphasized the comparison target and did not take into account the nature under evaluation and the surrounding dimensions under evaluation. These dimensions such as shyness, beauty or productivity on which a comparison could be made. Nature also varies in importance, such as how familiar it is or how personally important these variations have critical consequences for the comparison process. These dimensions or related attributes appear to have more impact than comparisons with others who are dissimilar, pointing towards more of a general importance to dimensions that surrounding dimensions under evaluation. People prefer to compare themselves against others how have similar characteristics as themselves (Wood, 1989).

Students will evaluate their attitude or perception by comparing with others within their group of friends. When a range people are presented for comparison, people that are close to that student's own attitude, opinion or ability will be chosen. However, if the only comparison available is completely at odds with the student there very clear opinion or attitude towards that such event is questioned. Festinger (1954) purposed that "a person will be less attracted to situations where others are very divergent from them than to situations when others are close to them for both ability and opinions "(p. 123). When difference of opinion exist within the group these pressures are manifested in an influence process. Members of the group will attempt to influence others. The pressure acting upon the individual from the group may manifest itself in two ways, one being the individual may lose self-esteem over time and ability and will spend time trying to improve. If this uniformity within the group concerning opinions or attitudes widens there is a tendency to redefine the comparison group to exclude those members whom their opinions differ the most (Festinger, 1954). This is followed by hostility to the extent that any comparison with those persons implies unpleasant attitudes and perceptions. However, if those individuals show strong attraction to the group it could redefine their own self-evaluation of those attitudes, opinions and perceptions, weaker individuals will change their opinion to be accepted by the group. The more attractive

the group looks to that individual the more influence the stronger member of the group have over opinions, attitudes and perceptions (Wood, 1989).

2.2.7 Perception and self-perception Theory

Perceptions are the views made by people that are seeing and viewing the world around them and creating a memory without that person being aware or intentionally (Ferguson & Bargh, 2004). Many factors influence the perception of people, such as judgement and attitudes, which are sometimes influenced by factors outside of their awareness. Given the ambiguity in social stimuli and situations, the range of behavioural responses that may be appropriate for any given situation, it seems likely that people's behaviour is shaped in part by knowledge and recent experiences. Ferguson and Bargh (2004) suggested that people's behaviour can be shaped in part by perception through incidental ways, such as unrelated recent experiences.

Along with Perception Theory, there is also a Self-Perception Theory related to knowing one's attitude, emotions and other internal states. Self-Perception Theory was born out of Skinner's 'Radical Behavioural' analysis in 1945 (Bem, 1972). According to Bem (1972), Self-Perception Theory "a person infers their internal state by observing their behaviour and the context in which it occurs" (p. 600). Perception is based on internal and external motivators and whether there are any significant satisfaction outcomes on each of those factors. Calder and Staw (1975) suggested "people are more aware of the effects of external factors on their level of motivation than intrinsic factors" (p. 603).

2.2.8 Attitude Theory

Attitude does not belong in one psychological school of thought; it is a concept that escapes the relative influence of heredity and environment (Allport, 1935). An attitude may be both instinct and habit; it avoids committing to either instinct-theory or environmentalism. As the term attitude is so elastic, it can apply to a single, group or even a broad pattern of cultures. The concept of 'attitude' has become widely accepted by both psychologists and sociologists and can play a central role in both camps (Maio, Haddock, & Verplanken, 2018). According to Allport (1935) "attitudes are individual mental processes which determine both the actual and potential responses of each person in the social world" (p. 4).

Katz (1960) proposed that attitude can serve four types of functions, including a knowledge function, a utilitarian function, an ego-defensive function and a value-expressive function. The knowledge function helps people organise and structure their environment; the utilitarian function helps in securing positive outcomes and stopping negative ones; the ego-defensive helps protect self-concept from threat, and the value-expressive function helps in one's self-expression. Katz (1960) defines attitude as "the predisposition of the individual to evaluate some symbol or object or aspect of their world favourably or unfavourably" (p. 168).

The functional approach to Attitude Theory is the attempt to understand the reason people hold attitudes they do. Katz goes on to suggest that opinion is the verbal expression of attitude. However, people can also show or express attitudes in a non-verbal manner. From these findings, Katz (1960) believed that attitude must include beliefs, but not all beliefs are attitudes. When thinking about attitude, people have to be aware that there is a distinction between beliefs, feelings, attitudes and a value system.

The intensity of an attitude refers to the strength that somebody feels. The belief component suggests two additional dimensions, these being specific and general attitudes, which will affect belief. If there are many specific beliefs contained in an attitude, it will be a lot harder to change that person's attitude. It is also the same for the value system if attitudes are favourable towards an object or aspect that is linked strongly to a value system it becomes difficult to change those attitudes. Finally, if an attitude is tied to a value system that relates to that individual's conception of themselves, then it becomes complex to be able to change that individual's attitude. An attempt to change people's attitude can be directed at their belief or through the feeling component. Katz (1960) suggested that a sufficient change in one component will have a resultant effect on other components of an attitude.

2.3 Perception and attitudes in the context of this research

Perceptions and attitudes cannot be taken for granted and viewed as generic terms, but as complex entities in their own right that have produced many theories and models (Allport, 1935; Bem, 1972; Katz, 1960; Maio et al., 2018; Phillips, Slepian, & Hughes,

2018). To be able to understand perceptions and attitudes, it is essential to understand that both can be influenced by many factors, such as behaviour and the changing of opinions that adolescents go through when thinking about careers, education and technology (Caplan, 2002). Student perceptions and attitudes relate to various theory-based constructs, like culture, social, structural, generational and self and many others attribute that can shape students' perceptions and attitudes that impact their decision making when it comes to ICT and career choice. Hatlevik et al. (2018) suggested that self-efficacy is an essential factor when thinking about self-belief in ICT, interest and self-determination. Bandura (1994) defined self-efficacy as "people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives" (p. 1).

The study explored the direct and indirect influences on students' perceptions and attitudes and the impact it has on their choice of subject and career pathway in ICT. The question of what causes perceptions and attitudes may appear to be simplistic. However, it becomes highly complex, and it includes many elements from many constructs to understand perceptions and attitudes. Each of these constructs focus on an area that influences students' perceptions and attitudes. In the following section, each construct is detailed.

2.4 **Conceptual Model**

Over the decades there have been numerous programmes and literature written, about the problem of a lack of females in the IT industry (Abu-Shanab & Al-Jamal, 2015; Marghitu, Hur, Rawajfih, Hall, & Stephens, 2014; Papastergiou, 2008). Over the past 20 years, there have been numerous models and frameworks that have been used and failed to provide an answer. Today, societies are adopting disruptive and enabling technologies at a rapid rate. Social media, as a disruptive technology has become an integral part of our lives and our children's lives. The origins of one such framework, Bernhardt's (2014) framework utilise research from other frameworks, methods and models (Merchant, 2013; Trauth, 2006a). This model is intended to represent a contemporary approach to the changing environment of ICT. Bernhardt (2014) stated, "We are in an era of disruption, with industry experts proclaiming a process of deep

change" (p. 16). Bernhardt's (2014) framework used literature to underpin the different layers, one of those layers being SocialIT layer which looks at today's problems rather than the past issues .

Bernhardt's (2014) conceptual framework was used as the starting point for the study and was based upon the STEMCell model. The framework builds from the individual influencing factors through to external factors that influence that individual. Each one of those layers has an impact on that individual's perception of ICT. Each section below expands on layers of the framework.

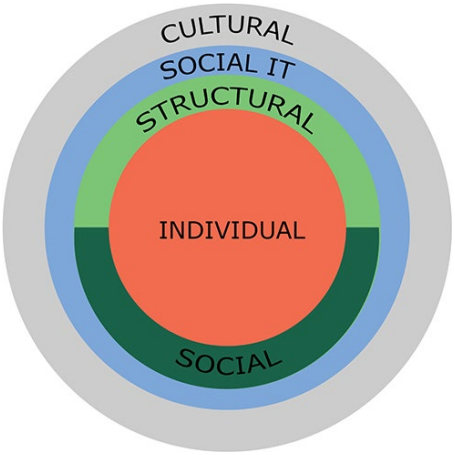
The STEMCell model can be broken down into its two major components, the STEM reflecting that IT is part of a broader field (Science, Technology, Engineering and Mathematics) and the Cell representing the central role of the individual (either male of female). Bernhardt discusses the power of the individual to become what they want, albeit constrained by their environment. The conceptual framework, as stated by Bernhardt (2014) shows:

- Cultural, Social and Structural contribute to factors that may encourage, discourage participation or present obstacles that inhibit incentives or enhance disincentives.
- Individual context determine how individuals (both male and female) react to their environment. Individuals accept, react to or overcome/override the Cultural, Social and Structural factors, influencers and obstacles.
- SocialIT represents the current disruptive technology, in its application as an influencing platform/environment for women in ICT.

The cultural factor encloses all parts of the framework and either expands or shrinks depending on how influential the other layers are. The Social and Structural layers from the framework wrap around the individual layer, which deepens their influence on the individual through such factors as stereotypes, role models, media, peers, family and mentoring. The structural factor that interacts with the other layers include education, information, access, support mechanisms and government policies. The SocialIT factor gives a disruptive and penetrating force to the framework. The layer surrounds and penetrates the other layers to interact with the individual layer. This layer represents the transformation of technology looking at some influential factors such as social, educational and career implications. With each layer of the model, there are influencing

factors that will either impede or incentivise the individual. Table 2-1 shows the initial conceptual framework from Bernhardt (2014).

Table 2-1. Conceptual framework of the STEMCell model (Bernhardt, 2014)

Factors	Influencers	Conceptual framework
Cultural	Popular culture, Cultural norms, Parental expectation, Occupational culture	
#Social IT	Social media, Technology, Technology change, Dynamic, Revolutionary	
Structural	IT Industry, Information, Education, Government, Access, Support	
Social	Stereotypes, Gender, Role models, Clubs, Mentoring, Networking, Peers, Family	
Individual	Ability, Curiosity, Creativity, Reality, Self-belief, Strength, Interests, Differences, Philosophic values, Assumptions	

2.5 Cultural Factors

There is no one definition that researcher have unanimously agreed upon for culture. Kroeber and Parsons (1958) defined culture as “a complex of values, ideas, attitudes and other meaningful symbols created to shape human behaviour and anti-facts of that behaviour as they are transmitted from one generation to the next” (p. 583). Betancourt and López (1993) agreed with Kroeber and Parsons (1958) but suggested that also culture is highly variable in meaning and is learned through shared experiences with people that identify with a segment of a population. From this understanding a child growing up in society will learn a set of values, perceptions and preferences as a basic rule through socialisation involving family/Whānau, peers, school and other factors. So depending on where that child grows up will depend on those set of factors (Tyagi & Kumar, 2004). Culture allows society to have a sense of common identity, understanding, attitude, value and behaviour. The mix of ethnicities also adds to those

cultural factors and shaping of each individual. Shown in Table 2-2 from the New Zealand ministry of education are typical numbers of students that can be found at high schools in the larger cities.

Table 2-2 New Zealand ministry of education, Ethnicity, age and sex

Dataset: Ethnic group (detailed single and combination) by age group and sex, for the census usually resident population count

Ethnic groups (detailed)	European Only		Maori Only		Pacific Peoples Only		Asian Only		Middle Eastern/Latin	
Age group	15-19 Years		15-19 Years		15-19 Years		15-19 Years		15-19 Years	
Sex	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Area										
Wellington Region	9225	9342	996	888	1131	1104	1371	1287	213	216

Source, taken from New Zealand Ministry of Education (2018)

This exposure to different cultures within the classroom might give students a better understanding of the different types of culture. However, the schooling that all students receive in high school within public education in New Zealand is based upon the European model (Bolstad et al., 2012). This European model does not always fit comfortably with other cultures and maybe one of the contributing factors to perceptions that put students off specific career paths (McCarthy, 2008). As students look towards parents, Whānau or guardians for guidance, they are exposed to their families' stereotypes based on their recollection of their time at school (Dimitriadi, 2013).

Through culture people get a sense of their own attitude and behaviour towards different aspect of day to day life. Teenagers are starting to understand the type of person they want to be, their personalities and a sense of their own self (Tyagi & Kumar, 2004). At this time in a teenager's life, they are also starting to think about their future and their role in society, which includes influence from family/Whānau, beliefs and career prospects. Teenagers also get cultural factors through other medium such as TV, film, technology and innovation, these may play a part in those cultural values, which may influence them or affect their decision making.

Some of or all of those factors may be influential in a person's culture, however, it is also important to understand that some of those factors may affect a person's culture. Value as a factor is very important part of someone's culture. Cultural value may include freedom, prosperity and security, so depending on that person's background will depend

on the priorities they give to these values, so, individual value priorities are the product of both shared culture and of personal experiences (Schwartz, 1999)

Alvermann, Moon, Hagwood, and Hagood (2018) revealed that generation Z was dominated by consumer capitalism and the product of capitalistic mass culture from music through to the internet. Alvermann et al. (2018) argued that students should develop a critical awareness of the media, and it should begin in primary school. Mansour (2018) discussed culture from many aspects from the culture of the classroom to the role ICT companies have when it comes to culture in the workplace. However, the role that culture plays in shaping students' experience often comes from stereotypes.

Dele-Ajayi, Shimwell, Emembolu, Strachan, and Peers (2018) suggested that culture stereotype also plays a role in generation Z students' willingness to pursue ICT at school. Dele-Ajayi et al. (2018) stated that "cultural stereotypes refer to the stereotypical information surrounding a particular field or discipline" (p. 2). Generation Z become influenced by the culture that they our embedded in because they may not have direct experience or prior knowledge of the ICT industry, they depend on cultural stereotypes to form their perceptions (Master, Cheryan, & Meltzoff, 2016)

2.5.1 Popular culture

Popular culture as defined by Kidd (2017) states that "Popular culture is the set of practices, beliefs, and objects that embody the most broadly shared meanings of a social system" (p. 1). Baby Boomers, Generation X and Y had different popular cultures associated with that generation growing up. Baby Boomers would have been the first generation that had access to television and easy access to music; both would have had an impact on their influences and choices (Wiedmer, 2015). The end of Generation X and the beginning of Millennials/Gen Y would have been the first generations to be exposed to computing. By the turn of the 1980s, Generation X was exposed to more information than the Baby Boomers through media, TV and films and popular culture expanded into the computer field with the likes of computer games (Wiedmer, 2015). Millennials/Gen Y was the first generation to have access to the internet, and through that medium, a new popular culture arose, this was the online community. TV shows in the 90s brought new popular cultures to teenagers with the likes of 'The Simpsons' and

‘Reality TV’. Computers started to appear in households across societies, and popular TV shows started to appear as video games (Koulopoulos & Keldsen, 2014).

Generation Z is the most connected generation when it comes to technology (Koulopoulos & Keldsen, 2014). The use of popular culture among Generation Z children could change their perceptions through popular TV shows. These popular TV shows and computer games are exposing children at an early age to technology without any stereotypical bias attached. Girls and boys enjoy playing computer games that they believe consists of fun, excitement and intensity. When teachers introduce game-based learning into the classroom, girls achieve higher marks than boys in creativity and collaborative thinking (Liu, 2018). The affect that popular culture has on career intentions is not a new phenomenon; over the decades there have been numerous TV shows that have influenced people to enrol in a course just because they enjoyed the TV show and thought it would be a good idea to follow that particular career path (Schneider, 2010). However, there are many TV shows that show the stereotypical view of IT, being male dominated. TV shows such as ‘Arrow’ or ‘Criminal Minds’ do not address many of the stereotypical views that generation Z has been brought up with, but in fact, exacerbate these already ingrained stereotypes. Generation Z girls watching such shows will have these perceptions that ICT is not a subject that would be suitable for them and that the characters do not relate to their self-expectations (Berg et al., 2018; Schneider, 2010).

2.5.2 **Parental expectations**

The generational influence of family members on children can become the catalyst for the direction they take while at school. Dimitriadi (2013) observed that family is the main avenue for children to discuss ideas for career choices. Family can be very influential, and the desire to follow in the footsteps of one’s parents has long been a very significant factor in the choice of career. If children view their parents as role models, they are influenced by their parents’ choice of career (Adya & Kaiser, 2005). Parents’ cultural norms will influence expectations; “the less rigid and less influential the freer and more cosmopolitan the society is” (Bernhardt, 2014, p. 103).

Dimitriadi (2013) stated, “within a culture of close-knit families, opinions of elders are respected and must be taken into consideration” (p. 5). Young’s (2003) research

concentrated on year nine students across Tasmania and found many females rejected a career in ICT due to misinformation and misguidance from parents who had limited or no knowledge of the subject or what jobs were available. As Millennials/Gen Y become parents themselves, the generational effect will affect how their children use and understand technology.

Parents' expectation for their children is for children to do the best they can in all subjects at school and to go on to either further education or to be able to get a job with the results from school. When it comes to gender, parents can have a gender bias when it comes to certain subjects such as STEM subjects. Ikonen, Leinonen, Asikainen, and Hirvonen (2018) suggested that parents of adolescents believed that such STEM subjects were more difficult and less interesting for girls than for boys, despite the lack of evidence. Ikonen et al. (2018) also suggested that parents of boys over-estimate their child's abilities in STEM subjects more often than the parents of girls. This has a direct effect on girls' self-efficacy and as a result, girls commonly under-estimate their ability in these fields,

Shin et al. (2015) suggested that parents have gender-related expectations for their children's career path at an early age. They also found that parents were more likely to push boys rather than girls towards STEM occupations. Not only do parents' expectations affect their children's motivation and career aspirations, but parents' beliefs and values will also have an impact on their children. Parents' beliefs, including their perception of importance in disciplines, will have either a positive or negative effect on those children's self-concept or abilities and values (Shin et al., 2015). Shin et al. (2015) also suggested that parents' income levels, education and career can contribute to cognitive achievement. Backed by findings by Seo, Shen, and Alfaro (2018) suggesting that children with parents who are more academically involved are more likely to develop realistic abilities and beliefs and achieve academic success.

2.6 **Social Factors**

When young girls start to think about their future many factors influence their perceptions and attitudes towards a particular avenue of study (Yu, Lin, & Liao, 2017).

Social factors have been defined as any variable which arise from environment, community, organisation, society, the media, technology and communication which influences an individual to think and act in a certain way (Ferguson & Bargh, 2004; Festinger, 1954; Kroeber & Parsons, 1958; Luhmann, 1995; MacKenzie & Wajcman, 1999; Wood, 1989). Ferguson and Bargh (2004) noted in their research that because of the amount of social stimuli, situations and the response range, people's behaviour is often guided in part by knowledge that becomes accessible through incidental means, such as unrelated experiences. This does suggest that some factors influence will greatly depend on that individuals circumstances

2.6.1 **Stereotypes: gender and ICT.**

The preference for females choosing 'pink collar' careers over ICT careers was described by Clayton (2006), who noted: "Australian girls are continuing to reject ICT careers partially due to negative perceptions and stereotypes" (p. 3388). This 'geeky' or 'nerdy' stereotype, which has been around for many decades, has a negative connotation putting many females off studying ICT subjects at high school and beyond (Bernhardt, 2014). In contrast, Grant, Knight, and Steinbach (2007) suggested that most of the students they surveyed thought that the 'geek' and 'loner' image was not indicative of people working in the ICT industry. Generation Z is obsessed with technology and devices, using such devices to interact with social media or to play games. This 'obsession' is replacing these older stereotypical views, but this new label of obsession could be more difficult to counter than the geek, and loner image it is replacing (Almond, 2013, June 23). Ellemers (2018) stated that "stereotypes reflect general expectations about members of particular social groups" (p. 276). However, stereotypical perceptions that a particular feature characterises membership of a specific group usually lead people to over-emphasise differences between groups and under-estimate variations within groups. Children and adults cluster people together by their gender, contributing to the formation of gender stereotyping and reinforces those perceptions (Ellemers, 2018).

In research carried out by Berg et al. (2018) in Scotland, they observed children drawing what they thought people working in ICT would look like. The majority of the pictures depicted Caucasian men with standard features such as glasses and spots or freckles.

Many of the drawings also labelled their pictures as either nerd, geek or 'lazy'. Also, many of the children indicated that computer science (CS) is a male subject. From Berg et al. (2018) findings, they found that girls are more conscious of their self-image and that the stereotypical image of a computer scientist was not compatible with the stereotypical image of a female.

In social stereotyping, males are seen as part of the computer age, and many companies fall into that category by hiring to type, which is a middle-class white male (Hall, 2013). It makes it difficult for females to identify with the ICT sector and to attain some sense of belonging. It becomes even worse for females of colour because of these stereotypes, and it becomes an unconscious choice for females to reject ICT early on in their educational path (Rodriguez, 2018). Starr (2018) discussed the stereotypical traits of someone working in the ICT sector and described them as "socially awkward, unattractive and naturally intelligent" (p. 2). Starr (2018) also revealed that when people described what a person looked like, descriptors fell into categories of male, lacking social skills and obsessive. Also from the same research, it was found that females, when paired with these stereotypical attributes of someone in the ICT field, felt significantly less belonging and less interest in ICT than females who interacted with a person with non-stereotypical traits. This finding agrees with prior research (Berg et al., 2018) that females' sense of belonging in ICT decreases after interacting with stereotypical people in the field (Breda, Grenet, Monnet, & Van Effenterre, 2018). Not only does sterotypical perceptions have an affect on girls, but peers can play a major role when choosing subjects.

2.6.2 **Peers and the media**

Communicating with friends inside and outside of school can have a powerful influence on teenagers' beliefs and behaviours when it comes to a career path (Bernhardt, 2014). Gardner, Sheridan, and Tian (2014) stated, "their friends and peers influence people's attitudes towards ICT, especially when choosing a major, peers and friends' opinions are important to consider" (p. 122). In contrast, Adya and Kaiser (2005) noted that peer groups in the teenage years have limited impact on career. Instead, they influenced social responsiveness, behaviours, fashion styles, and attitudes. If peers reinforce traditional gender role behaviours, then long-term goals and aspirations may distort

those children's views. During the teenage years, this gender difference, particularly males on females, can have a significant impact on females' self-concept and self-efficacy (Clayton, 2007). Students will change their perceptions towards many courses at school, especially ICT if peers' views are different. These views are shared with peers through different types of media, such as social media.

Film, television, print and electronic media can influence and also enhance the stereotype that ICT is a male occupation (Bernhardt, 2014; Clayton, Beekhuyzen, & Nielsen, 2012; Ellemers, 2018; Pantic, Clarke-Midura, Poole, Roller, & Allan, 2018; Rodriguez, 2018; Starr, 2018; Wille et al., 2018). Media influence has little impact on motivating career choices, however the media's focus is on enhancing gender stereotypes that centre on visible images. This stereotype mainly focuses on visual images such as the geek in the glasses and the darkened room of a teenage male in front of a computer screen rather than representing ICT as a career choice and a viable option for females (Gorden, 2011). Young adults' perceptions about ICT jobs become biased by media influences and how these depict people in the industry, rather than being influenced by facts and figures about actual people in the industry (Pantic et al., 2018; Pau, 2009; Starr, 2018; Wille et al., 2018). Females' perceptions of ICT jobs mirror the stereotypes presented throughout their teen years through television, film and other popular media. Television programs such as 'Criminal Minds', give the perception of ICT as being geeky, stating "the tech with the glasses" (Clayton et al., 2009, p. 156) and when shown in the program the female character is always portrayed working alone in a small dark room. However, Generation Z is using more of a dynamic platform through social media, and their stereotypical views will differ from those perceived by other generations that use traditional media such as newspapers and TV (Jones & Ramanau, 2009).

2.6.3 **SocialIT Factors**

For companies and education to embrace the new era of social media, they need to discard traditional beliefs and practices (Bernhardt, 2014; Noordin et al., 2018). The power of social media is in its infancy and has an opportunity to offer Generation Z females a different outlet to express their creativity within a 'net neutral' world (Murire & Cilliers, 2019). Facebook, Twitter, Instagram and Snapchat are at the start of this revolution. Young females can become anonymous on these platforms and use them

without stereotypes, allowing girls to show the world that young females belong in the new disruptive world (Bernhardt, 2014).The availability of social media tools, especially at school for use in learning are normally blocked on school computers. This becomes problematic for students and their learning of new technologies, because of the teachers' technology and literacy skills in these areas. Successful adoption of new social media tools to transform the educational environment needs teachers to develop a positive attitude towards ICT to enhance students learning (Murire & Cilliers, 2019). However, as the increase in development of new social tools comes the problem with the terminology and how students interpret their understanding of the ICT.

2.6.3.1 Terminology

Clayton and Beekhuyzen (2004) discussed the problematic use of acronyms in ICT as students often do not understand the meaning. Students hold perceptions based on the words they read and from learnt experiences from family, peers, school and through media. When a student reads terms such as computer science or CS or information science or IS, they build up a perception of who would do that as a job (Wille et al., 2018). By giving names to information, people will have a perception of what they believe it means from their learnt experiences. To be able to negate these stereotypical views of the subject such as CS and IS, terminology must be addressed to reflect the work carried out in the ICT sector, rather than trying to label the subject with incorrect terminology (Wille et al., 2018).

A study by Papastergiou (2008) noted that females are still in the minority when it comes to ICT related studies and still have a misconception of the differences between Information Systems (IS) and Computer Science (CS) related courses. The females' perception in the study found CS to be more hardware and computer programming and IS to be the use of software products such as Microsoft Office. Female students did not relate to the human side of CS and IS studies and focused only on the negative aspects and the stereotypical views of ICT. The misrepresentation of both subjects stems from the teachers' lack of understanding of how CS and IS have adapted over the years to include Human-Computer Interaction (HCI) and the soft skills of communication.

2.6.3.2 Technology

Access to computers, tablets, smartphones and laptops has increased to the point that most people in western society has one, or can access one. Generation Z have grown up in this society and accept technology as part of their everyday lives (Bernhardt, 2014; Schlegel et al., 2019; Yu et al., 2017). Access to technology has empowered young females to seek for information, support and guidance from anywhere at any time and on any device (Cummings & O'Neil, 2015).The Internet and the social media aspect has also changed the way we look at technology now compared to a decade ago. Akbulut and Looney (2007) found education has not moved forward as quickly as technology in the past two decades and as a consequence, the teaching and learning environment and culture trails behind. Until this imbalance is rectified, the gap between males and females is likely to continue growing.

As students embrace technology and utilise the tools available, generation Z students are creating a different digital divide between themselves and the teachers. Technology is the cheapest it has ever been before, and access to these devices has also become easy for people to get a hold of (Naqvi, 2018). The research from Naqvi (2018) found that 86% of teachers in Europe stated that pupils are more motivated when computers and the internet are involved in the classroom environment. However, many teachers fall behind many of their students when it comes to digital literacy and the use of technology. Naqvi (2018) also found that some teachers expressed concerns about overuse of technology, misuse and over stimulation and did not feel that they had adequate training or felt that it added more time to their preparation work. It has been shown through literature (Hatlevik et al., 2018) that when students have access to technology outside of school, it has a positive influence on their self-efficacy and ICT literacies. It can also be shown from Hatlevik et al. (2018) research that the more use of technology outside of school also has a positive influence on their attitude towards ICT.

2.6.4 **Role models**

Student career choices are influenced in many ways; role models are one of these influencers (Adya & Kaiser, 2005). Percival (2014) found attractive looking female role models not only decreased females' interest in Science, Technology, Engineering and Maths (STEM) subjects but also decreased their beliefs in their ability to succeed at

those subjects and the likelihood of studying them. Seeing attractive women as role models become demotivating to young females as their self-image does not match up.

The ICT and technology field in the past few years has focused on prominent males, such as the late Steve Jobs, Bill Gates or Mark Zuckerberg. These role models reinforce the way females and especially young females view the ICT industry as being male-dominated (Gorden, 2011) as the majority of people employed in high profile ICT roles are predominantly white males (Hunter & Boersen, 2015). However, as the Baby Boomer generation moves out of the workforce and are replaced with generation X or more than likely Millennial/Gen Y workers, there will be a shift in appointments towards a more balanced workforce, and towards female workers (Wiedmer, 2015). Ehrlinger et al. (2018) suggested that exposure to positive role models can be a factor for increasing female interest in STEM subjects such as information technology. They further showed from the results that females' interest increases after interacting with well-known female role models in the industry, and it can counter stereotypical views of CS. Females' self-efficacy also increased when interacting with female role models (Redmond, 2006).

Breda et al. (2018) found that the background of the role models, with respect to their ability and how personally relevant the role model is, increased positive attitudes and perceptions about ICT. Breda et al. (2018) found that the younger the role model the stronger the sense of identification by the students. In particular, role models' characteristics matter and younger professionals in the industry had a stronger effect on students' views about related careers than the older generations. However, the results of the research do suggest some bias, as the students who identified with the role models had already chosen STEM tracks in high school before the research. The results from Breda et al. (2018) should then lead yonger female professional to engage with schools to help with mentoring girls in ICT.

2.6.5 **Mentoring**

In the past, there have been many types of initiatives to change females' negative perceptions and to encourage females to participate in STEM or ICT based courses and strengthen the industry with more females. Clayton et al. (2012) explored Technology Takes You Anywhere (TTYA), an intervention that ran over two days. The research carried out by Clayton et al. (2012) into the TTYA intervention had a bias to the results

due to the fact the students who came along to the event were already interested in these fields. The research of Clayton et al. (2012) did not show any longitudinal evidence to show interventions progress females into careers in the ICT industry and more mentoring and interventions are not the answer (Bernhardt, 2014). Generation Z students are already typically 'tech savvy', socially connected, bright and require less direction. They have ready access to digital tools that enable them to think they can do pretty much anything; they want to be able to learn anywhere and at any time (Wiedmer, 2015).

Eckert, Metzger-Riftkin, and Nurmis (2018) found that mentoring through an interactive program such as WiKid Grrls intervention had many positives but also many negatives. The research found that the program had beneficial effects on girls' self-efficacy, critical thinking and awareness of typical careers. However, the research suggested that the girls' learning might be temporary and only short-lived for the duration of the intervention. Interventions used for mentoring girls in ICT have become popular over the last decade and have increased awareness for many girls from a wide variety of backgrounds (Eckert et al., 2018). However, many intervention programs have targeted girls who already have an interest in ICT and would probably have gone on to higher education to follow one of the tracks in ICT. Studies have suggested that the connection between interventions and girls pursuing ICT careers are weak (Outlay, Platt, & Conroy, 2017). The reasoning given by Outlay et al. (2017) is that there is no longitudinal evidence that interventions encourage more girls to take up careers In ICT. It maybe that education needs to change they way it looks at ICT.

2.7 **Structural Factors**

When girls think about their future and their career goals they seek advice and guidance from many areas, two of those areas being through school and industry. School can provide many avenues of information for students, from teachers to peers (Lang, 2012). These perceptions and attitudes acquired from those sources may either have a positive or negative impact on that individuals overall attitude towards certain topics or even choice of career. At school, students from year 11 onwards are exposed more to industry as they think about their future and start to associate their own career goals to particular

industries. Through that individual's perceptions, attitudes and stereotypes that have been built up over the past 10 years or so, that individual will have strong opinions based upon those perceptions and attitudes, if these are negative towards a certain industry it becomes very difficult for that particular industry to get that individual to change their mind (Hellens, Clayton, Beekhuyzen, & Nielsen, 2009).

2.7.1 **Education**

Most of the international research has concentrated on the university and ICT sectors; however, most career paths are chosen much earlier in the student's educational life (Broadley, 2015). The lack of understanding at an early age of what is available in the breadth and variety afforded by the ICT industry could be a factor in putting females off ICT opportunities (Dimitriadi, 2013). As suggested by Dimitriadi (2013), a reform of the curriculum has to take place to engage females more in ICT subjects. The school education sector does have issues in recruiting new teaching staff into ICT subjects (Jones, Albion, & Heffernan, 2016). However, teachers that do take up the challenge usually are Millennials/Gen Y, as they are more enthusiastic about technology. The older teachers, especially the Baby Boomers, have firm opinions and biases towards a disruptive way of teaching in the Social Era and find it hard to integrate technology into their teaching. This can have a knock-on effect of dissuading students from pursuing ICT at a higher level (George & Ogunniyi, 2016).

When it comes to collaboration at school it does appear that boys from enjoy working in teams to solve problems more than girls who valued their relationships with peers more (OECD, 2017). However, the program for international student assessment report (PISA, 2015) suggested that girls performed significantly better than boys when it came to collaborative problem solving (OECD, 2017). The research suggested that implementing problem-solving techniques in classroom activities increases creativity and problem-solving skills (Pellas & Vosinakis, 2018; Pusey, 2018).

Albion and Tondeur (2018) recognised that teachers had a lack of understanding when it came to the use of technology and suggested that if teachers are going to be influential in regards to the quality of the education that generation Z students are getting they need to embrace technology, "they need to engage in personal transformation through ongoing learning" (p. 1). Teachers need to be empowered to teach by allowing them the

resources and activities to match the learner's needs. Being able to teach current creative and transformative applications becomes a problem due to the lack of knowledge and resources to teach the students the required skills necessary for today's ICT. Education is slow to adopt new and exciting technologies within the classroom due to the access to technology, the personal understanding of technology from the teacher and policies that have been in place for decades. These policies do not align with today's learners and can be considered outdated.

Albion and Tondeur (2018) suggested challenging these preconceptions of the old policies and developing a new vision about teachers' professional learning within ICT. They suggested allowing teachers to be able to manage and control more freely what is useful and aligns with learner outcomes. This changes the landscape of education policy for the majority of the schools, as the old policies are focused towards achievement through standardised testing, which limits teachers in their approach to the subject. This can be shown from a report from the Ministry of Education, New Zealand that Māori students have the lowest retention at high schools across New Zealand with only 71.9% of Māori students going on to complete year 13, compared to non-Māori students whose retention sits at 84.9% (New Zealand Ministry of Education, 2018).If students are to leave school equipped with the skills necessary for this new era, education must also evolve to ensure that generation Z students have the required knowledge to be useful in their future career path. Salam et al. (2018) agreed with the findings of Albion and Tondeur (2018), which suggested governments need to allocate more funds to the educational sector for updated infrastructure and personal development. The education policy and curriculum need to be more flexible and adaptable in the disruptive era that generation Z student lives. They also suggested that addressing the lack of training given to teachers teaching ICT needs to be high on the priority list. However, Wille et al. (2018) found that teachers only picked up the necessary skills to teach the students. The teachers were not afforded professional development through education or through engagement with the ICT industry, whereby they could upskill and become more influential in the classroom environment.

Teachers and career advisors also need to have knowledge which is up to date to informed students. Students do not understand the depth that ICT went when it came to job opportunities. To help teachers and career advisors the Australian government have

produced career information for computing jobs and what level of training is required for the type of career choice within the computing industry, Figure 2-2, shows the diagram regarding ICT career streams available and the level of education required ("*ICT career streams*," 2018).

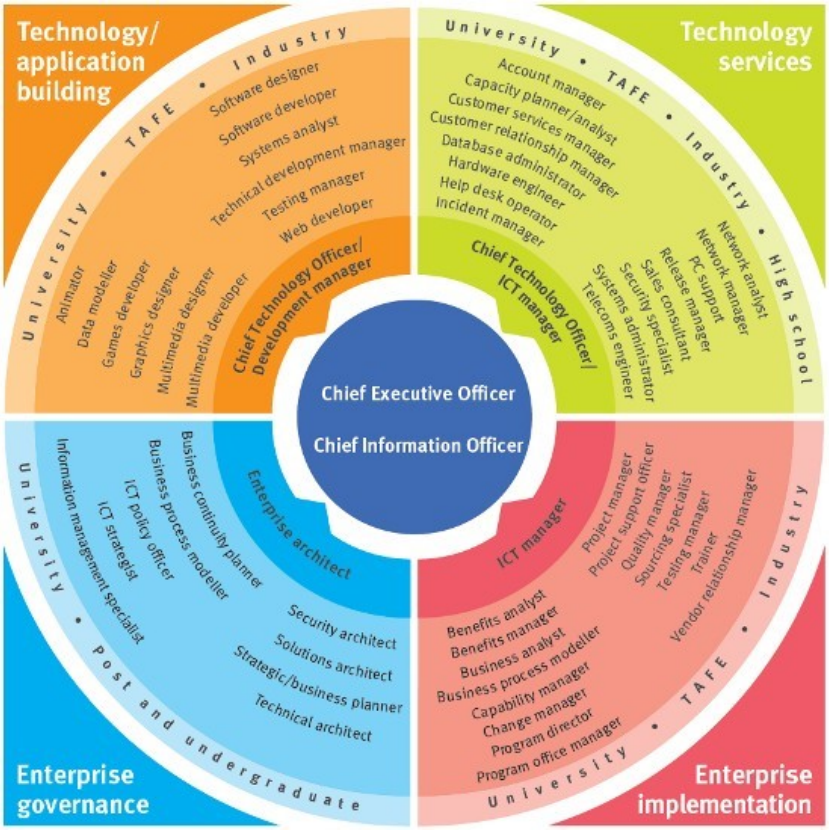


Figure 2-1. ICT career streams.

Source, Queensland Government Chief Information Office, https://www.qgcio.qld.gov.au/information-on/workforce-planning/ict-career-streams

2.7.2 Computing industry

A study carried out in Australia by Clayton (2006) showed female students are choosing 'pink collar' careers instead of ICT careers, even though those jobs on average are lower paid than those in the ICT industry (SEEK.co.nz, 2018). In 2019, according to an analysis of Labour Department data in the US, women held 28.6% of high tech jobs ("Women in the labor force", 2019) , those results parallel findings for Australia. Australian Computer Society (ACS) showed that in 2019 female participation in ICT was 29% up by 1% from the previous year (Australian-Computer-Society, 2019).

However, New Zealand labour market statistics showed in 2019, women represented only 17.7% of employees, which has not moved in the past two years in the ICT industry("Labour market statistics", 2019) Craig's (2014) research supported these statistics where the percentage of females entering degree courses for ICT related programmes is stagnating or decreasing, and the number of females employed in the ICT industry is representative of the shrinking number coming through from universities (Camp, 1997). There has been a decline in the number of women entering the ICT industry in the last two decades due to them not wanting to take ICT subjects at a higher level (Broadley, 2015). Only now in 2019 are big corporate companies in New Zealand starting to embrace gender and ethnic diversity in hiring (Diversity and Inclusion, n.d.). Spark, a New Zealand telecommunications company, have employed their first gender diversity manager to address these stereotypical views people have about the industry (Williams, 2019).

2.8 Generational differences

The generational difference between Baby Boomers, Generation X, Millennials/Gen Y and now Generation Z have been discussed in the press and in scholarly publications. Business people have also speculated that different generations that are enrolled in school and higher education require different approaches when it comes to education and training (Glass, 2007; Reeves & Oh, 2008; Wiedmer, 2015).

2.8.1 The naming problem

The naming convention used to label the various generations is not standardised. Researcher writing about generational difference come up with a variety of different labels for the different generations. There is also a disagreement among those authors of the span of time in years that should be used for a particular generation.

Table 2-3 Generational label and dates reported in different sources

Source	Generations or Cohorts by year			
Howe and Strauss (2000)	Boom Gen 1943-1960	13th Gen 1961-1981	Millennials 1982-2000	
Lancaster and Stillman (2003)	Baby Boomer 1946-1964	Gen Xers 1965-1980	Millennials/Gen Y 1981-1999	
Martin and Tulgan (2002)	Baby Boomer 1946-1960	Gen X 1961-1977	Millennials 1978-2000	
Oblinger et al. (2005)	Baby Boomer 1947-1964	Gen Xers 1965-1980	Gen Y / Net Gen 1981-1995	Post Millennials 1995-present
Tapscott (1998)	Baby Boom 1946-1964	Gen X 1965-1975	Digital Gen 1976-2000	
Zemke et al. (1999)	Baby Boomer 1943-1960	Gen Xers 1961-1980	Nexters 1981-1999	

Due to the differing dates that many of the authors have for each of the generations there is little consensus whether generational difference really exists (Reeves & Oh, 2008). As shown from Table 2-2 there are notable differences from each of the authors around the dates of each of the generations. Despite a lack of consistency of naming and dates, most authorities agree that variances exist among characteristics of any given generation. It can be assumed that a person born in 1990 would have most traits of that of a Millennial/Gen Y or that a person born in 1955 may not be technologically savvy as a person born into generation X or Millennial/Gen Y generation. However, it cannot be assumed that those assumptions about any one individual will be correct based on that person's generational cohort. To only consider one such factor as a year of birth to distinguish a generation would not hold up to critical rigor from experts in the field. Experts have agreed that generations are shaped by industry and social culture than just dates (Reeves & Oh, 2008).

According to Howe and Strauss (2000) three factors give a clearer understanding of generation than just a year of birth, these are:

- Perceived membership – The self-perception of membership that begins in early childhood and through into young adulthood.

- Common belief and behaviour – Attitudes (towards family, peers, personal life, religion, etc.) and behaviour (choices made towards jobs, education, health, sex, crime, etc.) that make up that generation.
- Common location in history – some significant event that occurs during a generations formative years, such as the climate change issue for generation Z.

All generations show a difference when it comes to attitudes and perceptions towards education, work and home life (Reeves & Oh, 2008). The research in this area is very subjective and can lack empirical evidence. Some critics have been very critical of the data used by Howe and Strauss (2000) as the data was drawn from interviews and focus groups of young adults that was conducted in the presence of parents, also the data has been criticized for the samples that were used which draws upon wealthy suburbs where the authors lived. Critics of the study maintain that it does not reflect regional differences, much less issues related to race, culture and other factors (Coffield et al., 2004).

2.8.2 **Self**

As the latest generation, generation Z poses many of the traits that makes up their new generation, however at the age of 15 or 16 year 11 students may not understand these traits and how they fit within the latest generation. Gottfredson's (1981) Circumscription and Compromise Theory identified 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). These four stages are shown in Appendix A, Table 9-1, Self-Concept and Occupational Preferences. Brown and Lent's (2004) Social Cognitive Career Theory (SCCT) highlighted the importance that self-efficacy, as well as outcomes expectations and other personal and environmental factors (e.g. gender, culture, barriers, and supports), contribute to shaping a student's self-image.

Self-efficacy is a concept that covers students' self-confidence and their expectations for their future. Exposing students to a positive learning experience increases their self-confidence, which increases their self-efficacy in that subject (Hatlevik et al., 2018). For generation Z students, especially girls, when it comes to ICT, it is all about the belief

they have in their capabilities of doing and learning the subject. Personal belief has a significant impact on an individual's behaviour and actions, meaning many girls are more likely to pursue activities within their perceived competences and avoid those subjects which they perceive as problematic (Hatlevik et al., 2018). Self-efficacy can be related to gender and culture. Girls, even though they outperform boys in various academic domains, are still inclined to report lower self-efficacy, especially in STEM subjects (Hatlevik et al., 2018).

In ICT at school, self-efficacy beliefs are developed through students' interpretations of their actual performance, implying that perceived experiences in ICT use are important for students' beliefs about their capabilities to succeed in specific activities (Hatlevik et al., 2018). When it comes to a more complex task, girls felt less confident in their abilities than the boys and when the ICT tasks become even more advanced and technical the more significant the difference in ICT self-efficacy can be seen.

ICT self-efficacy starts at home, with children's perception of support from parents and Whānau (Māori word for family). When the family have been involved in school-related activities, it provides encouragement and positive expectations that have an impact on that child's self-efficacy beliefs. However, parents or Whānau with a low socio-economic status do not always have the financial means, education or experience to foster their children's learning. Disadvantaged students are less likely to have digitally literate parents (Hatlevik et al., 2018). Students do not usually choose STEM subjects based on their belief that the field is too hard and only for intelligent people (Halim, Rahman, Ramli, & Mohtar, 2018). These perceptions relate to environmental factors such as the learning experience, social influence and internal factors such as self-efficacy. Some of the influences that contribute to self-efficacy come from teachers, peers and role models and if students do not receive the right help or motivation it will cause a disengagement with that particular subject causing that person's self-confidence to decrease and believe that their self-efficacy does not match up to the required standards (Halim et al., 2018).

One of the ways that social media has had an impact on generation Z students, especially girls, comes from the ability to increase their self-efficacy and self-belief in ICT through new learning approaches that have the potential to bring better understanding to certain

subjects via a bigger breath of information available to those generation Z students (Hong et al., 2016).

2.9 Related models and frameworks

Over the last four decades, many researchers have come up with some theories and models while investigating students', especially girls' choice of not taking ICT at the high school or further education and dismissing the ICT job sector altogether. Hatlevik et al. (2018) examined the theoretical relationship between contextual variables, students' characteristics, students' use of ICT, ICT self-efficacy and computer information literacy. Hatlevik et al. (2018) found that socio-economic backgrounds had a causal relationship for the students, impacting on their computer and information literacy and their self-efficacy was a lot higher for girls than expected, suggesting the traditional perception that boys are more confident than girls when it comes to ICT are diminishing.

Fisher, Lang, Craig, and Forgasz (2015) used a longitudinal model to produce a theory that they believed help encourage more girls into ICT. The model explored role models, school curriculum, learning environment and ongoing support mechanisms. They found that the intervention programme increased girls' interest in ICT. By creating a curriculum based around technology that supported the girls' interests they found that the majority of girls enjoyed the curriculum and the classroom environment, it also had an impact on the girls' academic outcome for ICT. The classroom atmosphere increased the girls' level of enjoyment for ICT due to all students being female. The girls also enjoyed having female experts within the classroom that they could look to as role models; again, this had a positive impact on the girls. To be able to sustain the ongoing reinforcement for the girls, Fisher et al. (2015) suggested more prolonged running of the programme, more speakers and follow-ups with the girls that took part. The only negative that came out of the findings was that the majority of the girls that did take part were already involved in some shape in ICT at school; this did skew the finding as the girls' perceptions and attitudes were already positive towards ICT.

Cheryan, Master, and Meltzoff (2015) identified a factor that causes girls to lose interest in ICT at University. The factors they identified included stereotypes in the culture of ICT and the stereotype inability in ICT and the effect they had on girls' participation in computer science and engineering. Changing students' stereotypes of culture by changing the environment and diversifying the people that represent the field will create a more inclusive culture and allowing students to discard preconceptions of the old stereotypes of culture and abilities.

Craig (2016) created an intervention evaluation framework from numerous intervention programmes to try an address the gender divide in ICT. The framework is composed of three stages. The first of those stages included the problem, its context and the development of the logical model. Secondly, the evaluation planning required answers to the questions of why to perform evaluations. Lastly, the framework guides the design of the evaluation and the evidence that is needed. Adopting this framework would encourage champions to articulate the problem that the programme is trying to solve and the assumptions of how the programme is expected to work. Utilising this framework should lead to a better understanding of which types of intervention programme work. This research has not shown any new evidence that intervention programmes increase females' interest in ICT and globally, the majority of intervention programmes have not shown increased enrolments for females in ICT.

Stern et al. (2018) investigated the impact that role models have on high-school students. Stern et al. (2018) believed that role models could contribute to students' sense of autonomy, competence and relatedness. They also found that from their study, students who identified having role models exhibited more positive measures of environmental responsibility, character development, leadership and attitude towards school. They reported that students who gained a teacher or parent as a role model exhibited the most positive gains. The results suggest that students who align with teachers or parents as role models rather than celebrities are linked with positive attitudes and intentions.

2.10 **Chapter summary**

The examination of the literature has shown that perceptions and attitudes of generation Z with regards to ICT are built up over a long period of time. Despite the investment from education and industry to change those perceptions and attitudes thee remains a 'shrinking pipeline' (Camp, 1997) of girls wanting to study ICT at high school or as ICT as a career choice. The literature in section 2.2 suggests that gender could be the key to understanding the meaning of ICT as it relates to computing, as many ICT teachers are male. Therefore this study focuses on those perceptions and attitudes of girls in year 11 of high school and the factors that discourage or encourage the uptake of ICT.

This study utilises gender theories including business theory, theory of generations, social comparison theory, generational difference, self-perception and perception theory and attitude theory. These theories have shaped the understanding of the social, cultural, structural and generational identity to which generation Z fined themselves. Literature presented in section 2.5 argues that culture plays a part in perception and attitudes of children and becomes part of their identity as they grow. The literature suggests that it is important to examine the cultural values that makes up a person and the priorities those individuals give those values and how it will shape their perceptions and attitudes. This study examines these factors and the relationship and how they impact on the decision making of generation Z.

It may not be the same for every generation Z student but social factors influence individuals, however, it depends on their own circumstances and other related factors. It has been argued over many years and by many authors that stereotypes have a big impact on perceptions and attitudes, it also can cement those gender relationships for girls when it comes to ICT through feminine and masculine traits at the educational level, from home and the ICT industry. When girls interact with these stereotypical people their sense of belonging in ICT decreases. In section 2.6.2 it has been argued that stereotypes have become normalised for girls and believing they need to adapt to these norms that meet social expectations. Therefore this study draws on aspects of four different factors to find if today's generation Z students have changed their attitude and perception in this disruptive era towards ICT.

This study also examined literature from structural factors suggested that along with other factors, including cultural, social and generational that structural factors such as education and industry play a role in each individual's perception and attitude which causes a gender divide through feminine and masculine roles and jobs.

3 METHODOLOGY

3.1 Introduction

The review of literature presented in the previous chapter highlighted the need to investigate the relationships between the social, SocialIT, cultural, structural, generational, and students' motivation and perceptions. There is a need for an understanding of these different factors that chapter two highlighted with the gaps in the literature found, also the misconceptions and understanding of perceptions and attitudes towards ICT, technology and computing.

This chapter will focus on the research paradigm and some background into research characteristics and considerations. It will also examine the methodology that will be used for the study. It will then focus on the data will be collected for each phase and the analysis and how it will be done. The final part to this chapter will focus on the ethics involved in conducting surveys and interviews and how these factors where adhered to.

3.2 Research paradigm

When developing a research project, it is crucial that the paradigm chosen matches the beliefs of the researcher, so it is essential to understand what paradigm fits with the research but also the researcher (Creswell & Plano Clark, 2011). A research paradigm is a "perspective about research held by a community of researchers that are based on a set of shared assumptions, concepts, values and practices" (Johnson & Christensen, 2008, p. 31). It has also been suggested by Ling and Ling (2019) that "paradigm refer to a world view or to a high order way of thinking about or categorising the approach or logic that underpins all aspects of the research undertaking from the intent or motivation for the research to the final design, conduct and outcome of the research" (p. 2). Any given paradigm's information will change based on human construction (Guba & Lincoln, 1994).

In educational research it was generally accepted that the main research paradigm to be used was quantitative (Johnson & Christensen, 2008), however during the 1980s a paradigm war broke out between quantitative and qualitative researchers arguing "their

approach was superior" (Johnson & Christensen, 2008, p. 31) and that the two approaches could not be used together due to differences in the worldviews or philosophies. This either-or position was called the 'incompatibility thesis' (Johnson & Christensen, 2008). The incompatibility thesis failed to take into account any activity and thoughtful mixing of assumptions and ideas, which laid the foundation for the third paradigm.

The third paradigm changed the way educational researcher thought about the characteristics of ontology "the nature of the knowable or the nature of reality"; and epistemology "the relationship between the knower (the inquirer) and the known (or knowable)" (Guba & Lincoln, 1994, p. 108). The third paradigm allowed the mixing of the other two paradigms of quantitative and qualitative because mixing ideas, assumptions and methods offers new ways of understanding and studying the world, giving new and exciting opportunities of conducting educational research (Johnson & Christensen, 2008).

Modern approaches accepted in educational research for paradigms could take the form of scientific, interpretive or critical research. This research also involves social theories, and they too have their own set of paradigms such as feminism, postmodernism and post-structuralism (Allan & Turner, 2000). Each paradigm will have its own set of values, terminology, methods and techniques to help understand such social and educational impacts they have on the person and their surrounding environment research ontology and epistemology. All paradigms are based on their assumptions of ontology and epistemology, and since all assumptions are conjecture, the underpinning philosophy can never be empirically proven or disproved. Different paradigms will contain differing views; therefore having different assumptions of what is real or not and the knowledge to understand that, brings together the research and this will be reflected in the use of the methodology (Scotland, 2012).

Paradigms contain assumptions concerned with truths (ontology) and knowledge (epistemology). Figure 3-1 shows how ontology and epistemology as concepts are grouped under the metaphysics within philosophy. Metaphysics is a way of showing how the divisions of philosophy deal with abstract concepts. Ontology looks at the nature of reality (does it exist?), and epistemology is concerned about how we know it is real (Willis & Jost, 2007). However, another view of reality would be idealism, which

suggested that reality is mental and spiritual (Willis & Jost, 2007). A further ontological position would be subjectivism, where no others perceptions exist except the one in our head (Willis & Jost, 2007). These different ontological views will influence epistemological views. Materialistic ontology looks to use an empirical approach towards what is known about the world through experiments. On the other side, feminism comes from an objectivist ontology using the experience of the researchers (Willis & Jost, 2007).

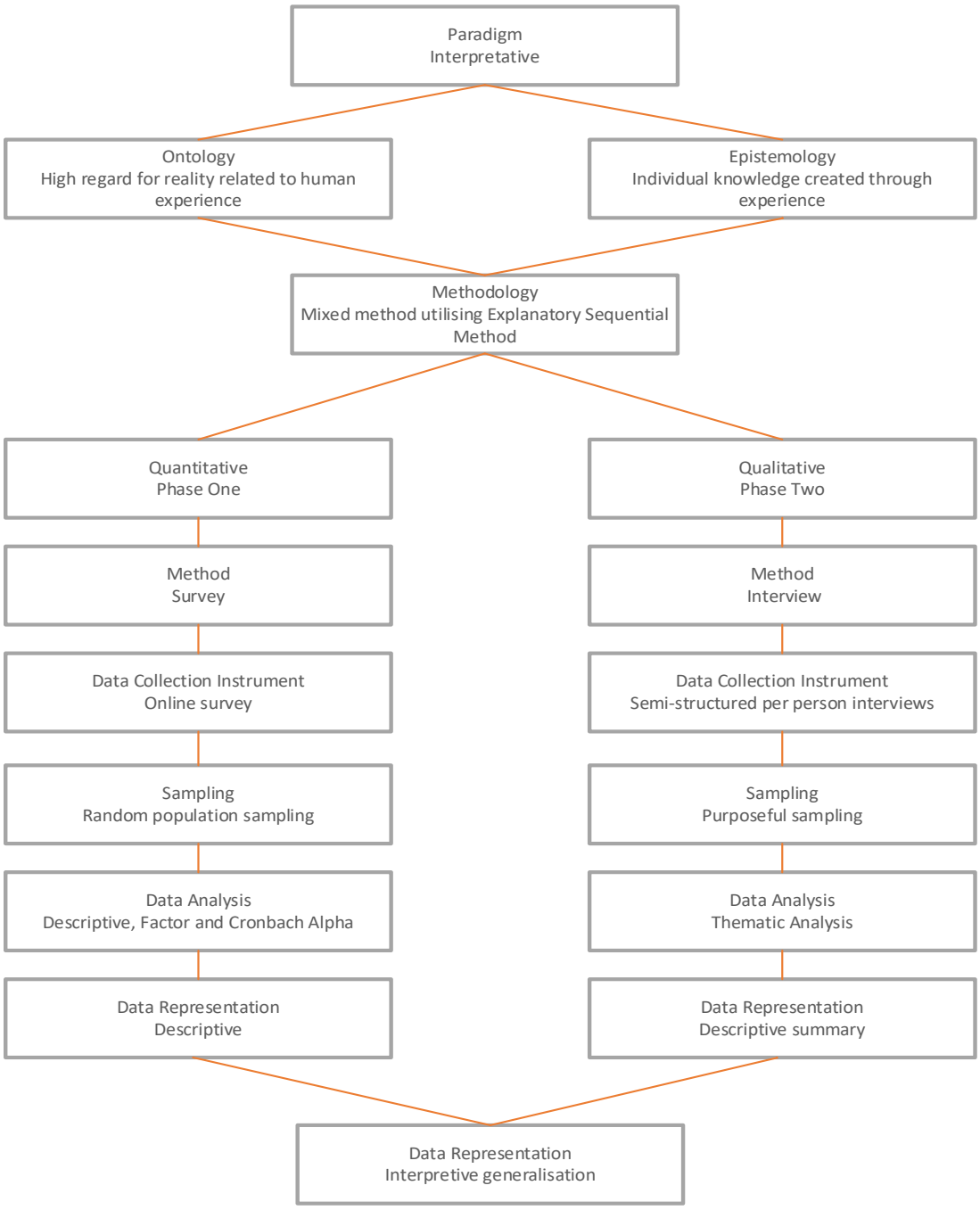


Figure 3-1. Research design. Created for this study

3.2.1 Research characteristics

The current research has some distinct questions. First and foremost, the main topic of focus for the study, this being the minimal uptake of females studying ICT, technology or computing at a higher level, based on perceptions and attitudes they have constructed through observation and communication and their motivations. The goal is to be able to develop an understanding of the problem that has not been addressed previously by other scholars.

Second, the literature review has exposed a gap in the literature that, as of now, has not been addressed, thus justifying the research. This justification came about from many years of research trying to solve the problem of the lack of uptake of female students towards further education in ICT, technology or computing qualifications (Adya & Kaiser, 2005; Bernhardt, 2014; Clayton et al., 2012; Dimitriadi, 2013; George & Ogunniyi, 2016). The gap emerging from the literature review suggested that a generational shift is happening and the changing generations within schools and the ICT industry need further examination.

Third, the research questions have been formulated to be open and allow comprehension of the participants' own experiences, perceptions, attitudes and motivation.

Fourth, the goal of the methodology is to allow the research to collect and analyse data from a sample demographic from a particular region from both students and employees in ICT, technology or computing industry, giving understanding from different generations of their perceptions, experiences, attitudes and motivation of the phenomena.

This research will employ a mixed method approach, using quantitative and qualitative methods from an interpretive standpoint. The characteristics of the given methodology in Table 3-1 is shown below:

Table 3-1. The characteristics of the methodology

Research Stage	Mixed Method characteristics	Current research characteristics
Research Problem	To generalise the finding to a population as well as develop a detailed view of the meaning of the phenomenon for individuals	Motivation and perceptions of students from year 11 and employees from the IT sector
Literature Review	The literature review will be consistent in the primary strategy of the quantitative approach and identify the central issues	Gap exist with little research in the area of generational effect
Purpose/Research question	Stating the purpose of the research question to be open and allow comprehension of participants' motivations, perceptions, attitudes and experience	
Data Collection	Use of a survey to understand the population view. Use of interviews so individual trends can be followed through from the survey	Data collection from multiple schools and companies. Data collected from a sample of the population that took the survey
Data Analysis	Analyse the data by way of software to define the trends, analyse the recording of the interviews so that participants views can be obtained	Results will be shown in two parts, quantitative from the survey and qualitative from the interviews
Discussion	Writing of the thesis using what will work. Evaluate the researcher's role and any bias that they may have	Discussion based on participants views from both quantitative and qualitative results and any bias from the role of the researcher

Source: Creswell and Plano Clark (2011, p. 16)

3.2.2 **Research considerations**

The current research paradigm considerations are listed in Table 3-2 below and highlight the interpretative paradigm for the current research.

Table 3-2. Current research considerations

Feature		Positivist	Neo-positivist Deductive	Neo-positivist Inductive	Pragmatic	Interpretative	Transformative	Super-complexity
Approach	Impartial					✓		
	Socially-concerned							
Process	Objective							
	Subjective					✓		
Contribution to Understanding	Confirm/prove or disprove an understanding							
	Give (qualified) support to or refute an understanding							
	Provisionally add (to) an understanding							
	Provide a perspective/account					✓		
	Provide a solution							
	Problematize or complexify understanding							

Source: Ling and Ling (2019, p. 17)

From an ontological point of view, whether consistencies and patterns exist or not, understanding of the social world are seen as socially constructed and can be viewed only through the observations of the researcher. Those finding can be subjective interpretations to the artefact investigated (Ling & Ling, 2019). In interpretative research the researcher will be certain that comprehension of reality will be socially constructed and there are multiple understandings to be explored. This hold true for this study as through a mixed method of collecting survey data and the interviews there will be multiple understanding from participants and the interpretation of those perceptions and attitudes. The contribution that this study will provide comes from the researcher's findings through the mixed method and the understanding and interpretation of those finding providing the researcher's perspective rather than a definite answer to the question.

The research in this study will impact on both social and academic issues. From a social standpoint, it will be around the background and culture of the participants, but also their motivation towards ICT, technology and computing in and out of school. It will take into account the shared understanding from both social and academic from the view of perceptions and attitudes of the world they have grown up in, and if the groups of participants share a common understanding.

For the research to be objective, the researcher made sure that any personal biases were taken into account. The first phase of data collection was conducted through an online survey, which limited any exposure of the researcher to the participants. In the second phase of data collection which was conducting interviews with participants, the researcher had a female colleague as a research assistant, asking the questions in the interview for the students to limit the bias that could be brought in by the main researcher. Only the researcher was present for the interviews with industry. In the write up of the results from the interview phase, the audio recording was sent to a professional service to be transcribed; this took out any bias that the researcher could have in writing up the audio recordings.

3.2.3 **Research paradigm: pragmatism**

After reviewing the ontology, epistemology and the characteristics of the research from the researcher and the mix of participant's perspective, the research will take on a pragmatism/constructivist paradigm. This will enable the researcher to understand the

types of mental, world and motivations coming across from the participants. The generalised characteristics of the paradigm in Table 3-3 are shown below:

Table 3-3. General characteristic of pragmatism paradigm

Issues	Pragmatism
Nature and Reality	Recognise the existence and importance of nature or the physical world. Places high regard for the reality of the influences of the inner world of human experience in action
Purpose of the research	The human inquiry viewed as being analogous to experimental and scientific inquiry. See what works, what solves the problem. Provide evidence to answer the question
Acceptable methods and data	What works to solve the problem
Meaning of data	Understanding is both constructed and based on the reality of the world of human experience in action. Endorses fallibilism, eclectism and pluralism
Relationship of research to practice	Endorse strong and practical empiricism as the path to determine what works, explicitly value-oriented approach to research that is derived from values such as culture and background

Source: Johnson and Onwuegbuzie (2004)

3.2.4 Research methodology: mixed method model

The last part of the research paradigm is the methodology or the third characteristic which is the "strategy or plan of action which lies behind the choice and use of particular method" (Crotty, 1998, p. 3) and "a methodology is concerned with why, what, from, where, when and how data is collected and analysed" (Crotty, 1998, p. 9).

With the use of a pragmatic ontology, there is no one way to conduct research; however, for the research, there are four main approaches that can be used under the mixed methodology approach, these include convergent, explanatory sequential, exploratory sequential and transformative (Creswell & Plano Clark, 2011). Table 3-4 highlights the main outcomes of each of the methods below:

Table 3-4. Four approaches of mixed methodologies

Method	Outcome
Convergent	A form of the mixed method where the researcher mergers qualitative and quantitative data in order to provide a comprehensive analysis of the research problem
Explanatory sequential	First conduct quantitative research, analyse the results and then builds on the results to explain in more detail with qualitative research
Exploratory sequential	First conduct qualitative research, analyse the results and then build on the results to explain in more detail with quantitative research
Transformative	The data can be converged or sequential with one building upon the other

Source: Creswell and Plano Clark (2011, p. 15)

The choice of method in mixed methods research depends on the decision to identify the type of information to be collected before the start of the study or allow it to evolve from the participants (Creswell & Plano Clark, 2011). Explanatory sequential mixed approach base the inquiry on collecting different types of data, providing a complete understanding of the research problem rather than just using either quantitative or qualitative data. Explanatory sequential mixed methods have been coined the third paradigm (Guba & Lincoln, 1994) and have a brief but very successful impact as this approach originated around the late 1980s. Many fields, including education (Johnson & Christensen, 2008; Johnson & Onwuegbuzie, 2004; Kerkhoff, 2017; Smith, 2013) have adopted this method.

Explanatory sequential methods start with a general survey allowing for results to be gathered for a population and then, the second phase, focusing on the open-ended qualitative interviews to help explain further points raised within the quantitative survey or survey (Creswell & Plano Clark, 2011).

Mixed method research is not as common in educational research studies as it takes a significant amount of time to conduct both quantitative and qualitative research. However, there are several studies that have used a mixed approach. Explanatory

sequential methods have been used to study participants' perceptions of skill levels (Bussell, Hagman, & Guder, 2017), participant motivation to learning (Kauffman & Kauffman, 2017; Kerkhoff, 2017), participant self-efficacy (Kauffman & Kauffman, 2017), digital access (Hartnett, 2017) and culture (Hartnett, 2017).

The intention is to understand how participant experiences of perception and attitudes affect decisions based around knowledge learnt and whether or not these decisions will lead them on to ICT, technology or computing. Understanding the participant's perceptions and attitudes about how they feel is vital towards increasing participation in ICT, technology and computing.

3.2.5 Explanatory sequential and why

With the use of mixed method research the researcher has different designs to choose that most fits with the research and the questions. For this study the researcher has chosen an explanatory sequential design. This design best fits with what the researcher is trying to accomplish through the main question and sub questions. The main question focuses on factors that discourage or encourage year 11 girl's participation in ICT at school. These factors are used in subsequent questions through perceptions, attitudes and motivations. The researcher want to be able to gather as much data as possible in a short period of time, using a quantitative method would be a suitable choice. However, analysing quantitative data alone would not give the full picture required for this study. Through quantitative design you lose the emotion and voice of the participant and because this research is about perceptions and attitudes the use of a qualitative method was needed. For this research the priority was given to the quantitative phase of the design as this would gather the most amount of data. The use of explanatory sequential design over other mixed method designs for this study was to be able to incorporate those year 11 girl's experiences through the qualitative phase, allowing the general picture of the research problem to be refined, extended or explained.

Many researchers (Creswell & Plano Clark, 2011; Ivankova, Creswell, & Stick, 2006) have agreed that explanatory sequential design to be most popular with researchers that are starting out or are novice to research and has both strengths and weaknesses. The strength of this design includes straightforwardness and opportunities for the exploration of the quantitative results in more detail. This design can become useful

when unexpected results arise from the quantitative data. One limitation of this design is that it can be lengthy to collect and analyse both types of data.

3.2.6 Research method: quantitative phase one

The methodology is the "plan of action which lies behind the choice and use of the particular method" (Crotty, 1998, p. 3), where the method is the "specific techniques and procedures used to collect and analyse data" (Crotty, 1998, p. 3). A survey "provides a quantitative or numeric description of trends, attitudes or opinions of a population by studying a sample of that population" (Creswell & Plano Clark, 2011, p. 155). The use of an online survey allows the researcher to reach a broader population and allows participants to interact quickly and efficiently with the online platform (Vicente & Reis, 2012). Surveys have been adopted in most quantitative method designs for several years (Vicente & Reis, 2012) and have played a pivotal role in educational research (Caruth, 2013; Creswell, 2002). When planned well, the technique of designing questions can be an efficient way of answering the research question (Creswell, 2002).

3.2.7 Research method: qualitative phase two

This study used a mixed method approach to allow the results in phase one, which will be quantitative, to inform phase two interviews using a qualitative approach to bring a better understanding to the issues of perception and attitude of females not wanting or not knowing about opportunities within the ICT, technology or computing field. The study has used Ivankova, Creswell, and Stick's (2006) approach to mixed methods of using explanatory sequential mixed methods and adapted Bernhardt (2014) framework to construct a sound design. This design, with the methodology and method, have been very carefully constructed to answer the research question.

The design of the explanatory sequential mixed method, as shown in Figure 3-2, has the intent to help explain the quantitative data by informing from the results the type of participants to be selected for the qualitative phase. The data from phase one will be collected from the surveys and formulated into results; those results will then guide the research into asking questions based on themes that present themselves from the data in the interviews, helping enhance the questions asked or following particular themes.

Figure 3-2 below shows the mixed method design.

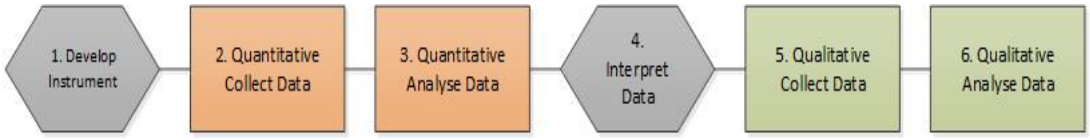


Figure 3-2. Mixed methodology design. Created for this study

3.2.8 Research question and method alignment

Looking at the main research question, it states: *What are the factors discouraging or encouraging the participation of year 11 girls' in ICT education?* In order to answer the main question, sub-questions shown below were formed and formulated to be able to answer the overall thesis question.

a) Has the disruptive era changed girls' perceptions and attitudes about ICT?
b) How do girls' perceptions differ compared to those of boys when it comes to ICT?
c) What impact does technology have on attitudes and perceptions of girls towards ICT?
d) What are the generational effects that influence the participation of girls in ICT?

To be able to align the research question and the mixed method approach, two phases of data collection were applied to the research. To obtain opinions, perceptions and attitudes based around the research, a survey was created for phase one. The results then were used in phase two to identify follow up questions with a selection of participants that had completed the survey using an interview process in a friendly, non-threatening environment (Boyce & Neale, 2006; Jacob & Furgerson, 2012).

The design intended to gather data effectively and efficiently, without impacting on the participants, especially the school participants in phase one. An online survey was chosen to be the format of choice. This fitted with the types of participants that the study was focusing on, as this became the easiest way to reach year 11 students. In phase two, interviews were chosen for the study as these allowed a much more in-depth understanding of the questions. It also allowed the researcher to understand the differences within the targeted groups rather than the commonalities from running focus groups (Roger, 2015). Table 3-5 below lists comparisons between focus groups, interviews and observations.

Table 3-5. Comparison between focus groups, interviews and observations

Type	Advantage	Limitation
Focus Group	Can elicit new information from the group, explore characteristics from group culture	Can be railroaded by individuals. Not all people may want to join in
Interview	Allows the researcher to control the line of questioning	The researcher may bias the responses
Observation	The researcher has the first-hand experience with the participant	Certain participants may present particular problems, such as gaining consent for minors

Source: Creswell and Plano Clark (2011).

The settings for an interview are considered unnatural and may bring its problems (Creswell & Plano Clark, 2011), with the type of study the research proposed, an observation approach would not be beneficial to the research and take too long to set up. Due to the time factor involved in getting into the schools and the companies a timeframe had to be adhered to.

From a social standpoint, the research was more inclined to use interviews as this gave greater access to the participants to be able to talk about the meaning of the questions and delve deeper into their perceptions and attitudes towards the questions asked rather than a group experience. Three concepts or strategies for getting at the real information from interviews is shown below in Table 3-6.

Table 3-6. Gathering real information using interview technique

Impositional Strategies	List themes, issues, problems, questions to be covered, drawn from phase one. This closed format aims to generate the conditions for generalisation across populations. Some flexibility may be built in with open-ended questions forming a semi-structured interview.
Grounded Strategies	Open interviews that have no prior list or pre-set questions but is grounded in the views and agendas of the interviewee in order to adopt strategies appropriate to the specific nature of the social context.
Emergence Strategies	The interviewer should adopt the pose of the learner in a way that parallels the language and manners of the interviewee and does not impose or objective the person. In this way, the possibility is increased that the voices are freed from the impositional power of the researcher. The data gathered and analysis that follows would be grounded in the experiences of the interviewee rather than grounded in the demands of the research.

Source: Barbour and Schostak (2005, p. 42)

3.3 Instrument and Protocol design

For this research, a modified version of the conceptual framework designed by Bernhardt (2014) based on the " STEMCell" model will be used. This modified framework is used as a lens to make a judgement about the likelihood of a student choosing ICT for study and future career, considering the constructs of Culture, #SocialIT, Structure, Social, Generational and Individual factors. Each construct will contribute to decisions about choosing ICT as a career path. Shown in Figure 2.1 is the adapted conceptual framework.

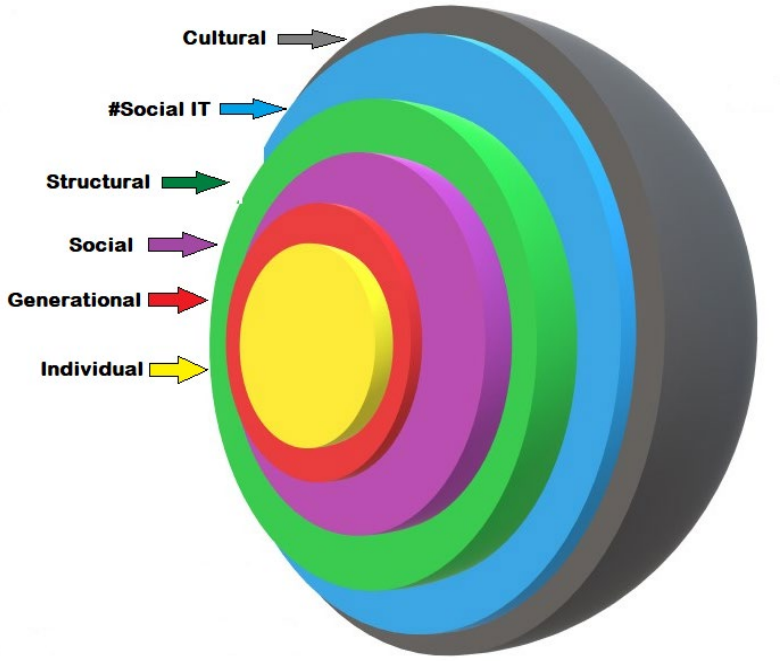


Figure 3-3. New STEMCell2.0 Framework architecture based on Bernhardt's 2014 STEMCell Conceptual model. Created for this study

Figure 3-3 is the New Framework based on STEMCell model (Bernhardt, 2014). The STEMCell2.0 framework architecture identifies six constructs: Cultural, #SocialIT, Structural, Social, Generational and Individual, each with its context and factors which may encourage or discourage participation, or present obstacles that incentives or disincentives participation in ICT. Each of the constructs from the framework is expanded through discussion of the literature to give background into some of the perceptions and attitudes that are to be measured through a survey and interviews. The outputs of the six constructs are synthesised to form the Likelihood of students choosing ICT.

3.3.1 Instrument design

The survey was carefully designed to extract the maximum information from the participants without overwhelming them with too many questions (Vicente & Reis, 2012). The survey used the adapted STEMCell 2.0 based on Bernhardt's (2014) work. The intention was to have a starting point based on previous work. However, the questions had to be manipulated for the design to fit the framework. The STEMCell 2.0 framework is based on a set of identifying factors. Table 3-7 below shows those factors.

Table 3-7. STEMCell2.0 framework architecture

Framework	Factors
Cultural	Factors that influence you from within your family and background
Social	External factors that influence your perceptions through stereotyping, friends, social media, gender, role models and mentors
Structural	External factors that influence you through school, home and industry and support you get from home, school or industry
SocialIT	Factors that affect your perception and attitudes of what the future holds for ICT, technology and computing
Individual	Individual context determines how individuals react to their environment. Individuals accept, react to or overcome/override the Cultural, Social and Structural contexts, influencers and obstacles.
Generational	Factors that affect your perceptions based on the older generations own perceptions and attitudes towards ICT, technology and computing

Source: Bernhardt (2014, p. 19)

This allowed the researcher to split up the questions into topics to cover all the sub-questions asked in the research. The use of an online survey was the easiest and effective way of seeking out a broad population (Creswell & Plano Clark, 2011). As shown in Table 3-6 above, each section has been broken into factors that use perceptions, opinions and attitudes towards the desired outcome of the thesis. The participants were year 11 students studying at high schools within the Wellington region and employees of ICT companies. This included all year 11 students studying at high school and not just

students taking ICT subjects and a cross section of different generations working in the ICT industry. LimeSurvey was the tool used to create the survey. In total, there were 46 questions that made up the six sections. From the six schools that took part in the survey, a total of 358 responses were collected. However, only 286 responses completed in full the survey and could be used. Thirty five employees participated in the survey and all completed all the questions. The majority of the survey used a Likert scale from one to five, one being, totally disagree with five being, totally agree. The other questions used demographic questions and one open-ended question at the end of the survey, gathering feedback from the student.

3.3.2 Phase one: validation

The survey was ready for validating and to test the reliability. Due to the survey being completely un-tested, validation had to take place. Creswell (2002) showed that there are three types of validation in quantitative research. Table 3-8 below shows these validations.

Table 3-8. Three types of quantitative validation

A	Content validity (do the items measure the content they were intended to measure?)
B	Predictive or concurrent validity (do scores predict a criterion measure?) Do result correlate with other results?
C	Construct validity (do items measure hypothetical constructs or concepts?)

Source: Creswell (2002, p. 160)

Using type A (content validity) from Creswell (2002), the survey were sent to a select set of experts, including a supervisor, USQ statistical team, educational experts, industry and colleagues. The feedback given were used to re-formulate some of the questions and remove duplicate, confusing and irrelevant questions. Table 3-9 feedback given on the surveys.

Table 3-9. Feedback from experts on the survey

Feedback 1	**Break down the questions and put them into the five subcategories. This was done after the first input from the statistics team**
Feedback 2	Answer the questions as a student or an employee would. This allowed the cutting of duplicate and complex questions

Feedback 3	Questions need to be re-ordered to make more sense with the framework. Changing the order again allowed the researcher to cut questions that did not belong in that section or other sections.
Feedback 4	Re-word some questions as I do not know what you are asking. Questions were re-worded to make it easier for year 11 students
Feedback 5	Some questions feel focused on teachers and parents, and I do not feel qualified to answer them

Source: Created for this study

Once the initial consultation with the experts had taken place and iteration had happened, the researcher was prepared to take the survey to the pilot phase and send it to a set school, who was prepared to carry out the study and a single company.

3.3.3 Phase one: reliability

Reliability is stated as "The degree to which the result of a measurement, calculation, or specification can be depended on to be accurate" (Oxford University Press, 2017). For the survey to be successful, it had to be reliable. A pilot study was carried out with a local school and a local ICT company to give feedback and to test the reliability of the questions. This was measured by running the pilot with 15 students from different classes across year 11 at the school and five employees from a company. The feedback was gathered and collated, providing feedback to the researcher to make changes to the survey, as shown in Table 3-10 below.

Table 3-10. Student and employee feedback (sample)

Feedback 1	I do not understand the sections and what they mean. A better synopsis was created for all sections to allow students and employees (more for the students) to understand what the content of the following questions was about.
Feedback 2	Spelling mistake in question. Changed
Feedback 3	Some of the questions can be classed as double negatives the way they are written. Questions changes to be positive
Feedback 4	I received mixed opinions on the gender female/male (woman/man) debate from employees, Made the call to keep as female/male for both questions.

Feedback 5	Would like to add some more information. From the feedback, have added open-ended questions at the end of the survey for any other suggestions or input.

Source: Created for this study

3.3.4 Phase one: pilot study

The pilot or feasibility study refers to a mini version of the study (Van Teijlingen & Hundley, 2001) to pre-test the research instruments such as the survey and the interview. This is a crucial element of good study design. Carrying out a pilot study does not guarantee success, but it does increase the likelihood for the main study (Vicente & Reis, 2012). Table 3-1 below suggested some reasons for conducting a pilot study.

Table 3-11. Conducting a pilot study

Developing and testing the adequacy of the research instrument
Assessing the feasibility of the full-scale study
Designing a research protocol
Assessing whether the research protocol is realistic and workable
Collecting preliminary data
Determine what resources are needed for the study

Source: Van Teijlingen and Hundley (2001, p. 2)

The pilot study was conducted with a local school that was close to the researcher work and a local ICT company. The pilot studies were conducted over separate days with both the school and the company. The school that participated in the pilot study allowed the researcher to take 14 students in a class to take the survey. Once the survey was completed the researcher then went around to groups of students asking questions about each section of the survey. These results from the students allowed the researcher to revise some of the questions before it went live to the other schools. The school that took part in the pilot was the ineligible to take part in the main study. The same process also was used for the company that took part in the pilot. The five employees took the survey online and then each individually gave feedback on the questions and the sections of the survey, mostly the feedback was around wording and explanations around certain words. Some questions were completely removed as it was felt by the employees that they did

not add any new insight. Table 3-12. The pilot study process was used to improve the internal validity of the surveys for both students and employees (Van Teijlingen & Hundley, 2001).

Table 3-12. Guidelines for gaining feedback from participants

Administer the pilot in the same way as the main study will be carried out
Ask for feedback on ambiguities and difficult questions
Record the time it takes to complete the survey and decide whether it is reasonable
Discard unnecessary or difficult questions
Assess whether questions give an adequate range of responses
Check whether all questions were answered
Re-word or re-scale any questions that are not answered as expected
Shorten, re-use and if possible pilot again

Source: Van Teijlingen and Hundley (2001, p. 3)

3.3.5 Design advantage

The advantage of using such a design is to make sure that participants do not see it as a burden on themselves, school or company. It has been noted (Ivankova et al., 2006; Van Teijlingen & Hundley, 2001; Wright, 2005) that to get useful input from participants without offering any incentive are keeping the questions short and make the questions very accessible. Having the survey as an online survey made the research more manageable, and also the participant were able to complete the survey in their own time (Wright, 2005). A significant advantage of the online survey was that it allowed the researcher to reach more people in a short amount of time and over a greater geographical distance (Wright, 2005). It also allows the researcher to be active in other tasks while the survey was live. The data from the survey can be imported into advanced statistical software tools easily, which saves time and money as the researcher does not have to pay additional costs to get someone else to enter the data for them (Wright, 2005).

3.3.6 Design disadvantage

When conducting quantitative research and collecting data from online surveys, there are also disadvantages that need to be considered by the researcher. The information that

a participant uses in the survey may or may not be true and accurate; participants can misrepresent their gender, age, and a host of other variables (Wright, 2005). When posting a survey online, there can be a tendency of some participants to respond and participate, while others can ignore it completely, leading to systematic bias (Wright, 2005). To address these disadvantages, the researcher checked the raw data after it was collected and removed any irregularities from the data set. However, the researcher did have to trust the majority of the results presented by the students.

3.3.7 Survey description

The survey, described in section 3.4, is briefly summarised to assist the reader. The survey is broken up into six sections. Demographic information was collected through questions A1 to A4, giving background information on the participant, such as gender, age, ethnicity and future career. Questions B1 through B9 determined the background and family values based on perceptions of family input into the participant's future career path and knowledge about ICT and the industry. Questions C1 through C9 were devoted to social impact and the influence and perceptions that participants have through stereotypes, friends and role models. Questions D1 through D10 are all based on the structural factors that influence the participant through home, school and industry. Questions E1 through E7 are questions looking at perceptions participants have of the future of ICT and what it will look like when they leave education and what knowledge will be necessary to have to be part of an industry that uses ICT. The final set of questions F1 through F7 examine generational effects that the participants perceive; these questions are a culmination of all other sections. The next section gives background information regarding the type of analysis that was undertaking for this chapter.

3.3.8 Design protocol

The two-phases that makes up the design protocol was the survey phase (quantitative) and the interview phase (qualitative). The development of the survey and the strategies used to ask the essential questions to the participants based on the research question made up the first phase. The data gathered from the first phase was then used to select questions that needed further investigation. The second phase used semi-structured interviews using those questions that needed further investigation from the first phase. To be able to get reliable data from the interviews, the questions needed to be validated, so it was determined that a pilot was going to be useful within the interview phase. This

would allow the researcher to test those questions that needed more clarification by introducing a pilot.

3.3.9 Interview Instrument Design

For the second phase of the data gathering, based on the explanatory sequential mixed method approach, qualitative data was gathered. Interviews are one of the most common strategies for collecting qualitative data (DiCicco-Bloom & Crabtree, 2006). There are many different interviewing strategies that a researcher could participate in coming from many different perspectives and approaches. The majority of interviews, as stated by DiCicco-Bloom and Crabtree (2006), "are used to know the interviewee better" (p. 314) and that knowing is based around the research question and the discipline of the research. There are three primary interview techniques, structured, semi-structured and unstructured. For the particular research, the researcher adopted a semi-structured interview technique. A semi-structured interview is usually organised around a "set or predetermined open-ended questions, with other questions emerging from the dialogue between the interviewer and interviewee" (DiCicco-Bloom & Crabtree, 2006, p. 314). This research wanted to explore motivation, attitude and perception to gain a better understanding of the participants' thoughts with regards to ICT. This would require some form of qualitative interview technique that would encourage the interviewee to "share rich descriptions of phenomena while leaving the interpretation or analysis to the investigators" (DiCicco-Bloom & Crabtree, 2006, p. 314).

For the qualitative interview phase of the study, max sampling theory was used to determine the number of participants to interview (Marshall, Cardon, Poddar, & Fontenot, 2013). In order to gain a diverse and credible perspective, the use of purposeful sampling (Creswell & Plano Clark, 2011) was used. The sample was purposefully selected for maximum variation in demographics; this included students from various schools and companies that took part in the first quantitative phase. A mix of male and female participants with varied backgrounds, generations and identities were used. Overall, 18 participants were chosen for the interview phase, nine females and nine males. These were made up five girls and four boys from the schools that took part in the survey phase and five females and four males from the companies that took part in the survey phase. Each interview lasted, on average, 25 minutes to discuss six semi-structured questions and sub-questions based on the results from the survey. In each

interview, the researcher and a female colleague research assistant were present along with the participant.

3.3.10 **Phase two: a pilot study**

Conducting a pilot for an interview may not be necessary (Rowley, 2012), however, to make sure that the questions asked are credible and of sound structure, it was believed that a pilot of the interview would create a logical structure as the main template for the interview process (Rowley, 2012). It also allowed the researcher to test out the skills required to conduct a good sound interview process and gain feedback on that process.

For the pilot study, two participants were chosen at random from the participants that participated in the quantitative phase. The main reason behind conducting a pilot was to check the questions and the process and that the research did not have the following traits within the interview process:

- Not leading or have implicit assumptions;
- Do not include two questions in one;
- Do not invite Yes/No answers;
- Not too vague or general and;
- Not in any way invasive.

Source: Rowley (2012, p. 265)

The order of the questions needed to be addressed, as the order should be self-evident as possible and lead naturally to a conclusion for the interview. Earlier questions should set the context for the following questions and should be relevant to the research topic (Rowley, 2012).

Some of the feedback given from the pilot carried out with a sample of participants is shown in Table 3-13 below.

Table 3-13. Feedback from participants, pilot interview

Feedback 1	Question 2-2 is a little ambiguous
Feedback 2	Question 2-4 does not make sense when talking about culture
Feedback 3	Question 3-3 needs to be explained to the participant (re-word)
Feedback 4	Question 4-2 Student did not understand the terminology (re-word)
Feedback 5	Question 5-3 The term generation may cause problems with students

Source: Created for the study

3.3.11 **Interview advantages**

The use of interviews in a mixed method approach provides much more detailed information than what can be collected just through quantitative data collection (Boyce & Neale, 2006). They also provide a relaxed atmosphere in which to collect information from participants in a comfortable surrounding and becomes just a conversation for the participant rather than filling out surveys or surveys (Boyce & Neale, 2006). The advantages of using interviews over other qualitative process noted earlier (Barbour & Schostak, 2005; Boyce & Neale, 2006; Carruthers, 1990) in the chapter are shown below and can include:

- Being reasonable and objective while still permitting a more thorough understanding of the participant's opinions
- The researcher can be confident of getting comparable data across to participants
- Person-to-person interviews are best for obtaining in-depth opinions
- People are remarkably frank and honest when asked their opinions within the context that is appropriately structured
    - Purpose of the interview
    - Properly worded
    - Anonymity is mostly guaranteed

3.3.12 **Interview limitations**

Limitations of interviews are not necessarily weaknesses but a set of characteristics that need to be acknowledged to avoid problems and errors in data gathering, analysis and discussion (Boyce & Neale, 2006; Creswell & Plano Clark, 2011). Some of the limitations of interviews include the following:

- Prone to bias, based on the interviewer

- Time-intensive can take up more time than necessary to conduct
- Not generalizable, in-depth interviews conducted generalisation about results are usually not able to be made because of the small sample size.

Source: Boyce and Neale (2006)

Due to the nature of interviews, it becomes impractical to interview a large number of participants, and the selection process does not become random (Alsaawi, 2014). Additional limitations taken into account comes mostly from the schools. The interviews will be dictated by the school time table and the availability of the participants. The time that the researcher can conduct the interviews will be dictated by the availability of the participant, room at the school and time table of classes. Also, the availability of a support person for the student; as the researcher wants the participant to feel comfortable as possible through the interview process. Each school gave the researcher a timetable when students would be available in school time and the availability of a room to conduct the interviews. The researcher made sure that the female research assistant was available for each of the interviews to make the student feel as comftable as possible whilst in the interview.

3.3.13 **Interview development guidelines**

Quality questions led to an improved understanding and provided the foundation for high-quality interviews (Rowley, 2012). The questions for the interview were developed from the quantitative phase one data analysis and expanding on the themes and unanswered questions. The structure of the questions has been developed from Jacob and Furgerson (2012) guidelines, as listed in table 3-14 below. The guidelines offer insight on how to order the questions and the interview process.

Table 3-14. Interview development guide

Script beginning and End	**Develop a script to guide you through the process**
Open-ended questions	Try to uncover as much as possible about the participant and their situation
Basics first	Start with easy questions and work up to more difficult questions
The phrase "tell me about…"	This is a great way to start a question and is almost impossible to create a question that is too complex
Write big expansive questions	Using big questions allows the participant to answer the question and may say things that you had never anticipated, small defined questions become too restrictive

Use prompts	Prompts help you remember your questions, creating prompts or probe will allow for unexpected data to emerge
Be willing to make on the spot revisions	Follow up questions might pop up into your head if so ask the question Emergent design (Creswell & Plano Clark, 2011) is one of the hallmark of qualitative research
Keep the time short	Think of the participants when thinking about the length of the interview Six to Ten questions can take over an hour to get through
Pilot	Make sure you test your questions on someone that will give you good feedback to allow you to adjust accordingly

Source: Jacob and Furgerson (2012, pp. 4-6)

The interview used six questions based on the quantitative phase data analysis. Using the development guideline in Table 3-15, the first question was a fundamental open-ended simple question that puts the participant at ease, thus gaining trust with the interviewee. The question started with "tell me about….". The second question asked about school and their experience associated with ICT, technology and computing; this question was used as a transition question. The next three questions focused on the results from the quantitative phase and became the key questions that answered the themes. These three critical questions based on the answers created to follow on questions given by the participants. The last question was a summary question, allowing the interviewee to express themselves further and provide feedback on the overall process (see appendix G for interview questions). The main structure of the interview protocol in Figure 3-4 is shown below.

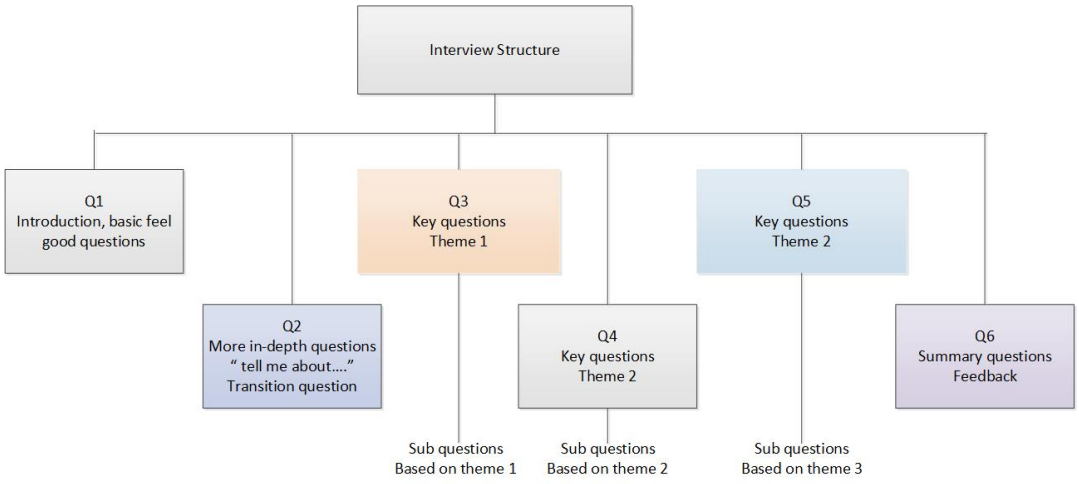


Figure 3-4. Structure of the interview protocol

Source: Jacob and Furgerson (2012)

All questions used the guidelines for the characteristics of good questions, and all questions were open-ended and straightforward. Also, probes were used when participants' answers were not clear and needed to be expanded. An example of the probes that can be used within the interview is:

> "can you expand on that please",
>
> "can you give an example that will help me understand your answer",
>
> "I am not sure that I fully understand your point, can you go into more detail for me" and in the summary question "Do you want to add anything or is there anything else you would like to talk about".

To engage the participant within the interview, participants were allowed to explore critical questions and areas that were not on the essential topics. However, the researcher always kept an eye on the time. This allowed the participants to express their feelings more openly and stimulate their interest in the interview.

3.3.14 **Interview constraints**

There were five interview constraints that the interview design followed in order to produce reliable results. These constraints were time, clarity, culture, language and location (Jacob & Furgerson, 2012). Both time and location can be taken as a single factor as they work together for many of the interviews. Table 3-15 below shows these constraints

Table 3-15. Interview constraints

Time constraints	**Question type** **Facts** **Examples** **Discussions**	**Time limit** **<1** **5mins to 7mins** **5mins to 7mins**
Clarity constraints	- Research must understand the question - The question should be clear and simple - The question must be understandable by the interviewee	
Cultural constraints	- Should be suitable for the culture of the interviewee	
Language constraints	- Language should be simple, clear and understandable by th interviewee	
Location	- Should be in a safe and welcoming place where interviewe feels happy and comfortable	

Source: Created for the study

The guide advises time constraints on specific questions; however, when an interviewee is in the mid flow of answering a question, giving extra time to answer the question could be vital to gathering data. In order to achieve clarity, the researcher should have a full understanding of the problem and the main thesis question. This allows the researcher to produce precise, understandable and straightforward questions that the interviewee can answer. Culture and language constraints relate to the type and use of questions that are deemed appropriate for the interviewee, language became a significant factor in the way the questions were phrased. The location became another factor as the researcher had to work closely with the schools to find a welcoming and safe place to conduct the interviews and the interviewee's felt comfortable.

The researcher attempted to keep track of the timing of the questions and the length of time it took for the interviewees to answer, however, the accuracy of the timing may be slightly off due to the different directions that interviewees took when answering the questions. Monitoring the time allowed the researcher to look at the questions that took the most time to answer and change the strategy for the next interview. This helped keep a tight schedule within the time constraints for the interviewees based in the schools.

The clarity of the questions was discussed with the interviewees as part of the feedback and changes made around that feedback. This became very helpful in later interviews to strengthen the questions. Feedback was sought from the interviewees in regards to the overall process of the interview and based around that feedback; changes were then made to the script and how the interviews were conducted.

3.4 **Role of the researcher**

Unlike most of the studies carried out in this field of research by academics and the literature written, the researcher comes from outside the secondary school sector and the IT industry, however, the researcher does have knowledge and work experience in the IT sector. The researcher does not have prior views, or interest in selecting specific themes, observations or records of information over others. However, the researcher did exercise self-reflection (Johnson & Christensen, 2008) to understand or control any potential bias to a minimum.

The researcher also had many roles to fulfil during the data collection phases. The researcher was involved in the planning and designing the quantitative survey in phase one. However, this is where the researcher's input stopped as the survey was online and no bias could be taken into account from the researcher as they had no interactions with the schools or companies administrating the survey.

The researcher's involvement in the qualitative second phase became more complex as the planning, moderation and interviewing was carried out by the researcher. These roles that the researcher took on in the second phase related to learning, cooperation, management and reflection to carry out successfully the execution of the research (DiCicco-Bloom & Crabtree, 2006). Table 3-16 shows the role that the researcher assumed in each of the phases of the research

Table 3-16. The role of the researcher

Phase **Data Collection**	**Task**	**Role/Detail**
Phase One	Planning	Coordination of logistics, ethical application, school and company recruitment
	Executing	A pilot study conducted, moderated, being able to challenge responses and seek understanding
	Executing	Self-critique, review feedback from notes, reflect on changes and biases in language and phrasing of questions
Phase Two	Planning	Coordinated with schools and companies, informed consent approval and screening participants
	Executing	Pilot run, interviews conducted, moderate responses, probe and seek understanding
	Executing	Self-critique, review feedback with interviewees reflected on any bias in language and content of questions used
Analysis	Interpret	Use of interviewees' own words in a descriptive style, results shown

Source: Created for the study

As per Table 3-16, during data collection, the researcher was involved in coordinating with the schools and companies. This allowed the researcher to seek guidance from both the schools and companies when the survey would be run, i.e. setting dates that worked with the school time table. Once completed, the role of the researcher was then to follow up with the schools and companies a couple of weeks later to make sure that they were giving the students and employees the right information to be able to complete the survey.

The qualitative phase became more complex as the researcher's role became more complicated, as multiple roles needed to be completed by the researcher. The researcher contacted each of the schools and companies to set up times and dates that the interviews could take place. However, this became more sensitive for the schools as the researcher required a support person to be present and available with all the interviews. The reason that a support person was asked for by the researcher was due to the interviewees would be minors and could feel unsafe and pressured into answering the questions with bias. Also, it would allow the interviewee to feel more comfortable through the interview process. Interviewing at the school also was a factor that the researcher took into account, as this would help the interviewee feel more comfortable in an environment that they knew.

Research information, including a consent form, was sent out two weeks before the interviews taking place. The researcher liaised with the school administration to make sure that all consent forms were completed before any participants were interviewed. At each of the schools involved the administration sent out emails to the participants two days before the interview, thus making sure that each participant knew the time, date, location and whom the support person from the school was going to be, or to provide the name of their support person.

When conducting the interviews, the researcher took on multiple roles, such as seeking understanding and challenger (Johnson & Christensen, 2008). The majority of the interviews conducted, the researcher played the role of seeking understanding, and the goal was to obtain interviewees' understanding by asking them questions using probes to obtain their knowledge and perceptions (Johnson & Christensen, 2008).

At the end of each of the interviews, the researcher played the role of self-critique, using reflective processes by asking the interviewee if they had any feedback on the overall

process, and the questioned asked. This process helped the research critique the interview for the next session. The feedback given by the interviews helped the research critique the way the interviews were conducted and the time given to each of the participants within the interview process. As the interviews progressed the feedback became minimal.

During the data analysis, the researcher tried as much as possible to voice the interviewees' perceptions, emotions and points of view using the most relevant quotes.

3.5 Data Collection

The data collection was made up of two phases, the first phase was to conduct an online survey using LimeSurvey software to collect the data and SPSS software used to analyse the data to get results, the second phase was to conduct semi-structured interviews; all interviews were recorded with permission and then sent to a professional service to be transcribed. Then the data were imported into NVivo software to analyse the data. Consideration of location had to be taken into account as the interviews must be carried out on-site during the school day. The researcher also had to consider the time of the interviews as not to disrupt student learning. These considerations are discussed in the following sections.

3.5.1 Locations

The data collection for the research comprised of two interview groups, group one, was school-based, and group two was company-based. However, the company interviews were conducted at different times during the day. This was down to participant availability. The interviews employees were conducted on-site at their place of work. Student interviews were conducted during the lunch break at each of the participating schools in one of the schools' classrooms.

All interviews took place within Wellington, New Zealand. Wellington is the capital of New Zealand and is situated in the lower part of the North Island. The main reason for this location being chosen by the researcher was that it was easy to access to the schools and companies for the researcher, as the researcher is based in Wellington. The schools that took part were all based in Wellington or the greater Wellington region.

All schools that took part in the interview process are public high schools dedicated to teaching the New Zealand curriculum. Year 11 students were chosen based on the curriculum as these students will choose their electives as of next year. This was an ideal set of participants, as suggested from the literature that year 11, is the time that students start to think about the pathway they will take in their education towards a career (Clayton et al., 2012; Craig & Coldwell, 2010; Pau, 2009).

3.5.2 **Venue**

Interviews were conducted in a permissive environment (DiCicco-Bloom & Crabtree, 2006); it is essential to select a place that is as neutral as possible. An improperly chosen location could distract and affect the quality of the responses from the participant (Barbour & Schostak, 2005). However, a neutral environment for the interviews carried out for the schools could not be accomplished due to ethical considerations for the participants. A classroom was used to conduct the interviews. This environment created a safe and known place for the participants and without any distractions. The researcher was able to work with the administration from each school to secure a classroom for the duration of the interview process.

For the company interviews, a meeting room was booked by the participant on the day of the interview. The participants that did not have access to a meeting room a quiet place was sought to hold the interview.

3.5.3 **Participants**

Selecting participants was based on phase one quantitative data. Only participants that had undertaken the survey were eligible to be involved in the second phase. The researcher talked to the administration team of each of the schools that took part in phase one to email the Year 11 students if they would be interested in the second phase of an interview based on the results from the survey. From the replies to the administration team, a selection of students was chosen. A small sample of female and male students was deemed the most appropriate technique to select the participants (Johnson & Christensen, 2008).

Defining the characteristics of the participants of the study is essential. The target was first and foremost completing the survey, and the second was a mix of female and male students from year 11 and lastly diverse backgrounds of the students. Help was sought

from the administration team into meeting the criteria. The other important factor on the selection process was to make sure that none of the participants selected was taking any ICT, technology or computing related classes as this could bias the results.

The researcher tried to incorporate the majority of the schools in the interview process. However, some of the schools did not respond to the email that was sent out and had no students wanting to do the interview.

For the company interviews, the researcher contacted some of the companies that were involved in phase one. This was done by using social media. The researcher asked for participants who had completed the survey to be involved in the interview process. These participants directly emailed the researcher through the social media link. The selection process for the company interviews was again a split of female and male participants. The researcher took two participants each from the age ranges from up to 20, 21 to 30, 31 to 40, 41 to 50 and through to 51 plus.

3.5.4 **Sample**

For phase one, the quantitative survey sample size was required to incorporate the population size of year 11 students across the Wellington region. The approximation for students studying at high school at year 11 was taken from the 2018 New Zealand census report and approximated to be 1000 students. From that number, sample size can be calculated using Krejcie and Morgan (1970) formula:

$$S = \frac{x^2 NP(1-P)}{d^2(n-1) + x^2 P(1-P)}$$

Where S = the required sample size

X = the table value of chi-square for 1 degree of freedom of the desired confidence level (3.841), N = the population size, P = the population portion (assumed to .50, since this would provide the maximum sample size), d = the degree of accuracy expressed as a proportion (0.5) For this research, the population sample that is required to complete the survey to give an accurate representation is shown in Figure 3-5 below:

$$S = \frac{3.841 * 1000 * .5(1-.5)}{.05^2(1000-1) + 3.841 * .5(1-.5)}$$

$$S = \frac{960.25}{2.4975 + 0.960}$$

$$S = \frac{960.25}{3.4575}$$

S = 277.729 approximate (278)

Figure 3-5. Population, calculation of sample size for the survey

Source: Krejcie and Morgan (1970)

This formula was used to calculate the sample size required for surveys to be completed for the companies based on 500 employees. Thus a sample of 76 surveys was needed.

For phase two, qualitative data collection, the sample size to conduct qualitative research is not the correct way to carry out qualitative research. However, some factors do need to be taken into account which includes the aim of sampling and the type; purposeful sampling and the method employed (Sandelowski, 1995) that will help the researcher decide whether they have collected enough data. As long as the data gathered gives sufficient depth to enable the researcher to generalise on the hypothesis, then that is the right amount of interviews (Baker, Edwards, & Doidge, 2012). Saturation within the context of this study are the same answers coming up multiple times for the same questions within the interview process.

3.5.5 Time consideration

Before the data gathering got underway by the researcher, the researcher talked to all the schools involved to work out the best time to present the surveys to the students. The researcher was aware of time constraints on students and the schools and around the school timetable, exams and significant assessments.

For the companies, a similar approach to constraints was taken into account by allowing employees to complete the survey at any time online. This allowed for minimal disruption to the workplace and company for their working day.

Phase two, the researcher had to consider assessments and exam constraints for the participants. The researcher also had to liaise with each school to conduct the interviews within the school day at each of the schools involved. Lunchtimes were chosen as the

preferred time to conduct the interviews and only one interview per-day, giving enough time for the interview process, just in case, it ran over the allotted time.

Company interviews were set up for in-house (at the company) or off-site (mutual place, such as a coffee shop). Again these were set to run over the lunch hour or after work not to disrupt the employee too much and or the company work time. Some of the employers were happy to be interviewed during the working day as they were interested in the research and had many more questions themselves about the research.

3.6 **Data Analysis**

Phase one, quantitative data were collected by using an online tool called LimeSurvey, which allowed all data results to be imported directly into a statistical tool such as Statistical Package for the Social Sciences (SPSS). Within LimeSurvey, it also collected the data and analysed against set statistical tools of its own. The data from the quantitative phase was imported into SPSS, and different techniques were used to gather the results from the tool. The results are shown and commented on in detail in chapter 4, 5 and 6. Phase two, qualitative data collection using semi-structured interviews were audio recorded for analysis with the permission of the participants. Data entry was completed through transcription (Ivankova et al., 2006). All recordings were sent away to a professional service to be transcribed, taking out the bias of the researcher from transcribing the audio to text. Each of the transcripts was sent through to each of the participants to make sure that they had correctly interpreted the audio for their sign off before moving forward with coding the data to create anonymity for the participants. Once the transcripts had been returned, interim analysis techniques followed using Ivankova (2002) steps. Table 3-17 Analysing qualitative data is shown below.

Table 3-17. Analysing qualitative data

Steps	Analysis of Data
1	Explore the data by reading through the transcript and write notes;
2	Code the data;
3	Develop themes by putting together similar codes;
4	Connect themes and;
5	Create the story

Source: Ivankova (2002)

3.6.1 Factors affecting analysis method choice

There are various approaches to qualitative data analysis; however, before selecting a particular strategy, a general guide will help in selecting a method that will help direct the research efforts. The first of these guidelines is the fitness of purpose, in the case of the study the research question was to see: What are the factors discouraging or encouraging the participation of year 11 girls' in ICT education?

It was vital that the researcher was able to explore and generate themes based on these factors. The second factor that influences the data analysis was what study type to use. The study used semi-structured interview technique to gather data based on key themes produced from phase one (Rowley, 2012).

Interview analysis can involve a spiral process (Creswell & Plano Clark, 2011), where you go round the data more than once before you reach the centre of the spiral (Rowley, 2012). There are many components of data analysis (Rowley, 2012); however, for the study, the characteristics used need to be verifiable and continuous. Table 3-18 below shows characteristics of interview analysis.

Table 3-18. Interview analysis characteristics

Characteristics	Meaning	Benefits
Spiral	The analysis is repetitive, may have to go around multiple times	Avoid making mistakes, to stop overlooking critical factors
Verifiable	Other research can arrive at the same conclusion	Avoid researcher's selective perceptions
Continuous	The analysis begins with the first interview	Help refine questions in subsequent interviews to get better results

Source: Kaabi (2016, p. 68)

Data analysis for the interviews was an on-going process from start to finish, changing questions as understanding improved from the data collected from participants, which helped enhance the results in subsequent interviews. For the study, data analysis from the interviews were driven by issues rather than people, since the participants in the interviews bear similar characteristics.

3.6.2 **Analysis approach: coding**

The researcher wanted to use a coding scheme that could be reproduced for other in-depth semi-structured interviews (Campbell, Quincy, Osserman, & Pedersen, 2013). Ryan and Bernard (2003) suggested that analysing text involves four tasks:

- Task 1 – Discovering themes and sub-themes
- Task 2 – Decide which themes are important
- Task 3 – Build theme hierarchy
- Task 4 – Link themes to the theoretical model

Discovering themes was the basis of the qualitative research, without identifying important categories, there is nothing to confirm the results found, the more themes that were found, the better the chance of finding good connections and how those themes were related to each other (Ryan & Bernard, 2003). A cutting and sorting technique was used as it is very versatile, allowing to sort expressions into piles at different levels of abstraction. The researcher then identified themes, sub-themes and meta-themes (Ryan & Bernard, 2003).

When deciding on a coding scheme the researcher explored the types of reliability associated with coding, according to Campbell et al. (2013), there are three types of reliability.

- Stability – Where the concern is whether the coder's use of codes change over time;
- Accuracy – Where a scheme is already established with high reliability and where other publications use or compare to it and;
- Reproducibility or inter-coder reliability – Where the concern is whether different codes used would give the same data the same way (Campbell et al., 2013)

As a starting point, the researcher used software tools to create codes and create themes using NVivo. Once created, another researcher with more experience was invited to check the classifications and coding in order to reduce any potential bias in the interpretation.

Framework analysis was used for the data analysis; using this approach is ideal for researchers in their first qualitative research (Rabiee, 2004). Framework analysis allows large amounts of complex data to be broken down into easy data units. The advantage

of using such a framework as framework analysis provides a precise series of steps. Figure 3-5 below shows the steps of how the researcher processed the results of the interviews based on the framework analysis steps.

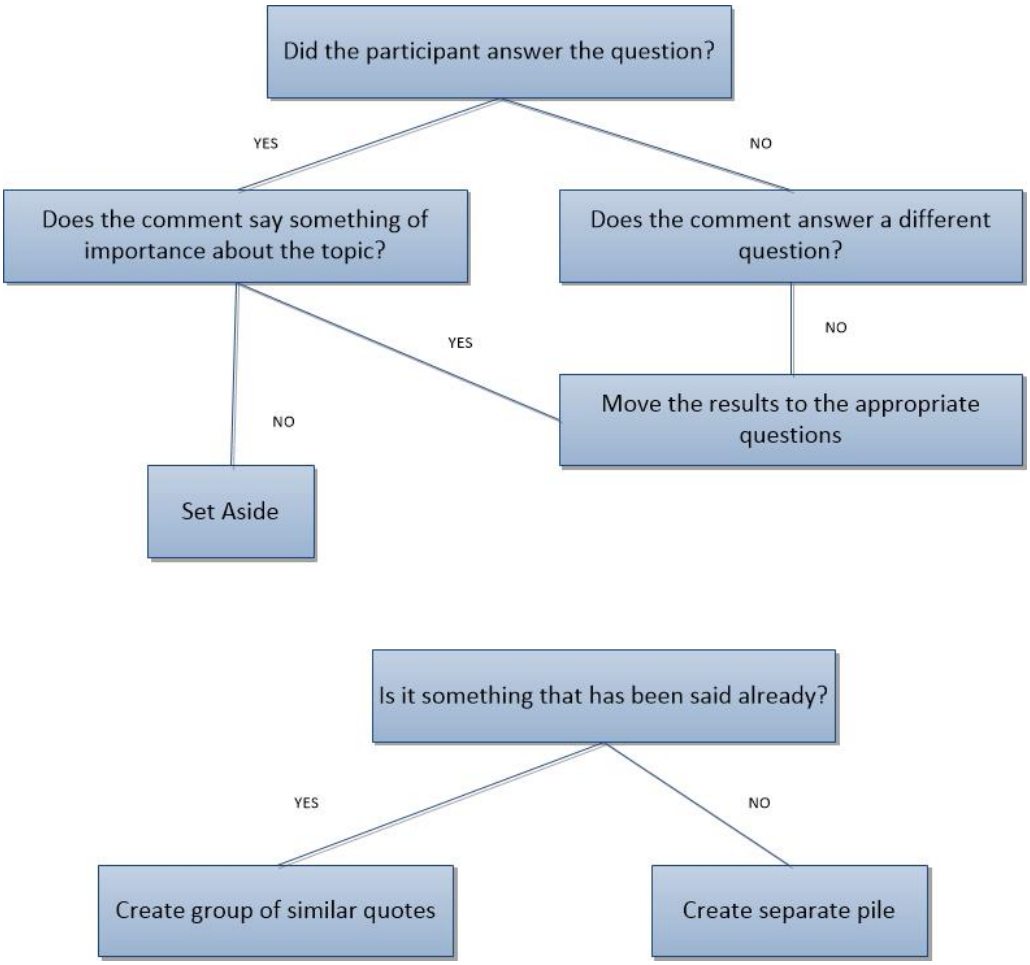


Figure 3-6. Framework analysis steps

Source: Rabiee (2004, p. 5)

3.6.3 **The trustworthiness of results**

Being able to validate the findings of any research study is vital (Campbell et al., 2013). Validating results is carried out by the researcher to make sure that the findings within the study represent what the participants either said or meant (Creswell & Plano Clark, 2011). Validation was carried out for the study by the use of triangulation and interview checking. The two methods used are described in the following subsections. Validation was achieved in phase one by way of pilot testing the survey with both students and employees. The feedback was used to enhance and change questions. In phase two, trustworthiness was achieved by piloting, participant feedback from the interviews,

feedback from colleagues and supervisors (Rowley, 2012). Themes developed from the interviews were achieved using framework analysis and triangulation.

3.6.4 Triangulation

Triangulation is the process of validating a study by "corroborating evidence from different individuals, types of data methods of data collection" (Creswell & Plano Clark, 2011, p. 259). The source of comparison for triangulation used in the study came from quantitative (the survey), qualitative (interview). To be able to accomplish triangulation the research choose schools and companies that did not take part in the final data gathering. Each phase was pilot tested, first, the quantitative phase with schools and companies to gather the data around the types of questions that would be used in the survey. The same process happened with the qualitative phase with the same schools and companies to make sure the questions for the interview were valid and credible. Evidence of each level of comparison was used to support the validity and credibility of the results.

With phase two, qualitative interview process, students' perceptions and attitudes were compared to other interviews to check the convergence of data. The next step was checking comparisons between the two groups, students and employees. These themes may not align due to the difference between the two groups.

3.6.5 Survey checking

The survey, as part of the validation process, went through many iterations before it went to the pilot stage. The pilot stage checked the questions based on two groups, students and employees. Feedback was given by both to validate the questions and credibility of each of the questions. From the feedback, many questions were changed, adapted or removed. This was shown in-depth in section 3.3.2 and 3.3.3.

3.6.6 Member checking

Another validation process that was adopted by the researcher was member checking. The use of member checking decreases the potential for research bias by involving the research participant in checking and confirming the results, allowing to validate, verify or access the trustworthiness of qualitative results (Birt, Scott, Cavers, Campbell, & Walter, 2016). The researcher, as part of the interview process, sought validation through feedback at the end of each interview. Each participant was given the option to

look at the transcript after it had been written up by the researcher to make sure their account of the interview was correct and accurate.

3.7 **Ethics**

Ethics are the "principles and guidelines that help us uphold the things we value" (Johnson & Christensen, 2008, p. 99). There were three approaches that Johnson and Christensen (2008) discussed when a researcher conducts ethical acceptability within their study. The first of these philosophical approaches are Deontological, where "ethics issues must be judged on the biases of some universal code" (p. 99). The second approach are scepticism where "concrete and inviolate moral codes cannot be formulated" (p. 99) and the last approach utilitarianism where "judgement of the ethics of a study depends on the consequences the study has for the research, participants and the benefits that might arise from the study" (p. 99).

The utilitarianism approach seems to be the primary approach used that allows a rational and logical basis for debating ethical issues that arise in conducting research (Johnson & Christensen, 2008). The research undertaken for this thesis used a utilitarian approach to ethics based on the researcher's ethical standpoint. Figure 3-6 below shows the approach to ethical acceptance of the research study.

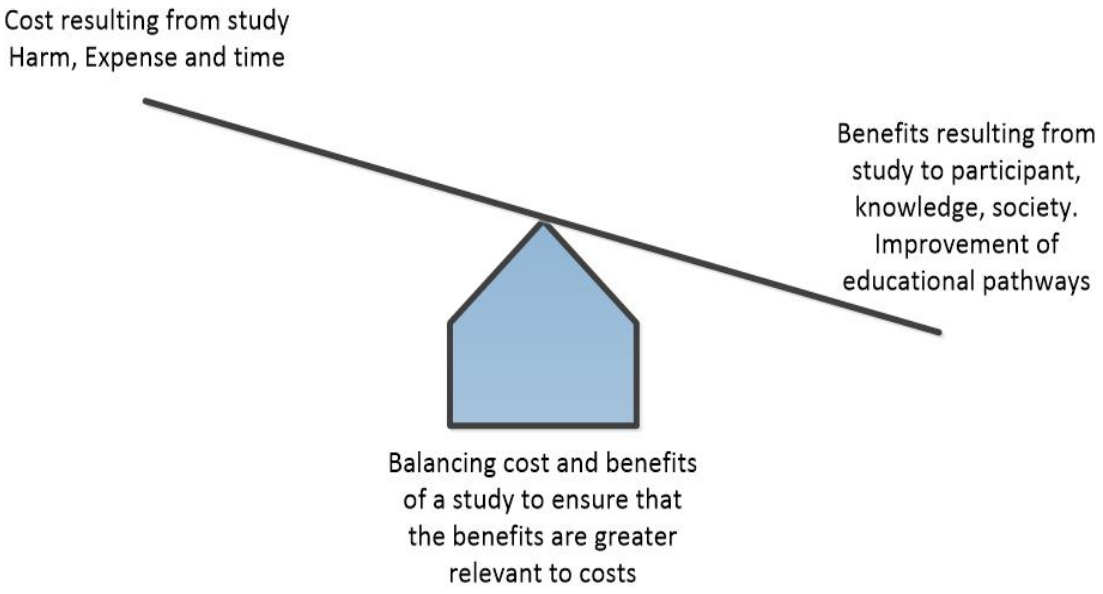


Figure 3-7. Ethical acceptance

Source: Johnson and Christensen (2008)

To be able to keep a balance across both phases of the data gathering, the researcher looked at the cost and benefit of gathering the data against the harm, expense and time. For phase one the survey, each school that wanted to take part was given an information sheet regarding the study (see Appendix J) and information to go in the newsletter (see Appendix I). To alleviate stress and undue harm to the participants the school agreed to allow the students to complete the questions online in class time. This allowed for a teacher to be present to help any students with any concerns that the questions raised. The students were reminded that this was their own choice to complete the questions and if they did not want to there was no repercussion to them. For the employees, each were sent the information sheet regarding the process and they could either agreed to be involved in the study by completing the online questions or not (see Appendix J). There was not related stress towards the employees from managers or external parties to complete the questions as this was completely voluntary.

For phase two of the data gathering through interviews, the researcher had to make sure that all students wanted to take part out of their own volition and were not coerced into the interview. For the safety of the students, all interviews took place in school. Again each students was given an information sheet about the second phase and how the

interview would be conducted (see Appendix K) and a consent form (see Appendix L). Each student was offered to bring a friend or parent to the interview to make them feel more comfortable. As the researcher is male and some of the interviews with students are with female participants the researcher felt that students may not be as open, so a female researcher was brought in to help in the interview process, alleviating stress from the students. To make sure that distress or harm was kept to a complete minimum the time limit for each interview for the students was 30 minutes. For the employees, each of the interviews were held at the employee's office or where that was not possible, the researcher acquired a quiet room within a company in the CBD. All employees were also given an information sheet and were in the interview at their own volition (see Appendix K) and a consent form (see Appendix L). The interviews were set to a maximum time of 30 minutes, again making sure that no extra harm or stress was brought to the participant. For their employees piece of mind they too were asked if they wanted to bring a support person with them. To be able to keep all students and employees information confidential and anonymous, no names were taken in the online questions and a pseudonym was used for each one of the interviews.

3.7.1 Ethical concerns.

If ethics are a guiding set of principles that are there to assist researchers in conducting ethical studies, it is essential to identify ethical issues that are important to the researcher (Johnson & Christensen, 2008). The critical areas of ethical concern for the research are the professional issues and the research participant (Johnson & Christensen, 2008). From a professional perspective, the researcher has no obligation to any funding organisation, grant agency or the university to publish results to receive a positive evaluation. These pressures can lead some researchers to engage in fraudulent activities to be able to complete their research results. In respect to the participants of the study, the researcher followed strict guidelines to make sure that no harm, psychological or physical came about through the data gathering phase of the research (Johnson & Christensen, 2008). These guidelines are discussed in more detail in the following section.

3.7.2 Ethics guidelines.

The research undertaken for the thesis involved human subjects. Therefore it was required that the researcher follow guidelines of ethics from the researcher's university, the University of Southern Queensland. As this study partly focused on minors

(participants below the age of 16), the researcher contacted government agencies to make sure that they followed the correct policies and procedures for the study. However, the only consent required to complete the data gathering phase had to come from the high schools themselves. This process had to go through the school board to be accepted. Out of the 20 schools contacted, only eight were accepting of the research and of those eight, only six participated in both quantitative and qualitative data gathering.

The researcher placed a great deal of emphasis on consent, freedom to withdraw from the interview stage, protection of the school and participants in both sections of the data gathering, confidentiality, anonymity, support and privacy and from any mental or physical harm towards the participants. Table 3-19 below shows these considerations.

Table 3-19. Considerations of ethics

Section	Details
Philosophy	Pragmatism
Ethics Committee	Obtained from University of Southern Queensland (USQ) Ethics reference number: H17REA007
Ethical Issues	School consent, Informed consent from participants, Deception Harm(mental and physical), Anonymity, confidentiality and support

Source: Kaabi (2016)

The researcher obtained ethical approval and clearance to proceed with the study from USQ. The primary factor taken into account was the use of minors within the study. The researcher had to define how the minors would be used within the study and any ethical impacts on those minors. This included the risks to each of the participants, how they would be treated, the consent process including all paperwork, such as information sheets, newsletters consent forms, how the data would be handled, stored, who would have access to that data and any privacy, anonymity issues raised by the school and participants.

Once the researcher had approval from the ethics committee at USQ and given an ethics number, the researcher was then able to approach the schools. The researcher went to each of the schools that were willing to participate in the study and talked to each of the heads of school for year 11 students. This allowed the researcher to show their dedication to the study and to present them with all the paperwork required, including a letter of acceptance. One factor that the researcher had taken into account when taking on the

research was the issues of an adult male interviewing young female and male students. These issues were discussed with each of the heads of school and agreed that a support person would suffice for the interview process as long as it was carried out on school grounds. Both parties agreed to this. This was not just for the safety and comfort of the participant but also the researcher.

3.8 Chapter summary

The chapter describes and justifies the strategy used in this research. A wide range of paradigms and methods were considered when developing the research design for this study. The research required an investigation into the social standpoint of the participants but also their motivation towards ICT. Consequently, this research took on a interpretative paradigm approach to seek to understand the point of views of the participants' and how knowledge learned through background, culture, social has altered their perceptions and attitudes towards ICT.

In order to explore the problem, an explanatory sequential mixed method approach was adopted for the design of the research. The study used a mixed method approach using quantitative in phase one for the online survey and then qualitative in phase two for the semi structured interviews to answer the researcher question and sub-questions to meet the aims that were deemed necessary for the study.

For phase one the survey was created for the purpose of the research based on questions from other research but predominately created from scratch. The researcher used triangulation to verify and validate the questions to make sure that any results from the survey were going to be usable. A pilot was conducted with one of the local schools and a couple of ICT experts to make sure that the questions asked were coherent and credible. The results from the pilot allowed the researcher to manipulate the questions based on the feedback from both students and ICT experts.

The data collection was outlined and a detailed process of how both phase one and phase two would collect participant data. This included timing, number of interviews and the length of the interviews. The final part of this chapter discussed ethical issues and the

concerns, paying special attention around informed consent, anonymity, confidentiality, protection from mental and physical harm and trust to all participants of the study.

In the next three chapters the results from both the students and employees on-line survey are examined, then the results of the interviews for both students and employees and examined.

4 ANALYSIS OF AND RESULTS FROM YEAR 11 STUDENT SURVEY

Chapter 4 and 5 presents the analysis of the data collected from the year 11 students and employee surveys. The purpose of this chapter is to analyse the data gathered through the on-line survey with the use of the adapted STEMCell2.0 framework architecture. Earlier chapters sought to show global trends towards ICT and the impact they are having on the global ICT industry. The previous chapter explored the methodology that was used to undertake the data analysis presented in this chapter.

The first part of the chapter presents the background information provided by the participants, followed by the cultural influence from family, which give the participants their perceptions about their career. The next section reports on the social IT factor that influence the participants and their perceptions through what the future holds for ICT. The next section to be presented through analysis is structural factors; these factors are external factors that influence year 11 students through the participant's home life, school and knowledge of the industry.

This leads to the analysis of data that presents year 11 students' perceptions of the industry. The penultimate section explores social factors that influence the participants through social, stereotyping and role models. In the final section, the analysis of data will look at perceptions of a career in ICT, the influence of family, school and industry. Any issues that arise from the data are presented at the end of each section and a summary at the end of the chapter. The results from this chapter are used to create questions used in the qualitative phase (the interview process) and are presented in chapter 6.

4.1 Analysis techniques

For all analysis within this chapter, SPSS (Statistical Package for the Social Sciences) was used to calculate the results from the data gathered. The version of SPSS used was v.23. The first technique used for data analysis was to conduct frequency analysis. Frequency analysis shows the number of occurrences based on the questions and is part

of descriptive statistics used for summarising frequency or measures of central tendency (Field, 2009).

The second set of tests carried out on the data was to normalise the data by using a normality test. This statistic tests the normality of continuous data. It is an assumption that parametric statistics that continuous variables achieve normality (Field, 2009). To be able to carry out normality, data transformation increased the ability to achieve normality. This test checked the skewness and kurtosis of the data.

The third test carried out on the data was a Chi-Squared Goodness of Fit. This test was to determine if there are significant differences in the level of a single variable about the frequencies of those levels (Field, 2009).

The final test carried out on the data was Principle Component Analysis (PCA) or a Factor analysis. This test is primarily used as a data reduction technique or discovering new and exciting constructs among an array or scaled data. It shows results with latent variables being formed by combining groups of variables that correlate highly among themselves. Usually, this type of test is not the final procedure (Field, 2009). However, the output from the PCA was used to compile a set of questions to be used in the second phase (qualitative) or the interview process.

4.2 Demographics

The demographics and characteristics of the participants are from the Wellington region in New Zealand were gathered. The type of data that was gathered from the survey was gender, age, ethnicity and proposed career. The information gives the basis of the type of participants that chose to fill in the survey.

4.2.1 Demographic data

Schools were invited to be part of the research by the researcher going to the schools to explain what the research was about. Each school that wanted to participate were asked to send a letter of compliance and acceptance. Once the schools agreed they were sent an email with the URL to connect to the survey.

The survey went live in early September 2017 and was live for just over one month. In the month the survey was live, 358 responses were uploaded to the LimeSurvey

application server. Out of the 358 responses uploaded only 286 students completed the questions fully. The 72 students' results that did not complete all the questions were removed due to not enough information gathered. From the 286 completed surveys, 167 completed surveys were from girls and 119 completed surveys from boys. This is illustrated in table 4-1, which presents the gender details of the participants. There is a slightly more significant percentage of girls than boys in the study. This conforms to New Zealand Statics for high school populations (Statistics New Zealand, 2013)

Table 4-1. Gender of participant

Gender of participant

		Frequency	Percent	Valid Percent	Cumulative Percen
Valid	Male	1	41	41	41
	Female	1	58	58	100
	Total	2	100	100	

Created for the study

The second question explored the age of the participants. As the research looked at year 11 students, the range of ages will be minimal. The largest group of participants was the age group of 15 years of age (59.4%); the smallest group was 14 years of age (1%). Table 4-2 shows all age groups of all participants between 14 and 17 years of age.

Table 4-2. Age of participants

Age of participant

		Frequency	Percent	Valid Percent	Cumulative Percen
Valid	14		1	1	1
	15	1	59	59	60
	16		31	31	92
	17		8	8	100
	Total	2	100	100	

Created for the study

It appears from the results of age, nearly two-thirds of the students were aged 15 years.

Ethnicity. Table 4-3 shows the ethnicity of the participants, the majority of the students that took part in the survey are from European descent (37.1%, overall), followed by New Zealander (32.9%, overall). The smallest group came from the Middle East, Latin America and Africa (2.4%, overall).

Table 4-3. Ethnicity

Gender * Ethnicity Cross tabulation

			Ethnicity							Total
			European	New Zealand	Māori	Pacific	Asian	Middle Eastern, America,	other	
Gender	male	Count	46	33	5	16	9	5	5	119
		% within Gender	38.70%	27.70%	4.20%	13.40%	7.60%	4.20%	4.20%	100%
		% within Ethnicity	43.40%	35.10%	33.30%	48.50%	60.00%	71.40%	31.30%	41.60%
		% of Total	16.10%	11.50%	1.70%	5.60%	3.10%	1.7%	1.70%	41.60%
	female	Count	60	61	10	17	6	2	11	167
		% within Gender	35.90%	36.50%	6.00%	10.20%	3.60%	1.20%	6.60%	100%
		% within Ethnicity	56.60%	64.90%	66.70%	51.50%	40.00%	28.60%	68.80%	58.40%
		% of Total	21.00%	21.30%	3.50%	5.90%	2.10%	0.7%	3.80%	58.40%
Total		Count	106	94	15	33	15	7	16	286

Created for the study

The final question within the demographic section explored what industry, at present, did the participants wanted to go into when they leave education. Table 4-4 shows a breakdown of gender, age, ethnicity and the types of industries that participants thought they wanted to head into when they left education. The major industry that had the most number of responses was medical with 39 participants; all of these participants were girls. The next biggest group was creative, art, design and beauty with 25 participants; 13 participants were from the girls and 12 from the boys. The top four career choices were medical, creativity, arts, design and beauty, science and engineering. The interesting aspect from a gender perspective, those top four industries, only 29 boys were interested in going into these areas, whereas 69 girls choose the top four industries. However, 72 participants did not answer this question, suggesting that they did not know at that time what they wanted to do as a career. Forty-six participants did answer 'I do not know', adding that to the 72 participants gives 118 students still undecided on their future career. ICT was ranked joint 9th on the list with only 5 participants indicating they were interested in the ICT industry and only one girl out of 167 girls.

Table 4-4. Careers

	Male												
	Euro			NZ			Ma		Pac		Asian		Other
	15	16	17	15	16	17	15	16	15	16	15	16	15
Law													
Teaching													
Science	3	1											2
Medical													12
Engineering	3			2				1			3	5	
Creativity, art, design and beauty	5			1	2					3			1
Trades	1			6				1					2
Hospitality	0							1					3
Government	1			1	4								
Sport				0			3	2					
Sales and Marketing	2	4											
Mechanics	1												
Other		1			2		1						5
ICT	2			2									
Do not know	2	1	2	7	2		1	1		1	1		6

Female										
Euro			NZ		Ma		Pac		Asian	
	15	16	16	17	15	16	15	16	15	16
Law								1		
Teaching		1		5						
Science		2	10							
Medical	5	8	1		3		2		3	1
Engineering								1	1	
Creativity, art, design and beauty		3	2		1	4	1			
Trades		1								
Hospitality	1						2			
Government		1				1	1			
Sport										
Sales and Marketing			1							
Mechanics										
Other			4							
ICT	1									
Do not know		11		1	1		7			

Created for the study

In summary, the demographic data from the survey shows that year 11 students were predominantly 15 years of age are descents of European and New Zealand origin. There

is a slightly higher representation of girls than boys in year 11, with a 60% to 40% split. It also shows that both girls and boys do not see ICT as a high priority as a career prospect with ICT being ranked ninth.

4.3 Cultural factors

The next set of questions asked about background, culture and family. These questions tried to understand where the participants got information about careers and how it would impact their perceptions of ICT.

4.3.1 Cultural analysis

Question B1, asked, *I have access to a computer at home?* and Question B2, asked*, I have access to the internet*? The total number of participants that have access to a computer at home was 95.4% and have internet access 96.8%. Table 4-5 and 4-7 and 4-6 and 4-8 show the gender split for each question. Māori and Pacifica students have less access to a computer than European and New Zealand students (20% Pacifica boys and 16.7% Pacifica girls do not have access to a computer and 20% Pacifica boys and 10% of Māori girls do not have access to the internet).

Table 4-5. Question B1: I have access to a computer at home

Ethnicity * B1 Cross-tabulation (Girls)						
			B1			Total
			Yes	No	No Answer	
Ethnicity	European	Count	5			6
		% within Ethnicity	98.30%	0.00%	1.70%	100.00%
	New Zealander	Count	6			6
		% within Ethnicity	100.00%	0.00%	0.00%	100.00%
	Māori	Count	1			1
		% within Ethnicity	100.00%	0.00%	0.00%	100.00%
	Pacific	Count	1			1
		% within Ethnicity	94.10%	0.00%	5.90%	100.00%
	Asian	Count				
		% within Ethnicity	83.30%	16.70%	0.00%	100.00%
	Middle eastern, Latin America, Africa	Count				
		% within Ethnicity	100.00%	0.00%	0.00%	100.00%
Total		Count	16			16
		% within Ethnicity	97.60%	1.20%	1.20%	100.00%

Created for the study

Table 4-6. Question B2: I have access to the internet at home

Ethnicity * B2 Cross-tabulation (Girls)						
			B2			Total
			Yes	No	No Answer	
Ethnicity	European	Count	5			6
		% within Ethnicity	98.30%	0.00%	1.70%	100.00%
	New Zealander	Count	6			6
		% within Ethnicity	100.00%	0.00%	0.00%	100.00%
	Māori	Count				1
		% within Ethnicity	90.00%	10.00%	0.00%	100.00%
	Pacific	Count	1			1
		% within Ethnicity	88.20%	5.90%	5.90%	100.00%
	Asian	Count				
		% within Ethnicity	100.00%	0.00%	0.00%	100.00%
	Middle eastern, Latin America, Africa	Count				
		% within Ethnicity	100.00%	0.00%	0.00%	100.00%
Total		Count	16			16
		% within Ethnicity	97.60%	1.20%	1.20%	100.00%

Created for the study

Table 4-7. Question B1: I have access to a computer at home

Ethnicity * B1 Cross-tabulation (Boys)						
			B1			Total
			Yes	No	No Answer	
Ethnicity	European	Count	4			4
		% within Ethnicity	93.50%	4.30%	2.20%	100.00%
	New Zealander	Count	3			3
		% within Ethnicity	100.00%	0.00%	0.00%	100.00%
	Māori	Count				
		% within Ethnicity	100.00%	0.00%	0.00%	100.00%
	Pacific	Count	1			1
		% within Ethnicity	80.00%	20.00%	0.00%	100.00%
	Asian	Count				
		% within Ethnicity	100.00%	0.00%	0.00%	100.00%
	Middle eastern, Latin America, Africa	Count				
		% within Ethnicity	100.00%	0.00%	0.00%	100.00%
Total		Count	10			11
		% within Ethnicity	92.40%	6.80%	0.80%	100.00%

Created for the study

Table 4-8. Question B2: I have access to the internet at home

Ethnicity * B2 Cross-tabulation (Boys)						
			B2			Total
			Yes	No	No Answer	
Ethnicity	European	Count	4			4
		% within Ethnicity	95.70%	2.20%	2.20%	100.00%
	New Zealander	Count	3			3
		% within Ethnicity	100.00%	0.00%	0.00%	100.00%
	Māori	Count				
		% within Ethnicity	100.00%	0.00%	0.00%	100.00%
	Pacific	Count	1			1
		% within Ethnicity	80.00%	20.00%	0.00%	100.00%
	Asian	Count				
		% within Ethnicity	100.00%	0.00%	0.00%	100.00%
	other	Count				
		% within Ethnicity	100.00%	0.00%	0.00%	100.00%
Total		Count	11			11
		% within Ethnicity	95.80%	3.40%	0.80%	100.00%

Created for the study

4.3.2 **Normal distribution test**

The next task was to check to see if the following questions fitted into a normal distribution. A normality test was carried out on each of the questions in the survey. Table 4-9 shows the output of Section B normality check using SPSS descriptive analysis and under the options button choosing skewness and kurtosis. If the sample size is >200 and <500, an absolute value of the score higher than 2.58 or lesser than -2.58 is significant at P<0.05 (noting that the variable is not normal). If the variable tested shows signs of not being customarily distributed then a transformation may be carried out, either by inverting, using Log, squaring or square rooting the variable to try and bring it back into normality.

Table 4-9. Normality test on section B questions

Descriptive Statistics					
	N	Skewness		Kurtosis	
	Statistic	Statistic	Std. Error	Statistic	Std. Error
B4	28	-0.7	0.1	-0.5	0.2
B5	28	-0.1	0.1	-1.7	0.2
B6	28	.	.	.	.
B7	28	0.6	0.1	-1.0	0.2
B8	28	-0.1	0.1	-1.5	0.2
B9	28	0.5	0.1	-1.0	0.2

Created for the study

From the descriptive analysis carried out, it shows that the data is either skewed + or – and or has kurtosis and cannot be manipulated by a mathematical formula to bring back into a normal distribution. It appeared that the data gathered would have to use non-parametric testing instead of parametric testing. The use of non-parametric tests on the data was adopted to check to see if the variables differed significantly in what was expected. The data file was split using the split file in SPSS to give the dependant variable levels through gender, and Chi-Square Goodness of Fit analysis was used.

4.3.3 chi-square goodness of fit

The following results are based on the Chi-Square Goodness of Fit statistic. This statistic is used to test the Ns on the level of a single variable to see if they significantly differ from what is expected. The test is undertaken when data results cannot be normalised by using a normality test. The Chi-Square test is known as a non-parametric test and is usually undertaken when the data is either skewed or has kurtosis and cannot be manipulated by maths to fit into a normal distribution (parametric) (Field, 2009).

For each of the following questions from the survey, Total N will be the count of girls and boys that completed the survey. Girls N=167 and Boys N=119, Table 4-10, shows the total amount of students before they were separated into gender. The analysis used for each question used Chi-Square Goodness of Fit and is noted as CSGF in the following text. For this study, the Likert-scale was converted to disagree, neither disagree or agree and agree to help better present the information.

Table 4-10. Question B4 as a total of all students

My parents/guardians are influential when I think about my future career

Year 11 students	Observed N	Expected N	Residual
Disagree	31	95.3	-64.3
neither disagree or agree	101	95.3	5.7
Agree	154	95.3	58.7
Total	286		

Created for the study

Below in Table 4-11 is the diagrams taken from the output of SPSS for the question (please note that this is shown in full for the first question and then for each subsequent question it will be shown as an equation for each question in chapter 4 and 5). Table 4-

12 show the Chi-squared table and the distribution of critical values according to each degree of freedom. This allows for an assessment to be made as to whether the data is statistically significant ($p<0.05$) or not.

Table 4-11. Question B4 as Male and Female students

My parents/guardians are influential when I think about my future career

Male	Observed N	Expected N	Residual
Disagree	14	39.7	-25.7
neither disagree or agree	32	39.7	-7.7
Agree	73	39.7	33.3
Total	119		

Female	Observed N	Expected N	Residual
Disagree	17	55.7	-38.7
neither disagree or agree	69	55.7	13.3
Agree	81	55.7	25.3
Total	167		

Created for the study

Test Statistics

	My parents/guardians are influential when I think about my future career
Chi-Square	Male = 46.101
df	2
	(expected cell frequency is 39.7)
Asymp. Sig.	.000
Chi-Square	Female = 41.581
df	2
	(expected cell frequency is 55.7)
Asymp. Sig.	.000

Created for the study

Table 4-12. Chi-Square Goodness of Fit

Degree of Freedom	Probability of Exceeding the Critical Value								
	0.99	0.95	0.90	0.75	0.50	0.25	0.10	0.05	0.01
1	0.000	0.004	0.016	0.102	0.455	1.32	2.71	3.84	6.63
2	0.020	0.103	0.211	0.575	1.386	2.77	4.61	5.99	9.21
3	0.115	0.352	0.584	1.212	2.366	4.11	6.25	7.81	11.34
4	0.297	0.711	1.064	1.923	3.357	5.39	7.78	9.49	13.28
5	0.554	1.145	1.610	2.675	4.351	6.63	9.24	11.07	15.09
	Not Significant							***Significant***	

Source, adapted from https://ib.bioninja.com.au/standard-level/topic-4-ecology/41-species-communities-and/chi-squared-table.html

Question B4, asked, *My parents/guardians, are influential when I think about my future career?* Significantly more boys (N=73) agreed than disagreed (N=14), and more girls (N=81) agreed than disagreed (N=17)

$$Boys, x^2(1, N = 119) = 46.1, p < 0.05$$

$$Girls, x^2(1, N = 167) = 41.6, p < 0.05$$

It appears slightly more boys are inclined to seek guidance from family members when thinking about their future career than girls. A further question that could come out of the results from this question in the interview would be: do you see your parent/guardian as a role model?

Question B6, asked, *Is ICT, technology or computing just programming*? CSGF was used, and it was found that there was no significance between the boys (N=119) than girls (N=167), both agreed that ICT was just programming. It appears that both girls and boys still agree that ICT is all about programming and nothing else.

Question B7, asked, *My family, encouraged me to take ICT in high school*? Significantly more girls (N=103) disagreed than agreed (N=28) compared to the boys who disagreed (N=41) and agreed (N=25)

$$Girls, x^2(1, N = 167) = 60.9, p < 0.05$$

$$Boys, x^2(1, N = 119) = 9.9, p > 0.05$$

It appears that the parents or guardians of the girls did not encourage them to take ICT at school.

Question B8, asked, *My parents/guardians, influenced my decision on the career path I will take*? Significantly more boys agreed (N=58) than disagreed (N=34) Compared to the girls who agreed (N=50) and disagreed (N=58)

$$Boys, x^2(1, N = 119) = 13.3, p < 0.05$$

$$Girls, x^2(1, N = 167) = .87, p > 0.05$$

It appears that the boys are more inclined to be influenced by parents or guardians when it comes to their future career. From the results of the survey, 63.6% of boys suggested that their parents or guardians had influence when it came to their career. The major talking point based on the finding from the data was that Māori and Pacifica girls and boys have a solid tie back to their Whānau and links to culture. This information will be further investigated within the interview process based on the findings of the results shown as this brings more questions about the integration of culture and ICT.

Question B9, asked if that the *participant families' view of ICT would affect them choosing ICT as a career?* Significantly more girls disagreed (N=96) than agreed (N=25) Compared to the boys who disagreed (N=38) and agreed (N=26)

$$Girls, x^2(1, N = 167) = 47.8, p < 0.05$$

$$Boys, x^2(1, N = 119) = 10.7, p < 0.05$$

It appears that boys are more influenced by parents or guardians than girls. It appears that girls are more inclined than boys to disagree with individual advice from family when it comes to a future career choice.

4.3.4 **Section summary**

From the response to each of the questions using CSGF, it does appear that girls more than boys at year 11 seem to be strong-minded in their future career path. They seem to know where they want to go, and influential factors such as family do not appear to change their minds. Boys, it appears, look towards parents and guardians for insight and guidance towards their future career path. It also suggests that girls think ICT is just programming

4.4 Section C Social Factors

The next set of questions asked about perceptions of stereotyping and role models. These questions tried to understand if stereotypes play a role in perceptions of role models and can this influence them towards a particular career path and finally do peers have any impact on their decision making.

4.4.1 Stereotypes

Question C1, asked, *did the participants believe there is a problem with stereotypes within the ICT community?* It was found that significantly more girls (N=60) than boys (N=37) found that they believe there is still stereotyping in the ICT community.

$$Girls, x^2(1, N = 167) = 15.6, p < 0.05$$

$$Boys, x^2(1, N = 119) = 5.3, p > 0.05$$

Question C2, asked, *would the stereotypes put you off ICT?* An analysis of the data indicated a significant difference between girls and boys again. Girls (N=45) agreed that it could put them off ICT and boys (N=17).

$$Girls, x^2(1, N = 167) = 26.6, p < 0.05$$

$$Boys, x^2(1, N = 119) = 8.7, p < 0.05$$

It appears that girls still see this as a potential problem, and it could put them off following a career path into ICT. For 15/16-year-old boys, stereotypical views would not be enough to put them off going into the IT industry as a whole. However, from the girls' perception, European females jump from 40% at 16 to over 80% at 17. Māori girls aged 16 was at 80% which suggested there is still a problem perceived by girls more than boys that stereotypical views of ICT, IT and technology still would play a role in their minds when making decisions based on career and pathways. This ties closely to question C1. Again, this needs to be investigated within the interview as more information will be required to understand where these perceptions are coming from. From the results of question C2, many of the answers were placed in the unsure bracket from the girls as well as the boys. The answers suggested that the students were put off somewhat by stereotypes. However, many students were unsure if stereotypes would affect them enough to stop them from going down a career pathway for ICT; again, this can be followed up in the interview questions.

Question C3, asked, *are stereotypical views being kept alive in the industry by the older generation*? There was a significant difference between girls and boys. Girls (N=33) agreed that there could be a problem with the ICT community and the older generation keeping the stereotype alive just through perceptions. The boys only agreed (N=24) but still showed significance.

$$Girls, x^2(1, N = 167) = 63.03, p < 0.05$$

$$Boys, x^2(1, N = 119) = 21.4, p < 0.05$$

It does appear that girls' more than boys' perception of the older generation in the workforce are keeping stereotypes alive.

Question C4, asked, *do film and TV show females and men in a stereotypical view when it comes to ICT*? It was found that significantly more girls (N=117) than boys (N=48) agreed.

$$Girls, x^2(1, N = 167) = 104.4, p < 0.05$$

$$Boys, x^2(1, N = 119) = 13.2, p < 0.05$$

It appears that girls still view the ICT industry from the influence of film and TV, giving the perception that critical roles show actors as 'geeky' or 'nerdy'. From the data, it can be established that the link between stereotypical views and TV/Film is propagated through to what people watch and girls are picking up more on these subtle nuances' about stereotypes a lot more than the boys. It would be interesting to investigate further within the interview process and understand what it is that puts girls off ICT through TV/Film. This subtle perception based around viewing information and the negativity it has on the industry and the impact it has on attitudes seems to be keeping these stereotypes in the minds of many girls.

4.4.2 **Role models**

Question C7, asked *if their teacher was a good role model?* It was found that significantly more boys (N=32) than girls (N= 33) agreed that their teacher was a good role model.

$$Girls, x^2(1, N = 167) = 44.9, p > 0.05$$

$$Boys, x^2(1, N = 119) = 27.7, p > 0.05$$

It appears that boys found their teachers more of a role model than girls.

Question C8, asked *should there be younger role models in ICT?* It was found that significantly more girls (N=91) than boys (N=59) would like to see younger role models in ICT and to have exposure to them.

$$Girls, x^2(1, N = 167) = 59.8, p > 0.05$$

$$Boys, x^2(1, N = 119) = 25.5, p > 0.05$$

It appears that girls would like to see younger role models in the ICT sector.

Question C9, asked *do role models play a big part in you choosing your future career?* It was found that girls (N=102) more than boys (N=60) like to look up to a role model that they can relate to.

$$Girls, x^2(1, N = 167) = 58.9, p > 0.05$$

$$Boys, x^2(1, N = 119) = 19.2, p > 0.05$$

It appears that girls more than boys use role models as part of them choosing their future career. Students still see role models as a significant influence on them choosing a career path. However, this question does not point to a role model in ICT but rather just a role model. Māori girls 15/16 are 100%.

4.4.3 Section summary

From the response to each of the questions using CSGF, it does appear that stereotypes are still alive in school and the industry. This is affecting year 11 girls' perceptions of ICT through education and also the industry. Girls are influenced by what they see, especially on the television and in film. Teachers as role models do not play a part in year 11 girls' decisions they make on their future career.

4.5 Section D, Structural Factors

The next set of questions come from external factors that influence, such as school and industry. It also looks at the perception of ICT and the type of work they could be doing in a future career.

4.5.1 **School**

Question D1, wanted to discover *if participants wanted ICT to be compulsory in high school*? It was found that significantly more girls (N=106, expected=55.7) than boys (N=34) disagreed that ICT should be compulsory. Boys were slightly lower than what was expected (39.7) from CSGF.

$$Girls, x^2(1, N = 167) = 68.3, p < 0.05$$

$$Boys, x^2(1, N = 119) = 6.8, p > 0.05$$

It does appear that girls are very averse to having ICT made compulsory within the high school, whereas the boys are neither for nor against the idea. What has put students off having ICT as a compulsory subject? Questions around this question need to be addressed in the interview phase as this could be very critical towards moving the sector forward and more students into the industry.

Question D2, asked *if the work they did in ICT classes, reflects the type of work they may do in an ICT job?* It was found that more girls (N=45) than boys (N=20) agreed that the work they do in ICT course reflects their perception of the ICT industry.

$$Girls, x^2(1, N = 167) = 32.3, p < 0.05$$

$$Boys, x^2(1, N = 119) = 18.3, p < 0.05$$

It appears that girls slightly more than boys think the work they do in school in the ICT lessons would be the same type of work that they would carry out if they were in an ICT job.

Question D4, asked *would you choose a subject purely if their friends were taking that subject?* It was found that slightly more girls (N=83) than boys (N=49) disagreed with the question and would take a subject just because their friends were.

$$Girls, x^2(1, N = 167) = 20.7, p < 0.05$$

$$Boys, x^2(1, N = 119) = 3.7, p > 0.05$$

It appears that girls are more likely to choose subjects that they want to do rather than follow friends into subjects they have no interest in. However, the boys were just slightly

above what was expected (39.7) from CSGF and were not significant. However, there is a huge disparity when it comes to Māori girls 15 and 16 years of age, up to 80% of Māori girls (16) would be influenced by peers to take subjects that their friends are taking. A question needs to be asked, especially in the interview phase to Māori students and industry. This identity towards family or friends over what the student wants and desires becomes quite an anomaly that needs to be addressed.

Question D5, asked *should there be more female teachers teaching technical subjects such as ICT*? It was found that there was a significant difference between girls and boys. Girls (N=66) were slightly higher than expected from CSGF (55.7), but the boys neither agreed nor disagreed (N=73).

$$Girls, x^2(1, N = 167) = 45.6, p < 0.05$$

$$Boys, x^2(1, N = 119) = 45.2, p < 0.05$$

It appears that girls more would like to see more females teaching in the typical male subjects such as ICT, but the boys neither agreed nor disagreed if their teachers should be male or female.

4.5.2 Industry and perceptions of career

Question D3, asked *working in the ICT industry means working on your own?* It was found that there was a significant difference between the girls (N=75) and boys (N=53). They both disagreed that it would mean working on your own.

$$Girls, x^2(1, N = 167) = 32.2, p < 0.05$$

$$Boys, x^2(1, N = 119) = 30.0, p < 0.05$$

It appears that girls', slightly more than boys' perceptions of the ICT industry, corresponds to industry trends with working in teams or collaboration.

Question D9, asked *where do you get career advice, was it from family, friends, teachers, career advisors or online media TV magazines and newspapers?* It was found that boys (N=79) significantly chose family for their first advice, with teachers (N=53) coming in second.

$$Boys, x^2(1, N = 119) = 58.7, p < 0.05$$

$$Boys, x^2(1, N = 119) = 9.4, p > 0.05$$

The girls also chose family as their first career advice support (N=109). However, the girls disagreed with career advice from the career advisors (N=85).

$$Girls, x^2(1, N = 167) = 77.9, p < 0.05$$

$$Girls, x^2(1, N = 167) = 27.5, p > 0.05$$

It appears that both girls and boys look to parents or guardians for career advice.

Question D10 asked common questions that students ask about ICT. The questions asked were as follows: *ICT is more for men than women, Studying ICT lock you into a specific job, ICT work is fun, ICT work is repetitive, ICT means working on your own and ICT is not necessary for my future career?* It was found that there was a small significant difference between girls and boys regarding the question about repetitive work in ICT, girls (N=55) and boys (N=32).

$$Girls, x^2(1, N = 167) = 32.2, p < 0.05$$

$$Boys, x^2(1, N = 119) = 30.0, p < 0.05$$

The next significance found from the questions was about ICT work is fun. The girls (N=63) disagreed with the statement. However, the boys (N=32) agreed it was fun, but there was no significant difference for the boys.

$$Girls, x^2(1, N = 167) = 19.34, p < 0.05$$

$$Boys, x^2(1, N = 119) = 7.5, p > 0.05$$

It appears that there is still a lot of stereotypical views and perceptions about the industry and not being fun and having to do the same things over and over again.

4.5.3 Section summary

From the response to each of the questions using CSGF, it does appear that year 11 girls look at ICT as a subject that should not be compulsory at high school. They do believe there should be more female technical teachers. For career advice, both girls and boys still look to their parents or guardians for advice first and foremost. Both the girls and boys recognised that ICT is no longer working on your own but in collaboration with others.

4.6 Social IT Factors

The next set of questions come from factors affecting the participant perceptions of what the future holds for ICT? Social IT is about perusing passions, creating amazing things using existing, evolving and future technologies and adjust quickly to an ever-changing technical world.

4.6.1 Perceptions of jobs in ICT

Question E2, asked about *what new types of jobs that might be available to participants when they leave school in the ICT sector?* It was found that girls (N=46) significantly agreed that new jobs would be available when they leave school in the ICT sector. Boys (N=24) agreed but was slightly less than the girls.

$$Girls, x^2(1, N = 167) = 40.5, p < 0.05$$

$$Boys, x^2(1, N = 119) = 39.5, p < 0.05$$

It appears that both girls and boys agree that there are excellent opportunities within the ICT sectors in the future. Girls' perceptions appeared to be more open to the scenario than the boys.

Question E4, asked do *you have to be technically minded to be able to work in the ICT industry?* It was found that boys (N=37) agreed. However, this was not a significant finding. Girls (N=62) significantly agreed that you have to be technically minded to be able to work in the ICT industry.

$$Girls, x^2(1, N = 167) = 14.8, p < 0.05$$

$$Boys, x^2(1, N = 119) = 3.8, p > 0.05$$

It appears stereotypical views of a person working in the ICT sector having to be technical.

4.6.2 Personal qualities

Question E5, asked *is creativity and imagination required if they wanted to go into the ICT industry*? It was found that girls (N=74) significantly agreed that these qualities were right to have, and boys (N=49) agreed but only slightly less.

$$Girls, x^2(1, N = 167) = 40.3, p < 0.05$$

$$Boys, x^2(1, N = 119) = 29.6, p < 0.05$$

It appears that both girls and boys, slightly more girls, suggested such qualities as imagination and creativity are excellent skills to have not only in the ICT sector but in any sector. However, the previous question (E4) could still overshadow the results from (E5), and also the participant's attitude towards ICT may play a part.

4.6.3 **Social media**

Question E6, *does social networking allow participants to interact with like-minded people when it comes to school work and outside activities*? and that question E7, asked *does collaborative social media allows you to share schoolwork-related problems amongst fellow students and online friends*?

It was found girls (E6, N=94, E7, N=104) significantly more than boys (E6, N=50, E7, N=51) agreed that social media is a tool to be used to help collaborate and connect the participants to fellow students and friends. The boys did see social media as a tool but only slightly more than expected (39.7) from CSGF.

$$E6\ Girls, x^2(1, N = 167) = 66.8, p < 0.05$$

$$E6\ Boys, x^2(1, N = 119) = 14.6, p < 0.05$$

$$E7\ Girls, x^2(1, N = 167) = 81.1, p < 0.05$$

$$E7\ Boys, x^2(1, N = 119) = 8.04, p < 0.05$$

It appears that girls' more than boys' attitude sees social media as an excellent tool to help them work collaboratively and connect with fellow students and friends on school work. However, boys also did see social media as a tool but not to the same extent as girls. The interesting fact that has come out of the data is the rise in boys' use of applications just as a tool. This could be a question that might be asked in the interview phase.

4.6.4 **Section summary**

From the response to each of the questions using CSGF, it does appear that girls have perceptions about what is required to be an ICT employee. Girls appear to think still that you must be technical to work in the industry. Both girls and boys, but slightly more girls, believe that creativity and imagination are good assets to have if you are going into

the ICT industry. Girls suggested that social media, is just a tool to be used to help them complete a task and to collaborate on schoolwork with fellow students and friends. Girls also suggested that they can see opportunities in the ICT industry.

4.7 Generational Effect

The next set of questions come from factors affecting the participant perceptions of the effects and influence of the older generation on ICT at home, school and in the industry. For this research, the older generation constitutes any person that is over the age of 50.

4.7.1 Attitude of the older generation towards ICT

Question F1, asked *if there is a negative attitude towards ICT from the older generation*? It was found that girls (N=67) significantly agreed and boys slightly less (N=39). Girls were above what was expected (55.7) from CSGF. However, the boys' results were the expected result (39.7) from CSGF, that the perception of the participants of the older generation's attitude on average was negative towards ICT.

$$Girls, x^2(1, N = 167) = 11.5, p < 0.05$$

$$Boys, x^2(1, N = 119) = 11.3, p < 0.05$$

It appears that the older generation's perception filter down to both girls and boys, slightly more girls than boys, and can have an effect of their decision about ICT.

Question F3 and F4 follow on from the previous question about the negative attitude towards ICT from the older generation. Follow up question F3, asked about *when the older generation retires from work, and attitudes will change towards ICT*? and question F4, asked about *do the older generation understands the importance of ICT*? It was found that significantly more boys (N=48) than girls (N=58) found that when the older generation leaves the workforce, there will be a change in attitudes towards ICT.

$$Girls, x^2(1, N = 167) = 56.2, p < 0.05$$

$$Boys, x^2(1, N = 119) = 30.5, p < 0.05$$

Significantly girls (N=34) agreed more than boys (N=29) and found that the older generation understands the importance of ICT.

$$Girls, x^2(1, N = 167) = 38.8, p < 0.05$$

$$Boys, x^2(1, N = 119) = 10.9, p < 0.05$$

It appears that boys more than girls see the older generation of propagating the stereotypical view of ICT and the negativity towards females, however, the girls did find this but slightly less than the boys. It appears that girls found that the older generation understood the importance of ICT in today's society. This aligns with the previous question.

4.7.2 Attitudes toward school and industry

Question F2, asked about *that there would be more women in ICT at school and industry in the next ten years?* Significantly, girls (N=74) more than boys (N=52) found that there will be more women in ICT in schools and the industry.

$$Girls, x^2(1, N = 167) = 54.3, p < 0.05$$

$$Boys, x^2(1, N = 119) = 36.01, p < 0.05$$

It appears that a girl's perception of more women in the industry and female teachers in schools will increase in the next ten years.

The following question F5 followed on from the previous question and asked *that younger teachers in their 20's and 30's would have a better understanding of the way students think and be more helpful than older teachers*? Significantly girls (N=70) agreed more than boys (N=51) that would be more helpful to them, especially when it came to ICT.

$$Girls, x^2(1, N = 167) = 58.8, p < 0.05$$

$$Boys, x^2(1, N = 119) = 12.1, p < 0.05$$

It appears that girls would like to see younger teachers.

Attitude and perception of the participant

The final question F6 asked *about their perceptions and attitudes towards ICT for all the questions answered, and would it change their mind about ICT.* A significant finding emerged between the girls (N=70) and boys (N=51) concerning thinking about ICT and could it be right for them.

$$Girls, x^2(1, N = 167) = 58.8, p < 0.05$$

$$Boys, x^2(1, N = 119) = 12.1, p < 0.05$$

It appears that girls slightly more than boys would re-think their career future after answering this question.

4.7.3 Section summary

From the results of each of the questions using CSGF, it does appear that both girls and boys see the older generation as a stumbling block when it comes to the propagation of some stereotypes about ICT; it also appears that boys rather than girls see an attitude shift coming when the older generation leaves the workforce. Girls more than boys see more opportunities for them in the next ten years in the ICT industry, including ICT jobs at schools. They also have the perception that younger teachers in the 20s or 30s would increase more girls in ICT as they would see them more in touch with the latest generation.

4.8 Factor analysis

After carrying out the Chi-Square Goodness of Fit to the majority of the questions, the following SPSS statistic test was undertaken on the data gathered. Factor analysis is a statistical test carried out as a data preparation process used as a reduction technique or to discover new and exciting constructs among an array of scaled data (Fabrigar, 2012). The results of the factor analysis create latent variables by combining groups of variables that correlate highly amongst themselves. Each new variable can be given names and investigated.

The questions that were deleted from the factor analysis was due to no high correlation amongst themselves. These questions are as follows: B2, 6, 8, C8, D6, 8, E2 and F4. Initially, under SPSS, the use of factor analysis is carried out by using the dimension reduction factor (Field, 2009). The method chosen for the analysis was principle components and used a correlation matrix with the un-rotated factor solution and a scree plot. The use of the scree plot allows finding the number of factors that need to be extracted.

4.8.1 **Principal component analysis (PCA)**

A principal component analysis (PCA) was conducted on 37 items with oblique rotation (direct oblimin). The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis, KMO=.629 ('adequate' according to Field, 2009) and all KMO values for individual items were all >0.5, which is the expectable limit (Field, 2009). Bartlett's test of sphericity $x^2(946) = 5160.085, p < 0.001$ indicates that correlations between items were sufficiently large for PCA a,s shown in Table 4-14.

Table 4-13. KMO and Bartlett's test

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.629
Bartlett's Test of Sphericity	Approx. Chi-Square	5160.085
	df	1035
	Sig.	.000

Created for the study

An initial analysis was run to obtain eigenvalues for each variable in the data. Five components had eigenvalues over Kaiser's criterion of 1 and in combination, explained 37.196% of the variance. The scree plot was slightly ambiguous and showed an inflexion that would suggest retaining up to five components. Given the sample size and the convergence of the scree plot and Kaiser's criterion of five components, this is the number that was retained for the final analysis. Figure 4-1 shows the scree plot and eigenvalues.

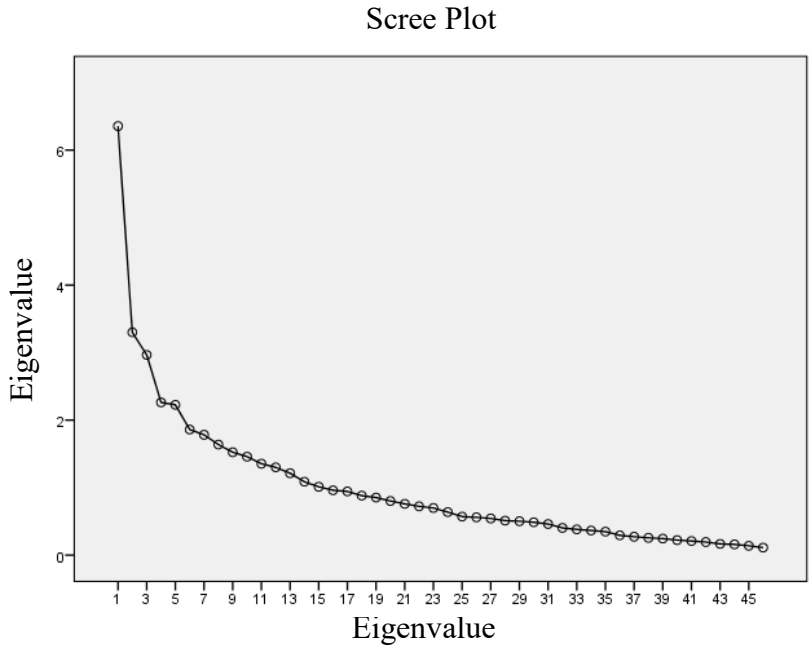


Figure 4-1. Scree plot and eigenvalues. Created for the study

Following the findings from the scree plot, a structure matrix is produced; this shows how the variables cluster together amongst themselves that correlate highly. Table 4-15 shows the output of the structure matrix.

Table 4-14. Structure matrix (N=286)

Structure Matrix					
	Component				
	1	2	3	4	5
F3	0.721				
E6	0.719				
E5	0.655				
F2	0.649				
E7	0.62				
F6	0.584				
E3	0.565				
E4	-0.555				
F1	0.552				
D5	0.412				
B7		0.693			
D1		0.677			
C7		0.646			
D10b		0.619			
B5		0.591			
B9		0.478			
D2		-0.413			

D10a			0.766		
D10d			0.743		
D10			0.656		
D10e			0.537		
D3			0.463		
D4			-0.409		
B1			-0.401		
C4				0.691	
C3				0.55	
C1				0.468	
C5				0.443	
D9d				0.438	
D9b					0.68
D9					0.649
F5					-0.554
D9c					0.481
B3					0.468
D9a					0.468
B4					0.432
C9					0.418
Extraction Method: Principal Component Analysis.					
Rotation Method: Oblimin with Kaiser Normalization. ***#Note – Factor loading over 0.4***					

Created for the study

The items that cluster on the same components suggested that each component represents perceptions, as shown in Table 4-16 below:

Table 4-15. Clustering of questions

Clusters	Factors
1	Social IT factors
2	Structural Factors
3	Industry Factors
4	Social Factors
5	Career factors

Created for the study

4.8.2 **Mann-Whitney statistical test**

From the output of the PCA test, the five factors were used to conduct a Mann-Whitney test on the results against the independent variable of girls and boys. The dependent variables used were the five factors from the PCA test.

4.8.3 Factor one, social IT

Factor one combined all questions that showed a strong relationship towards SocialIT , that relate to perceptions of what the future holds for ICT. Results indicated no significance between girls and boys when it comes to the perceptions of the future of ICT Z=-1.312, $p > 0.05$. It appears that gender does not affect perceptions of social IT; Table 4.17 shows the output of the Mann-Whitney test.

Table 4-16. Factor 1, SocialIT

Test Statistics

	BART factor score 1 for analysis 1
Mann-Whitney U	8954.000
Wilcoxon W	15975.000
Z	-1.312
Asymp. Sig. (2-tailed)	.190

a. Grouping Variable: Gender

Created for the study

4.8.4 Factor two, structural

Factor two combines all questions that show a strong relationship towards structural perceptions that relate towards factors that bring influences from home, school and industry. Results indicate a significant difference between girls and boys. Girls strongly disagree with perceptions Z= -6.87, $p < 0.0005$. It appears that females have a strong negative perception when it comes to ICT at school and towards the industry. Table 4-18 shows the output of the Mann-Whitney test.

Table 4-17. Factor 2, Structural

Test Statistics

	BART factor score 2 for analysis 1
Mann-Whitney U	5147.000
Wilcoxon W	19175.000
Z	-6.867
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: Gender

Created for the study

4.8.5 **Factor three, industry**

Factor three combines all questions that show a strong relationship towards the industry. These influences indicated the perception of the ICT industry. Results indicate that there are no significant differences between girls and boys when it comes to the participant's perception of the ICT industry, Z= -0.29, p > 0.05. It appeared that both girls and boys neither agree nor disagree regarding the perceptions of the ICT industry. They both still think that it locks you into a specific job; it is just for men and not necessary for their future career. Table 4.19 shows the output of the Man-Whitney test.

Table 4-18. Factor 3, Industry

Test Statistics

	BART factor scor 3 for analysis 1
Mann-Whitney U	9833.0
Wilcoxon W	16854.0
Z	-.0
Asymp. Sig. (2-tailed)	.9

a. Grouping Variable: Gender

Created for the study

4.8.6 **Factor four, social**

Factor four combines all questions that show a strong relationship towards social factors that relate to influences through stereotypes, friends and social media. Results indicated a significant difference between girls and boys when it comes to social factor Z= -3.45, p <0.05. It appears that girls see these perceptions as still an issue. Perception of stereotypes within school and media is of concern and that these stereotypes are being kept active by the older generation in the industry. The influence of parents and guardians and teachers could be a factor that promotes these stereotypes. Table 4-20 shows the output from the Mann-Whitney test.

Table 4-19. Factor 4, Social

Test Statistics

	BART factor scor 4 for analysis 1
Mann-Whitney U	7492.0
Wilcoxon W	14513.0
Z	-3.4
Asymp. Sig. (2-tailed)	.0

a. Grouping Variable: Gender

Created for the study

4.8.7 **Factor five, career**

Factor five combines all questions that show a strong relationship towards careers that relate to perceptions and influence through parents and guardians, education and industry. Results indicated a significant difference between girls and boys. Girls appeared to disagree regarding ICT careers. Girls' perceptions show a negative perception towards ICT careers, $Z= -2.76$, $p <0.05$, it appears that perceptions of a career in ICT for girls show that family, teachers and friends do not influence girls. However, role models appear to have an impact on girls' career choice. Table 4-21 shows the output of the Mann-Whitney test.

Table 4-20. Factor 5, Career

Test Statistics

	BART factor scor 5 for analysis 1
Mann-Whitney U	7965.0
Wilcoxon W	21993.0
Z	-2.7
Asymp. Sig. (2-tailed)	.0

a. Grouping Variable: Gender

Created for the study

4.8.8 **Section summary**

From the responses to each of the questions using CSGF, it does appear that some significant findings need to be explained. Factor one did not show any significant new findings regarding the future of ICT and job expectations. Both girls and boys were neutral about their perceptions of the number of jobs that are likely to be created in the

ICT industry. Factor two did bring up a new finding that girls at year 11 do seem to be more focused in their career path than the boys and cannot be influenced easily by external factors such as family, friends and teachers. Factor three did not suggest any new findings, as both girls and boys neither agreed nor disagreed with their understanding of the industry. Factor four brought new findings regarding stereotypes as girls, more than boys, appear to be more open to these ingrained stereotypes. These stereotypes may or may not be influenced by family, friends and teachers. The final factor, factor five found a significant new finding that girls, again more than boys, appear to not take advice from family, friends and teachers as much as the boys. Girls, at year 11 of high school, do appear to have a clearer understanding of where they want to go on their career path. However, role models appear to have more of an impact on girls than boys.

4.9 Chapter Summary

This chapter presented data analysed using multiple statistical analysis on the online survey. The survey was analysed through the use of software (SPSS). Normality testing was carried out on the data to check if the data complied with the rules of normality. The normality test also checked the data for skewness and kurtosis. These tests found that the data gathered did not comply with normality, so non-parametric test was used. A simple frequency analysis test was used to give simple frequencies for each of the questions. Non-parametric tests used on the data included Mann-Whitney and Chi-square goodness of fit.

The next test carried out on the data was principal component analysis (PCA) to reduce the data into clustered factors that may give new findings to the data. The PCA gave five factors based on the output of the scree plot. Each of these factors clustered together variables that had significance among themselves. This allowed each of the factors to be tested against gender using the Mann-Whitney test, giving new findings that were then used to create the questions for the interview phase (qualitative). Each cluster from the scree plot represents groups of questions based on the factors from the adapted STEMCell 2.0 model.

The majority of students that completed the survey were 15 years old and were descendants of European or New Zealand origin. It was also found that there were around 60% of the participants being girls. From the analysis of the data, girls more than

the boys seemed to know their future career path at year 11 and influential factors such as family or Whānau do not appear to change their minds. It also appears from the analysis of the data that stereotypes are a key perception of ICT which is still negative. Girls did recognise that one of the stereotypes of working alone is no longer true and it is about collaboration in ICT, however, some stereotypes that are still present are that girls felt you needed to be technical to work in the industry, applications used in ICT such as social media are just tools to complete a task and that the older generations are keeping these stereotype alive in the industry. Girls were influenced by what they saw in the media, increasing those stereotypical imagery. The girls did however suggest that creativity and imagination to be two key assets that would be useful in the ICT industry. A surprise result from the analysis showed that girls looked to role models in decision making when it came to their future, more than career advisors. Girls also suggested that there needs to be younger female teachers teaching ICT subjects at school, thus increasing the popularity of the subject, showing more opportunity for girls and giving them new role models to look up to, but they also suggested that ICT should not be a compulsory subject at school. This suggest that perceptions about the subject are still negative in the minds of year 11 girls.

The following chapter, Chapter 5 brings together the results of the analysis of the employee survey, which was based on the online survey given to year 11 students. Questions in the employee survey have been changed to take into account the age of the respondents. The respondents were a mixture of females and males from different generations and from ICT companies based in Wellington's CBD.

5 ANALYSIS OF AND RESULTS FROM THE EMPLOYEE SURVEY

The analysis presented in this chapter reports on data gathered through quantitative means by use of an online survey. The analysis is based on industry employees at ICT companies within the Wellington region in New Zealand. For the purpose of clarity around the ICT industry, the types of companies and the types of roles the participants held within those companies, they are explained in the following paragraph.

The companies that took part in this study were all located within Wellington's CBD. The companies that took part ranged from small start-up companies that had one to 10 employees working for them, the mid-sized company that had up to 50 employees and then large organisations, such as government and multi-national companies that have hundreds, even thousands of employees. All participants that took part in the survey and this study work in the ICT industry and the types of jobs that they have varied depending on the size of the business. For the start-up companies many of the employees wear multiple hats and as such could not define a single job title. For the mid-size companies and the larger companies, some of the job roles were software developer, security consultant, network engineer, human resource, marketing, many different management positions, project leads, business analysis, cloud consultant and many more.

This chapter presents the background information provided by the participants, followed by each section of the survey. Any issues that arose from the data was presented at the end of each section. The results from this chapter and chapter 4 were used to create the basis of the questions to be used in the qualitative phase (the interview process).

5.1 Demographics

The demographics and characteristics of the participants from the Wellington region in New Zealand were gathered. The type of data that was gathered from the survey was gender, age and ethnicity. Each of these questions is explained in this section. The information gives the basis of the type of participants that chose to fill in the survey.

5.1.1 Demographic data

ICT companies were invited to be part of the research through a closed LinkedIn group organised by New Zealand Information Technology Professional group (ITP) on behalf of the researcher. Each participant was then given access to the URL to complete the online survey.

The survey was live for just over one month. In that month, 60 responses were collected. Thirty-five completed surveys were from females and 25 completed surveys from males. This is illustrated in table 5-1, which presents the gender details of the participants. There is a slightly more significant percentage of females than males in the study.

Table 5-1. Gender of participants

Gender of participant

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	25	41.7	41.7	41.7
	Female	35	58.3	58.3	100.0
	Total	60	100.0	100.0	

Created for the study

The second question explored the age of the participants. The largest group of participants was the age group of 50 - 59 years of age (33.3%), the smallest group was 20 - 29 years of age (8.3%). Table 5-2 shows all age groups of all participants between 20 and 60+ years of age. It appears from the results of age, 46.6% of the employees were over the age of 50.

Table 5-2. Age of participants

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20-29	5	8.3	8.3	8.3
	30-39	11	18.3	18.3	26.7
	40-49	16	26.7	26.7	53.3
	50-59	20	33.3	33.3	86.7
	60+	8	13.3	13.3	100.0
	Total	60	100.0	100.0	

Created for the study

Table 5-3 shows the ethnicity of the participants. Just over half the participants that took part in the survey are from European descent (58.3%, overall), followed by New Zealander (25%, overall). The smallest group came from Māori representation (3.3%, overall).

Table 5-3. Ethnicity of participants

Ethnicity of participants

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	European	35	58.3	62.5	62.5
	Asian	3	5.0	5.4	67.9
	Māori	2	3.3	3.6	71.4
	New Zealander	15	25.0	26.8	98.2
	Other	1	1.7	1.8	100.0
	Total	56	93.3	100.0	
Missing	System	4	6.7		
Total		60	100.0		

Created for the study

5.1.2 Section summary

The demographic data from the survey show that employees were predominantly over the age of 40 and are descents of European and New Zealand origin. There is slightly more representation of females to males with a 60% to 40% split.

5.2 Cultural factors

The next set of questions explored participants responses based on the influence of background, culture and family. These questions tried to understand where the participants got information about careers and how it impacted their perceptions of ICT.

5.2.1 Chi-square goodness of fit

This statistic is used to test the Ns on the level of a single variable to see if they significantly differ from what is expected (Field, 2009). The test is undertaken when data results cannot be normalised by using a normality test. The Chi-Square test is known as a non-parametric test and is usually undertaken when the data is either skewed

or has kurtosis and cannot be manipulated by maths to fit into a normal distribution (parametric) (Field, 2009).

For each of the following questions, Total N will be the count of females and males that completed the survey (females N=35 and males N=25). For each question, N will either be the number of participants that answers agree or disagree. The analysis used for each question used Chi-Square Goodness of Fit and is noted as CSGF in the following text.

Question B4, *asked as a parents/guardians, would you be influential over your child's future career?* Significantly more males (N=21) disagreed than agreed (N=0) and more females (N=14) disagreed than agreed (N=0).

$$Females, x^2(1, N = 25) = 11.56, p < 0.05$$

$$Males, x^2(1, N = 35) = 1.400, p > 0.05$$

It appears that males believe that they are not influential on family members when talking about future career than females. A question that could come out of the results from this question in the interview would be: do you see your parent/guardian as a role model?

Question B6, asked *is ICT just programming?* There was no significant difference between the males (N=25) than females (N=35), both disagreed with the statement that ICT was just programming. It appears that both females and males employees agree that ICT is not all about programming and nothing else. This would be an expected result of employees working in the industry every day.

Question B7, asked *did your family encourage you to take ICT at high school*? Slightly more females (N=27) disagreed than agreed (N=0), compared to the males who disagreed (N=18) and agreed (N=0).

$$Females, x^2(1, N = 35) = 16.88, p < 0.05$$

$$Males, x^2(1, N = 25) = 30.22, p > 0.05$$

It appears that the parents or guardians of both females and males did not encourage them to take ICT at school. This would be a possible question to follow up in the interview section of phase two.

Question B8, asked *did your family influenced your decision when it came to making a career choice?* More males disagreed (N=22) than agreed (N=0), also more females disagreed (N=23) than agreed (N=0).

$$Males, x^2(1, N = 25) = 14.44, p < 0.05$$

$$Females, x^2(1, N = 35) = 3.457, p > 0.05$$

It appears that the slightly more males were inclined not to be influenced by parents or guardians when it comes to their career than the females.

5.2.2 Section summary.

It does appear that both females and males seem to be strong-minded in their career path. They seem to know where they want to go, and influential factors such as family do not appear to change their minds.

5.3 Social Factors

The next set of questions asked about perceptions of stereotyping and roles models that would influence ICT. These responses helped the researcher to understand if stereotypes play a role in participant's perceptions if role models can influence them towards a particular career path and also do peers have any impact on their decision making.

5.3.1 Stereotypes

Question C1, asked *do you believe there is still a problem with stereotypes within the ICT community?*. It was found that (N=28) females and (N=18) males agreed.

$$Females,\ x^2(1, N = 35) = 26.57, p < 0.05$$

$$Males, x^2(1, N = 25) = 16.40, p < 0.05$$

Both females and males agreed 100%, and they believe there is stereotyping in the ICT community.

Question C2, asked *would this put you off ICT?* It was found that both females and males disagreed. Females (N=27) disagreed that it could put them off ICT and males (N=21).

$$Females, x^2(1, N = 35) = 30.91, p < 0.05$$

$$Males, x^2(1, N = 25) = 29.14, p < 0.05$$

It appears that females more than males see stereotyping as issues in the industry.

Question C3, asked *are stereotypical views being kept alive in the industry by the older generation*? There was a significant difference between females and males. Females (N=20) disagreed that there could be a problem with the ICT community and the older generation keeping the stereotype alive through perceptions. Males disagreed slightly less (N=16).

$$Females, x^2(1, N = 35) = 4.26, p > 0.05$$

$$Males, x^2(1, N = 25) = 5.24, p > 0.05$$

It does appear that both males and females' perception of the older generation in the workforce do not believe that the older generation is keeping stereotypes alive.

Question C4, asked *do film and TV show females and men in a stereotypical view when it comes to ICT*? It was found that significantly more females (N=27) than males (N=18) agreed.

$$Females, x^2(1, N = 35) = 24.28, p < 0.05$$

$$Males, x^2(1, N = 25) = 21.60, p < 0.05$$

It appears that females view the ICT industry from the influence of film and TV, giving the perception that critical roles show actors as 'geeky' or 'nerdy'. From the data, it can be established that the link between stereotypical views and TV/Film is propagated through to what people watch and females are picking up more on these subtle nuances about stereotypes a lot more than the males. It would be interesting to investigate further within the interview process and understand what it is that puts females off ICT through TV/Film.

5.3.2 **Role models**

Question C9, asked about *role models, and did they play a big part in choosing a future career*? Again it was found that there was no significance found between female and males, It was found that only (N=6) females and (N=7) males were influenced by a role model that they could relate to.

$$Females, x^2(1, N = 35) = 8.08, p > 0.05$$

$$Males, x^2(1, N = 25) = 9.20, p > 0.05$$

It appears that the majority of females and males do not use role models as a factor when choosing their future career.

5.3.3 Section summary

It does appear that stereotypes are still alive in the industry. Stereotypes are still a problem within the industry. Based on the industry survey, role models become less critical in decisions made on future careers the older you become.

5.4 Structural Factors

The next set of questions come from external factors that influence the participant. It also looks at the perception of ICT and the type of work carried out in the ICT industry.

5.4.1 School

Question D1, asked *should ICT to be compulsory in high school*? It was found that significantly more females (N=30) than males (N=18) agreed that ICT should be compulsory.

$$Females, x^2(1, N = 35) = 33.49, p < 0.05$$

$$Males, x^2(1, N = 25) = 5.88, p > 0.05$$

It does appear that females more than males would like to see ICT made compulsory within the high school. This contradicted the student results, becoming an exciting point to bring up as an interview question.

Question D2, asked *does ICT at school reflects the type of work you would do in an ICT job?* It was found that more females (N=16) than males (N=12) disagreed that the work they do in ICT course reflects their perception of the ICT industry.

$$Females, x^2(1, N = 35) = 15.54, p > 0.05$$

$$Males, x^2(1, N = 25) = 5.91, p > 0.05$$

It appears that females slightly more than males think the work students do in school in the ICT lessons would not be the same type of work that they would carry out if they were in an ICT job.

Question D4, asked *would you have chosen a subject purely if their friends were taking that subject?* It was found that slightly more females (N=24) than males (N=16) disagreed with the question and would not take a subject just because their friends were.

$$Females, x^2(1, N = 35) = 14.85, p < 0.05$$

$$Males, x^2(1, N = 25) = 10.00, p > 0.05$$

It appears that females are more likely not to choose subjects that they want to do rather than follow peers into subjects they have no interest in,

Question D5, asked *should there be more female teachers teaching technical subjects such as ICT*? It was found that there was a significant difference between females and males. Females (N=28) were slightly higher than expected (18), males (N=23) was a lot higher than expected (13).

$$Females, x^2(1, N = 35) = 14.25, p < 0.05$$

$$Males, x^2(1, N = 25) = 21.56, p < 0.05$$

It appears that females would like to see more females teaching in the typical male subjects such as ICT, males also agreed, and this was slightly higher than that of the females.

5.4.2 Industry and perceptions of career

Question D3, asked *working in the ICT industry means working on your own?* It was found that there was a significance from both females (N=26) and males (N=22). They both disagreed that it would mean working on your own.

$$Females, x^2(1, N = 35) = 22.85, p < 0.05$$

$$Males, x^2(1, N = 25) = 22.52, p < 0.05$$

It appears that both females and males perception of the ICT industry corresponds to industry trends with working in teams or collaboration, based on their experience in the ICT industry.

Question D9, *asked would you get career advice from family, friends, teachers, career advisors or online media TV magazines and newspapers*? It was found that males (N=12) significantly chose family for advice, with friends (N=12) coming in with the same amount.

$$Males, x^2(1, N = 25) = 11.20, p > 0.05$$

$$Males, x^2(1, N = 25) = 7.20, p > 0.05$$

Females also chose family as their first career advice support (N=15). However, females disagreed with career advice from career advisors (N=24).

$$Females, x^2(1, N = 35) = 3.14, p > 0.05$$

$$Females, x^2(1, N = 35) = 18.85, p < 0.05$$

It appears that both females and males looked to parents or guardians for career advice. However, the only significance that came from question D9 was females disagreeing with getting advice from career advisors.

Question D10, asked about ICT, the questions asked were as follows: *ICT is more for men than women?* Studying ICT lock you into a specific job? Is ICT work fun? Is ICT work repetitive? And ICT means working on your own? It was found that both female and males for the first two questions both disagreed that ICT is just for men and studying ICT locks you into a specific job.

$$Females, x^2(1, N = 35) = 72.00, p < 0.05$$

$$Males, x^2(1, N = 25) = 28.88, p < 0.05$$

$$Females, x^2(1, N = 35) = 43.25, p < 0.05$$

$$Males, x^2(1, N = 25) = 18.32, p < 0.05$$

5.4.3 **Section summary**

It does appear that females more than males would like to see ICT compulsory at high school and that working in the industry is entirely different from studying the discipline. Females also wanted to see more female teachers in roles that have historically been male, such as ICT. Both female and male participants from industry disagreed that studying ICT would lock you into one kind of job.

5.5 Social IT Factors

The next set of questions come from factors affecting the participant perceptions of what the future holds for ICT? Social IT is about perusing passions, creating amazing things using existing, evolving and future technologies and adjust quickly to an ever-changing technical world.

5.5.1 Perceptions of jobs in ICT

Question E2, asked about *what new types of jobs that might be available to school leavers in the ICT sector?* It was found that females (N=18) significantly agreed that new jobs in the ICT sector would be available when generation Z leave school. Males (N=10) agreed but was slightly less than the females.

$$Females, x^2(1, N = 35) = 10.00, p > 0.05$$

$$Males, x^2(1, N = 25) = 14.2, p > 0.05$$

Both females and males agree that there will great opportunities within the ICT sectors in the future.

Question E4, asked *that you have to be technically minded to be able to work in the ICT industry?* It was found that males (N=13) disagreed. However, this was not a significant finding. Females (N=17) also disagreed that you have to be technically minded to be able to work in the ICT industry.

$$Females, x^2(1, N = 35) = 17.62, p < 0.05$$

$$Males, x^2(1, N = 25) = 2.36, p > 0.05$$

Employees can see that there are lots of opportunities for all different kinds of people in ICT. However, this is not filtering down to the high schools and the need for a diverse set of people in the industry is needed.

5.5.2 Personal qualities

Question E5, asked *about is creativity and imagination required if you want to go into the ICT industry*? It was found that females (N=21) significantly agreed that these qualities were good to have, and males (N=18) agreed but only slightly less.

$$Females, x^2(1, N = 35) = 20.85, p < 0.05$$

$$Males, x^2(1, N = 25) = 12.00, p > 0.05$$

It appears that both females and males agree but slightly more females. Imagination and creativity are good skills to have to help further participant's careers not only in the ICT sector but in any sector. However, the previous question (E4) could still overshadow the results from (E5), and also the participants own attitude towards ICT may play a part. It does show that the females more than the males are looking outside the box when it comes to different types of jobs available in the industry.

5.5.3 Section summary

It does appear that employees within the industry have a good understanding of what it takes to become a good employee within the ICT sector. Both females and males, slightly more females, see great opportunities in the ICT industry in the future with new jobs for school leavers.

5.6 Generational Effect

The next set of questions come from factors affecting the participant perceptions of the effects and influence of the older generation on ICT at home, school and in the industry. For this research, the older generation constitutes any person that is over the age of 50, which for this data was the majority of the participants.

5.6.1 The attitude of the older generation towards ICT

Question F1, asked about *if there is a negative attitude towards ICT from the older generation?* It was found that females (N=22) significantly disagreed and males slightly less (N=19). Females were above what was expected (11.3) from CSGF analysis, as were the male results (12) that the perception of the participants of the older generation's attitude on average was not negative towards ICT.

$$Females, x^2(1, N = 35) = 16.64, p < 0.05$$

$$Males, x^2(1, N = 25) = 8.16, p < 0.05$$

Question F3, asked *when the older generation retires from work, will attitudes change towards ICT?* It was found that both female and males (N=8), (N=2) found that when

the older generation leaves the workforce, there will be a change in attitudes towards ICT. This result for question F3 from the industry did not show any significance.

$$Females, x^2(1, N = 35) = 3.45, p > 0.05$$

$$Males, x^2(1, N = 25) = 6.87, p > 0.05$$

It appears that both females and males see the older generation not to be the propagator of stereotypical views of the industry and not a problem towards the recruitment of generation Z students.

5.6.2 Attitudes toward education and the ICT industry

Question F2 Will there be more women in ICT at school and in the industry in the next ten years. Significantly, males (N=14) more than females (N=11) expect that there will be more women in ICT in schools and the industry.

$$Females, x^2(1, N = 35) = 2.25, p > 0.05$$

$$Males, x^2(1, N = 25) = 10.52, p < 0.05$$

It appears that perceptions of more female employees in ICT and teachers in schools will increase in the next ten years was not significant from the females, whereas the male employees result found a significance and thought that there would be more females in ICT and teaching at schools.

The following question F5 followed on from the previous question and asked *that younger teachers in their 20s and 30s would have a better understanding of the way students think and therefore be more helpful than older teachers?* Significantly, females (N=17) disagreed more than males (N=11) that would be more helpful to them, especially when it came to ICT.

$$Females, x^2(1, N = 35) = 6.81, p > 0.05$$

$$Males, x^2(1, N = 25) = 6.75, p > 0.05$$

It appears that both females and males disagreed regarding younger teachers in the classroom.

5.6.3 Section summary

It does appear that both females and males do not see the older generation as a stumbling block when it comes to the propagation of some stereotypes about ICT. It also appears that both females and males do not see a shift in attitude coming when the older generation leaves the workforce. Both female and males also have the perception that younger teachers in the 20s or 30s would not increase more females in ICT.

5.7 Factor analysis

After carrying out the Chi-Square Goodness of Fit to the majority of the questions, the following SPSS statistic test was undertaken on the data gathered. Factor analysis is a statistical test carried out as a data preparation process used as a reduction technique or to discover new and interesting constructs among an array of scaled data (Fabrigar, 2012). The results of the factor analysis create latent variables by combining groups of variables that correlate highly amongst themselves. Each new variable can be given names and be investigated.

There were several questions deleted from the factor analysis due to no high correlation amongst themselves. These questions are as follows: B2, 6, 8, C8, D6, 8, 10c, E2 and F4 (see Appendix H for a full list of questions in the survey). Initially, under SPSS, the use of factor analysis is carried out by using the Dimension reduction factor. The method chosen for the analysis was principle components and used a correlation matrix with the un-rotated factor solution and a scree plot. The use of the scree plot allows finding the number of factors that need to be extracted.

5.7.1 Principle component analysis (PCA)

A principal component analysis (PCA) was conducted on 37 items with oblique rotation (direct oblimin). The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis, KMO=.579 (‘low to adequate’ according to Field, 2009) and all KMO values for individual items were all >0.5, which is the expected limit (Field, 2009).

Table 5-4. KMO and Bartlett's test

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.579
Bartlett's Test of Sphericity	Approx. Chi-Square	254.079
	df	105
	Sig.	.000

Created for the study

An initial analysis was run to obtain eigenvalues for each variable in the data. Five components had eigenvalues over Kaiser's criterion of 1 and in combination explained 65.32% of the variance. The scree plot was slightly ambiguous and showed an inflexion that would suggest retaining up to five components. Given the sample size and the convergence of the scree plot and Kaiser's criterion of five components, this is the number that was retained for the final analysis. Figure 5.1 shows the scree plot and eigenvalues.

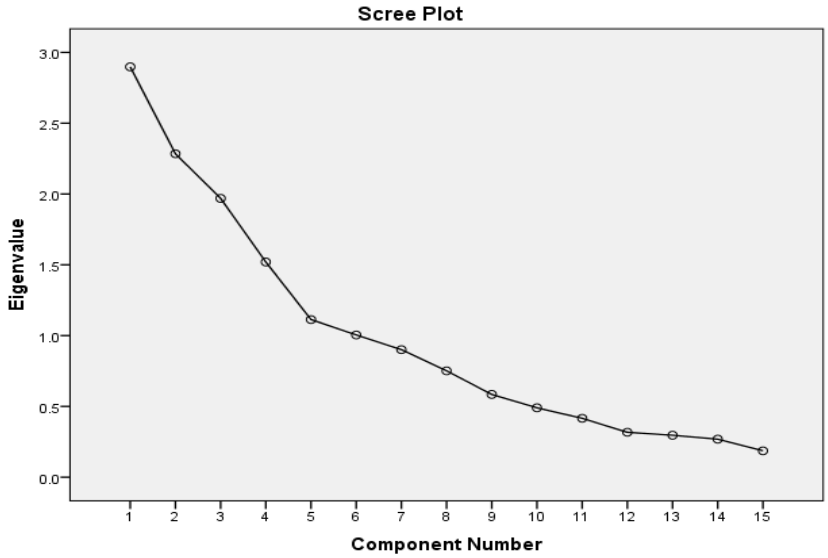


Figure 5-1. Scree plot and eigenvalues. Created for this study

Following the findings from the scree plot, a structure matrix is produced; this shows how the variables cluster together amongst themselves that correlate highly. Table 5-5 shows the output of the structure matrix.

Table 5-5. Structure matrix (N=60)

Structure Matrix

	Component				
	1	2	3	4	5
B8	.834				
B9	.780				
B7	.731				
B4	.593				
D91	.588				
C1		.894			
C4		.798			
D5		.557			
F3			.809		
F1			.780		
E4			.505		
D3				.891	
D104				.860	
C9					.816
D4					.697

Extraction Method: Principal Component Analysis.

Rotation Method: Oblimin with Kaiser Normalization.

Created for the study

The items that cluster on the same components suggested that each component represents perceptions of:

1 – Cultural IT factors

2 – Social Factors

3 – Generational Factors

4 – Structural Factors

5 – Role model factors

5.7.2 **Mann-Whitney statistical test**

From the output of the PCA test, the five factors were used to conduct a Mann-Whitney test on the results against the independent variable of females and males. The dependent variables used were the five factors from the PCA test.

5.7.3 **Factor one, cultural IT**

Factor one combined all questions that showed a strong relationship towards cultural IT, that relate to perceptions of what influences you from within the participants own

background. Results indicated no significance between females and males when it comes to the perceptions of the culture of ICT, Z=-1.142, p > 0.05.

It appears that the perceptions towards cultural IT have no impact on genders; Table 5-6 shows the output of the Mann-Whitney test.

Table 5-6. Factor 1, Cultural IT

Test Statistics

	Cultural Z
Mannn-Whitney U	361.500
Wilcoxon W	686.500
Z	-1.142
Asymp. Sig. (2-tailed)	.254

a. Grouping Variable: Gender

Created for the study

5.7.4 **Factor two, social**

Factor two combines all questions that show a strong relationship towards social perceptions that relate towards factors that bring influences from stereotypes, role models and friends. Results indicated no significant difference between females and males, Z= -0.043, p > 0.05. Table 5-7 shows the output of the Mann-Whitney test.

Table 5-7. Factor 2, Social

Test Statistics

	Social Z
Mann-Whitney U	435.000
Wilcoxon W	760.000
Z	-.043
Asymp. Sig. (2-tailed)	.965

a. Grouping Variable: Gender

Created for the study

5.7.5 **Factor three, generational**

Factor three combines all questions that show a strong relationship towards a generational change. These influences indicate the perception of how different generations can affect the perception of the industry. Results indicated that there are no significant differences between females and males when it comes to the participant's

perception of the ICT industry, Z= -0.964, p > 0.05. It appears that both females and males neither agree nor disagree regarding the perceptions of how different generations can affect the ICT industry. Table 5-8 shows the output of the Mann-Whitney test.

Table 5-8. Factor 3, Generational

Test Statistics

	Generational Z
Mannn-Whitney U	374.000
Wilcoxon W	699.000
Z	-.964
Asymp. Sig. (2-tailed)	.335

a. Grouping Variable: Gender

Created for the study

5.7.6 **Factor four, structural**

Factor four combines all questions that show a strong relationship towards structural factors that relate to influences through the home, work and education. Results indicated that there is no significant difference between females and males when it comes to structural factor Z= -1.791, p >0.05. Table 5-9 shows the output from the Mann-Whitney test

Table 5-9. Factor 4, Social

Test Statistics

	Structural Z
Mann-Whitney U	349.000
Wilcoxon W	674.000
Z	-1.791
Asymp. Sig. (2-tailed)	.073

a. Grouping Variable: Gender

Created for the study

5.7.7 **Factor five, role models**

Factor five combines all questions that show a strong relationship towards role models, which relate to perceptions and influence through parents and guardians, education and industry. Results indicated that there is no significant difference between females and males, Z= -0.367, p >0.05. Table 5-10 shows the output of the Mann-Whitney test.

Table 5-10. Factor 5, Role models

Test Statistics

	Role Models Z
Mann-Whitney U	414.500
Wilcoxon W	1044.500
Z	-.367
Asymp. Sig. (2-tailed)	.713

a. Grouping Variable: Gender

Created for the study

5.7.8 Section summary

From the response to each of the questions using CSGF, factor one did not show any significant new findings regarding the culture of ICT and background for ICT professional. Both females and males were neutral about their perceptions of influence from family regarding the ICT industry. Factor two again did not show any new significant findings of social factors from either gender. Factor three did not suggest any new findings, as both females and males neither agreed nor disagreed with their understanding of the generational effect. This may be biased since the majority of ICT professionals were over the age of 50 years of age. Factor four also did not show any new finding regarding structural elements. The final factor, factor five, also did not show any significant new finding when it came to role models.

Both female and male seemed to neither agree nor disagree strongly with the questions asked. The Mann-Whitney test also did not show any new evidence regarding the factor analysis carried out of the questions.

5.8 Chapter Summary

In this chapter, the industry professional's survey results have been presented and the use of multiple statistical analyses carried out on the online data. Each section of the survey were analysed through the use of software (SPSS). Tests carried out on the data to see if the data complied with the rules of normality, testing the data for skewness and kurtosis. The test found that the data gathered did not comply with normality and parametric testing could not be used on the data. The first test carried out on the non-

parametric data was a simple frequency analysis to give simple frequencies for each of the questions. Non-parametric tests used on the data included Mann-Whitney and Chi-square goodness of fit.

From the results obtained through the analysis of the data from the survey questions it was found that female employees agreed with female students around the influence of family or Whānau appearing to have little to no impact on changing their minds on a given career choice. It was also found that female employees found that stereotyping and stereotypical imagery still plays a part today in the ICT industry. This mirrors the finding from the female students. These findings are very interesting and become an avenue to follow for the interview questions. It can also be shown from the results that as females get older the role of the role model becomes less critical, again a question that could be further investigated in the interview phase regarding at what age do females look less towards role models?

A difference in opinion between employees and students showed that employees would like ICT made compulsory at school which differed from female students, again a question that could be expanded on in the interview phase Employees also thought that more female teachers in male dominated roles such as ICT would be a good idea but suggested that younger female teachers may not be ideal to teach ICT. Another question that needs to be investigated further with the interviews as to the reasoning behind the results of that question. Finally, the employees can see good opportunities for students in the coming years in ICT with regards to new and exciting jobs, however employees did not think that a shift in attitude was necessary from the older generation. This result was a strange finding, as the stereotypes for ICT comes from the older generations and they believe that a change to the attitude of ICT was not necessary. This again would be a question that needed further investigation in the interview stage. From the results there have been many new questions that need to be answered. Each of these new questions will be taken into phase two of the study and crafted into questions for the semi-structured interviews

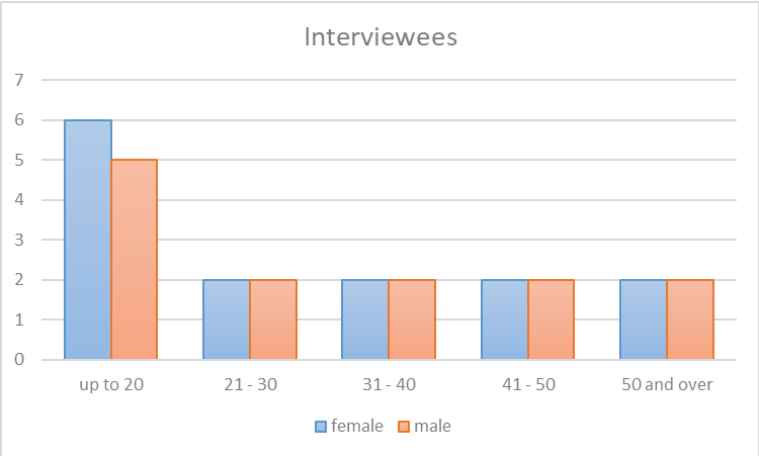
The next chapter, chapter 6, will analysis the results of both year 11 student and employee interviews. The interviews were a mixture of females and males from the schools and companies that contributed to the online survey and were based in Wellington's CBD.

6 ANALYSIS OF AND RESULTS FROM STUDENT AND EMPLOYEE INTERVIEWS

6.1 Introduction

Following the quantitative data collection phase, this chapter presents the research results obtained from the semi-structured interviews carried out from March 2018 to May 2018. This chapter will present the views of students at school and employees from ICT companies regarding their opinions, perceptions and influences on the questions asked of them in the interview process. There was an even mix of gender for students with five females and five males and five females and four males for the ICT employees. Table 6-1 below shows the distribution of the ages of the interviewees of the students and employees.

Table 6-1. Age range of the interviewees.



Created for the study

The interviews followed up with questions based on phase one questions that needed more data for analysis to extract more detail. These opinions, perceptions and influences are presented along with quotes that have led to themes emerging from the participants' views. The analysis methods used to extract the themes from the data are explained, followed by the findings and then a chapter summary.

The analysis of the raw commenced using the steps outlined by Ivankova (2002) as depicted in table 3-21. The first step undertaken was to explore the data by reading through the transcripts and writing notes on each of the interviews. This would form the

beginning of the themes of the data. Figure 6-1 on page 151 shows the initial starting point from the research to show the first thoughts of how the themes would take shape from the first run through the transcript data.

6.2 Qualitative Analysis themes

For the interview transcript analysis, the interviewees' responses were classified, which relate to the STEMCell 2.0 framework established in chapter 3. These groups from Figure 6-1 matchup with the constructs of the framework of Social, Structural, Cultural, SocialIT, Generational and the likelihood of ICT study/career. However, from the initial data results from the interviews, more themes started to emerge and are shown in Table 6-2. From Table 6-2 shows the qualitative data that has been coded as belonging to the project theme (references) from the different sources (files).

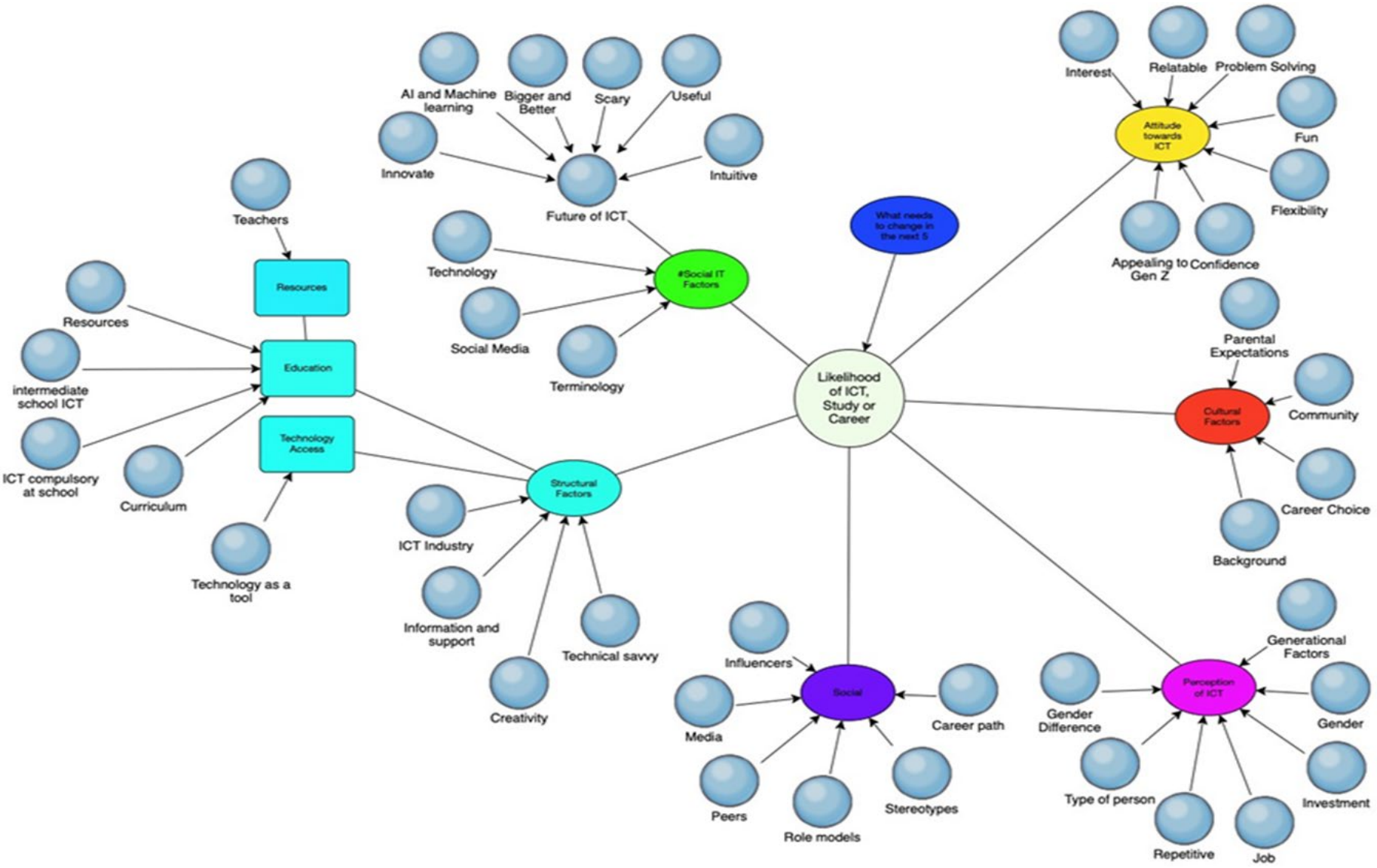


Figure 6-1. Initial themes. Created for this study

Table 6-2. Themes arising from the interviews

Name	Description	References
#Social IT Factors	How the transformation of technology has changed the landscape and shaped the future of IT; this includes social, educational and career implications together with the disruptive technologies	144
Future of ICT	What does the future of ICT look like to you	61
AI and Machine learning	The influence that AI and Machine learning will have on the future of ICT	4
Bigger and Better	What does ICT look like in the future	4
Innovate	What does the future hold for ICT	1
Intuitive	How will people use ICT in the future	4
Scary	Why will ICT be scary in the future	2
Useful	How will ICT be used in the future	5
Social Media	the power of communication and co-creation and how the new generations are embracing the new technology	34
Technology	The ease and access of technology today	24
Terminology	The use of terminology and how this affects people's understanding of the ICT sector	25
Attitude towards ICT	These are all the attitudes that affect the interviewees regarding ICT	142
Appealing to Gen Z	The types of information that students and companies think would appeal to the newest generation	33
Confidence	How confidence plays a role in the attitudes of the genders	7
Fun	How fun should be incorporated into ICT	34
Interest	How interest should be connected to ICT	7
Problem Solving	How creative ideas need to be incorporated into ICT	10
Relatable	Make ICT more relatable to the latest generation	5

Name	Description	References
What needs to change in the next five years	Ideas from both students and companies on how they think ICT should change in the next five years to incorporate those sub-themes above	11
Cultural Factors	This should bring together all the cultural factors that all interviewees discussed, such as home, family and background	114
Background	How the background of students and company staff have had any impact on them	19
Career Choice	Who had any impact on them choosing their career choice	51
Parental Expectations	What parents or guardians expect from their family members	19
Likelihood of study ICT	Bring all the other factors together to give the outcome of students choosing ICT as a career choice	12
Perception of ICT	This brings together all the perceptions observed from the interviews regards perceptions of ICT from both students and companies	338
Gender	Does gender matter today for ICT What are the perceptions of the difference between the genders	66
Generational Factors	What are the perceptions of different generations	53
Investment	What companies are doing to invest in ICT and the gender balance	2
Job	What a student wants to do when they leave school, what staff members think about the jobs available in ICT and how they perceive them measuring up to those perceptions of students	43
Repetitive	What perceptions students and staff thought of ICT being repetitive	30
Type of person	What were the perceptions of students and staff of the type of person go into ICT	28
Social	How factors influence through social interaction via media, peers, role models and mentoring	161
Media	How do students and industry employees	2

Name	Description	References
	perceive the media in all shapes and forms and are their attitudes different from other generations	
Peers	Do students believe that their peers have a role to play in their future career	9
Role models	Do role models play any part in today's society for students and employees	61
Influencers		18
Stereotypes	Are stereotypes still an issue today for students and families, but also in the workforce and are they doing anything to combat this	89
Creativity	How creativity is playing a part in ICT	49
Education	How educators are driving or not driving ICT at school and the impact on students	194
Curriculum	What needs to change in the educational sector to make ICT appealing	41
ICT compulsory at school	Should ICT become compulsory	30
intermediate school ICT	What students are doing at Intermediate school	6
Resources	What type of resources are available in ICT for students and how companies can help	24
Teachers	What resources can teachers use to encourage students	11
ICT Industry	How the industry is adapting to the new generation or not and what are they doing about the future of the industry	42
Information and support	What support do teachers, family and industry get to help bring a more diverse culture to our children regarding ICT	12
Technical savvy	How students see ICT jobs and their perceptions of technology being too technical for them	40
Technology access	The amount of access student has to computer equipment at home and school	29

Name	Description	References
Technology as a tool	Why students see technology only as a tool to use rather than the bigger picture	10

Created for the study

6.3 SocialIT Factors

This section looks into the findings related to the qualitative analysis of how the transformation of technology has changed the landscape for students and employees based on social, educational, career implications and disruptive technologies. First, the interviewees were asked what the future of ICT looks like to them and what impact this could have on students coming into the industry? This was followed by perceptions and impacts that social media has on the interviewees. The interviewees were then asked about technology and their perceptions based on technology and the usage of such technology. Finally, the interviewees were invited to express opinions on terminology and issues that arise from the use of acronyms. Table 6-3 shows the classifications of those sub-themes that have emerged from the interviews.

Table 6-3. Sub-themes of #Social factors of ICT

Future of ICT	What the future of the industry looks like and how the landscape will change
AI and Machine Learning	The influence that AI and Machine learning will have on the future of ICT
Bigger and Better	What does ICT look like in the future
Innovative	What does the future hold for ICT
Intuitive	How will people use ICT in the future
Scary	Why will ICT be scary in the future
Useful	How will ICT be used in the future
Social Media	The power of communication and co-creation and how the new generations are embracing the new technology
Technology	The ease and access of technology today
Terminology	The use of terminology and how this affects people's understanding of the ICT sector

Created for the study

6.3.1 The significance of SocialIT factors

The majority of interviewees expressed opinions related to disruptive technologies and the challenges they face now and in the future. Many of the company interviewees see the automation process happening at all levels of technology and are adapting the job space around these areas. Company interviewees see technology and ICT becoming more and more ingrained and a natural part of generation Z and millennials' lives. The majority of the employees expressed that they believe automation will start to have a more significant impact on the types of jobs available today; however, some also saw this as a negative aspect. Employee G discussed automation as being bad for students and their learning.

> *"I think the problem we have now actually will become worse because the technology will become even more remote and more complex the chances of individuals understanding it becomes more remote and become more divorced from the student's experience."*

The student interviews did not understand the impact of SocialIT on the landscape and how disruptive technologies were changing the way of the world. As a generation that has been immersed in technology, all the student interviewees had embraced the SocialIT aspect more as a tool rather than a technology, just like the mobile phone, and did not see this as a paradigm shift from the internet age to a disruptive age. The students agreed with the employees regarding automation, and the expectation ICT would be everywhere.

6.3.2 Future of ICT

As the landscape is ever changing in this era of disruptive technologies, the researcher questioned the interviewees on the future of ICT and what it looks like to them. The employees all agreed that a more flexible work environment with automation would take away some of the mundane jobs. Employees agreed that AI (Artificial Intelligence) and ML (Machine Learning) would become a more significant subset of the jobs available in the industry. However, one word kept coming through time and time again from the employees, 'creative'. The employees believe as automation takes hold of the industry the sector will have to start to become more creative in the way it does things such as processes and thinking and the roles that will be available to students or employees in the future. Employee F discussed logical and problem solving in general rather than specific jobs in the industry.

"I need know to what you are trying to do enough so I can put blocks together and join them up in a way that you get what you want. So, I need some logical thinking but I need to ask the right questions, and I need to be able to make something. It is almost if you could repurpose an art class because today we are going to make something kids. There is no paint involved; it is virtual paint."

When the students answered this question, the results were broader in scope; however, there were strands of themes that did mirror the employees' answers, these themes are as follows:

- Artificial Intelligence and Machine Learning
- Bigger and better
- Innovative
- Intuitive
- Scary
- Useful

The students also discussed bigger and better, and the use of technology utilising gadgets such as VR (virtual reality), AR (augmented reality). Student E stated that *"Bigger and greater and just more things that will I guess overpower humans in a way",* whereas student, I talked about "*It is going to be a big future for IT, because there are many things coming in like AR, VR, it is going to turn into a big thing I reckon".*

Student H discussed innovation and how it may be one area that could become big in the future "*…not just stuff like coding and all of that, but the innovation it brings as well, like the phones and all of that….*". Another theme that both employee and student agreed upon was intuitive, Employee B said "*My child knew how to skip ads on YouTube before the age of two… more intuitive to the future students*" and Student F said, "*It should be integrated into everyday life if it has not already".*

Whereas student A goes the complete opposite and believes that the future for ICT will be scary "*I think it is going to get scary…. caused by futuristic technologies".* The final theme that the majority of the students thought of when talking about the future of ICT was how useful it should be to them. Student B thought "*I think it will be useful, which is probably why more people should take the subject*" and Student F said, "*Hopefully, it will make a massive change to everyday life*". Employees and students can see that ICT is changing and the mundane will be automated. The important finding from the

interviews is the soft skills that industry and some of the students think are becoming essential in ICT such as creativity and innovation need to be investigated further.

6.3.3 **Technology**

Technology has become cheap and ubiquitous; the use of technology is not just in the workplace or in schools, but our homes and our pockets. The theme that emerged from the interviews for both employees and students suggested that technology has become an integral part of everyday life and again has become a tool to use rather than a technology that they must understand. Employee D suggested that "*Everything is at their fingertips, so it is what they – how they perceive that they use it is quite different*" and Employee I *noted that "In the past computing was about learning what – how a computer functioned, but I am not sure that it is relevant now".* The employees suggested that technology is so integrated into our lives that students have taken it for granted and do not care about the black box and how it all fits together, as long as it gives them the answers.

The employees also suggested that in today's society, you do not have to know how the black box works on your desk, as that is moving into the cloud space and becoming more remote. Employee C pointed out "*they do not know what life is like without technology*". Employee E suggested, "*We take it for granted, but some students do not have access to them, with libraries closing down, there is a problem there as well"*.

From the student interviews, they too also came to the same conclusions as the employees; however, many of the students interviewed opted out of ICT at high school because of perceptions about not wanting to break stuff, feeling frustrated, not knowing what to do and thinking it was going to be just the same as primary school. The students also perceived ICT to be programming and writing lines of code that they did not understand, and, for students' technology or computers have just become a tool that they use as a means to an end. Students A said "*I got very frustrated any time things did not work. I've learnt to type a lot faster that I can write, it's also a lot cleaner, because I don't have to scribble things out if I spell then wrong and auto-correct and stuff it's great, love it.* ", whereas student F said, "*If I broke something I knew I could fix it, whereas the girls are a bit worried about breaking anything*".

Students take technology for granted; they expect it to be there to use as it. However, both students and employees agreed that the perception of girls when it came to

technology was somewhat fearful of breaking it and not having the confidence to be able to find a solution to fix the problem if things go wrong.

6.3.4 **Terminology**

This theme was interesting, as the majority of the students had no clue what ICT was and what it meant. Terminology within the industry and the use of it has divided students and their understanding. Even some employees struggled to determine the difference between computer science (CS) and information science (IS) as subjects that students can study in school.

Employee D discussed much inaccessibility of information around ICT for students "*So, I think having – especially in terms of careers having a good categorisation of different sorts of fields in IT and a good definition to go with those categories"*, and the terminology can be off-putting for students. Employee D also discussed the issues both boys and girls have when studying at university around CS and IS courses "*Yeah, there just seems to be so much overlap"*.

Employee E discussed introducing initiatives into the ICT industry where they bring in high school students to shadow them for the day to allow students to understand what they do. However, Employee E also felt that schools have a part to play in making IT more appealing "*I think that if teachers felt more comfortable about the day to day realities of ICT jobs as well that could be cool"*. Employee F discussed acronyms could have many different meanings "*You can just put acronyms on top of acronyms"*. They also discussed the industry not being as old compared to the medical or legal field and the need for their language to appear as a professional entity. Concerning the use of acronyms, it goes to show that even employees in the industry still have difficulty in the use of some acronyms "*I never even understood what ICT was, I still really do not".* Employee G went on to talk about creating definitions and splitting up the names just like they do in medicine "*What you mean is a doctor, epidemiologist, anaesthetist and all that stuff. Kids do not understand that; they see a doctor"*.

When this question was asked to the students through the interview process, the majority of the students gave the same sort of answers. Student A thought "*It is like programming and people who make video games and stuff"* and Student C said, *"I do not know exactly what that is".* Students find it hard to perceive what people do in the ICT industry, even industry employees find it hard to put a name to the job they do. It usually gets bundled

into one definition of IT or ICT. Student C said "*What is IT again? What does that even mean? That is why it is confusing".* Students G and H contradicted some of the other students as they had some understanding of the terminology and some inside knowledge of the industry. Student G gave and well informed definition of ICT "*Information, Communication and Technology, it is everything in the IT industry, software development, security, literally everything to some degree".* Whereas Student I sugegsted "*I just thought it was like a lot of stuff around computers, yeah".*

There is a huge misconception about what ICT is when it comes to students' understanding of the industry. They cannot perceive different jobs and sectors within the industry. School staff, from teachers to counsellors, are not understanding different avenues that students' career paths can take when it comes to ICT. This suggested that terminologies used in the industry and the perception of students do have a significant influence on them when thinking about a career in ICT. Students are not given enough information required to make a reasonably informed choice based on the results given by the interviews. As suggested by the employees, a clear pathway and good descriptions of what type of jobs are available would go a long way toward breaking down these acronym barriers.

6.4 **Attitudes towards ICT**

Another major theme that came out of the interviews carried out for both employees and students were their attitudes towards ICT and the effects that would have upon them when looking at ICT as a career choice. After analysing the data, it was found that many sub-themes started to emerge out of the different attitudes of both employees and students. Table 6-4 shows the classifications of those sub-themes that have emerged from the interviews.

Table 6-4. Sub-themes of attitudes towards ICT

Appealing to Gen Z	How appealing can ICT be made to the latest generation
Confidence	How confidence is affected by the use of ICT
Fun	Why is ICT not fun at school
Problem Solving	Do you need the creativity to be embedded into the subject
What needs to change	What students and employees think that needs to happen to make it more appealing and attractive to more people

Created for the study

6.4.1 **Appealing to generation Z**

Within the attitudes towards ICT, several sub-themes emerged. Appealing to Gen Z was one of these themes. Both employees and students offered insights into what they thought would make ICT more appealing. The majority of the employees thought that the schools needed to make ICT relatable to what the current generation is doing and how they are using technology today. Employee B said, "*Make the curriculum more interesting by building something that has interest to them*". Many employees' attitudes towards ICT suggested that schools and the curriculum are out of touch with this latest generation for their technology needs and the need to present people in the industry and at school who are closer to the age of the latest generation. Employee D discussed making ICT more relatable to the new generation "*Being able to make ICT more relatable to this generation will provide a new pathway for students to seek careers in the ICT sector"*. This was shared with Student E, who told of their story of making ICT relatable "*We paired up with the robotics club and came up with a solution to use a robot to navigate the school, picking up rubbish. Both clubs had agendas that needed to be accomplished and coming together to work out a solution was interesting and fun. It was interesting to learn how to use the robots to do stuff, especially when it helped with picking up the rubbish. I found it fun learning something new with computer stuff"*.

If schools can find a way of making ICT subjects more relatable, it may build interest from the students and increase students' self-belief and confidence in the ICT area. Student B suggested, "*Yeah, like make it relatable for lots of people rather than just the people that are interested in it. Teach us to build something that we can use such as apps to use on social media or something would be better than writing documents in Word"*. Employee E put this very succinctly and said:

> *"Making ICT more appealing and exciting for every kind of person it needs to happen at the educational level. I think that everyone wants to solve problems and an impact and things better, it is about schools making the subject exciting and showing them they can achieve anything they put their mind too. It is about telling better stories that relate to the future generation, that ICT is just the air that we breathe. It is going to be part of your life, a big part of creating a solution – do not just be a consumer of it*."

6.4.2 **Confidence**

Students, especially girls, have lacked confidence when it comes to ICT. Girls' attitudes have been to stand back and let the boys take over; however, if schools can find what excites this new generation of students when it comes to ICT, then it will bring those girls back and engage them into having a go. Employee C believed it is about teaching good problem-solving skills "*I might not know what the consequences are going to be, I have planned how if it goes wrong, what I can do to back out of it. That is what gives me the confidence to that thing",* and student E also agreed with the employees not only when it comes to ICT but in any job "*I do not know how to phrase it but like a lack in confidence to go for it"*. Whereas employee D thinks "*I think girls just are not given the confidence with using computers".* A few of the students thought that confidence was an issues in ICT, Student E suggested "*I don't know how to phrase it but like a lack in confidence to go for it".* Also Student A suggested *"I feel I can't ask questions in the class as it makes me feel stupid when everyone else seems to get it".*

6.4.3 **Fun**

People find it hard to perceive what an ICT person does apart from preconceptions and stereotypes they have about ICT. One of the sub-themes that emerged from the results was fun and how attitudes could be changed in the industry to try and make ICT more fun. Employee B discussed using new and exciting technology to interest students "w*hen there is a fun opportunity that comes up to try a new technology or something such as VR or drones, it will be a lot more effective"*. Bringing these newer technologies into the classroom will open up students' understanding and show there are lots of different opportunities for them within the industry apart from programming. Employee E remembered what they had to do when at school learning ICT "*Oh yeah, having to do Word, Excel spreadsheets, programming and all that at high school, yeah that was boring"*. Employee D then suggested using new technologies to work on projects "*You start learning ICT, like coding concepts and they sound really dry and dull, but there are lots of game based, sort of frameworks that can be used to learn to code. It is about finding what appeals to the masses and what fun is for them. Open people's minds to the possibilities rather than shut them off"*. Employee I suggest a simple way to make ICT more fun to students was "*Yeah, to me it comes down to the creativity".*

When it came to the students, and the question asked about fun, their attitudes towards ICT were not positive. Student A suggested "*You don't do the fun stuff at high school like you did at primary school, now it's just like write a 10-page report* ". Student B and C were put off taking ICT at high school because their perceptions and attitudes towards ICT were that it was not fun. Student B talked about "*Using computers is fun, playing games is fun, understanding how they work and stuff is not fun"* however, most of the time, they struggled and were put off. Student C could not see any of their interests in the subject and also do not take up the subject at high school "*It was not stimulating and did not interest me".* Students F, G, H and I contradicted the other students and discussed ICT at school being fun. Student F said "*It is fun to learn new ways of technology and how it is progressing"* and student H said, *"I find it fun because it provides a bit of a challenge".* Whereas Student G said "*I love computing because it's so logical"* and Student I talked about *"Oh yeah seeing what you built, if you don't like it, you can just erase it and start again".*

6.4.4 **Problem solving**

The majority of employees believe that people who are creative and problem solvers are the types of people that enjoy ICT and will end up in the sector somewhere. Most of the employees think problem-solving is a skill that needs to be taught in high schools, not just in the ICT subject area but across the curriculum. Employee C suggested that "*Teaching problem solving and education on don't just go ahead and do something have confidence but not over confidence",* also Employee D suggested the same *"'I think it's in the problem-solving skills and promoting the sort of self-learning, self-teaching skill*". Employee E suggested that "*I think the fundamentals – critical thinking, problem-solving, asking good questions, being curious, those kinds of traits are important".* Both Employee G and H suggested problem solving techniques were needed by generation Z students, Employee G suggested "*I think the people that go into ICT are good at solving puzzles"* and Employee H suggested "*Yeah problem solving is needed by today's students".*

6.4.5 **What needs to change in ICT**

A question that was asked of the employees around attitudes was what needed to change in ICT to make it more attractive to students. The majority of employees had the same answers and the same opinions about what could be done and Employee D said "*Better*

course in schools for ICT". Employee B suggested "*Make it relatable to what today's generation finds interesting and exciting to them*", Employee C and D though that "*Some form of ICT as a core subject*" and *Better course in schools for ICT*". Whereas Most discussed the school curriculum and how it cannot be to adapt quickly and easily to the changing landscape of ICT. Employee H gave this answer "*Create more awareness in schools at the educational level, so the student is aware of what is available to them".* Employee I suggested they need to focus on the outcome of technology "*I guess where I am coming from – is the need to focus on the outcome of the technology like the creative side of it".*Most of the employees discussed making it relatable and interesting to the new generation; they also discussed making it compulsory at high school and how to engage students early in their education and how the industry needs to make more junior positions available and not just the highly skilled positions. They also discussed looking more for creative people and not just technically minded people.

6.5 Cultural Factors

This factor looks at influences brought through from the employees and student interviewees' perceptions and attitudes from home, family and their background. In the questions asked, the researcher tried to elicit information about what made them the person they are. The answers given were through perceptions that came from families and their upbringing. This was to see if this had any impact on their choice, perception and attitudes towards ICT and the industry. Table 6-5 shows the classifications of those sub-themes that have emerged from the interviews.

Table 6-5. Sub-themes of Cultural factors of ICT

Background	How the background of students and company staff have had any impact on them
Career Choice	Who had any impact on them choosing their career choice
Parental Expectation	What parents or guardians expect from their family members

Created for the study

6.5.1 **Background**

The first sub-theme to come out of the interviews was how the interviewees' background affected their perceptions and attitude towards ICT. Employee A had strong feelings about attitudes towards ICT and went on to talk about engaging with the rural schools and applying technology to what they know such as farming for instance and working with indigenous people to take up technology and build it into their communities.

> *"I'm speaking about culture in regards to indigenous culture – they are fearful of engaging with them because they don't know how to engage with them, they don't know the approaches, they don't know the methods. We've not just talking about websites here, were talking about smart communities, we're talking about smart indigenous groups. They are looking at staff going into schools and colleges, but they need to go down a couple of layers, into the primary schools, so it's becoming layered out. I think they're going about it the right way by getting resources in there, but they need to evaluate the quality of that engagement and the level of engagement".*

From Employee C's perspective, they believe that families are starting to see the importance of technology "*I mean I feel like they are already beginning to get it*" in the latest generation, such as generation Z with their use of technology. Employee C goes on to talk about seeing the positive impact on international companies hiring in New Zealand being more diverse and less biased in terms of whom they hire. Employee E discussed getting the cultural stories across and showcasing diverse role models *"I need to tap into Māori and Pacifica who are already in the industry and them to tell their story, because students can see people like me, so I think it comes down to role models and great storytelling"*. Employee F discussed walking the floors of their building and noticing that employees were a predominantly white male and mostly of European descent. This stems from the background of those ethnic groups not having the same opportunities as more privileged groups "*That's quite interesting how it ended up that way? Is it because for a while you needed a level of higher education and ethnic groups are then filtered out because they don't go onto higher education? So, you are picking your workforce from a smaller pool of people who are the same"*. Companies then get caught in a cycle of hiring only like-minded people, which end up as white, middle-aged men.

Students in the interview process were asked cultural questions that looked more closely around attitudes and perception that they had picked up from home and family members and had this in any way influenced their choice in career one way or another. With the answers given, it was split whether they perceived their background and family had been influential in their decision making for their future career path. Student A did not think it made a difference "*I do not think so really",* Student B did not know *"I'm not sure",* whereas Student C suggested

> "*I think so, from a young age it was just like make sure that you do well in school so you can go to university and do a degree and get a good job. In terms of actually what I want to, not so much. I would be inclined to follow along the same path as my parents then go in the opposite direction".*

Student E and I contradicted Student A by suggesting that *"I think that my culture, like my family and stuff, does affect what kind of job I want" and "very much so".*

6.5.2 **Career choice**

A sub-theme that came out of the interviews was around career choice. Students were asked if their family had any influence over them when it came to their future career and did it become a factor when they think about a job.

Student A had a clear mindset early on what they wanted to do as a future career but changed their mind in Year 11 based on influences through school "*I am now looking at something like psychology and social work. IT has never really something that has interested me that much"*. Student B already had a clear career path from an early age "*I have always been interested in social work, but starting to know about ICT, I think it could be massive but no not a career changer for me"*, as did Student E "*Yeah, I want to be a lawyer when I'm older, so I guess it was a bit of both, I guess my family influenced me but I think it all comes down to my interest levels essentially, what I'm into. With ICT, it has never been an interest of mine".* Student D also had an idea of their pathway, which did include ICT "*Yeah sort of, I have always considered ICT, but it is very hard to decide on a job*". Student I had a very clear view on where they were heading "*Very much so, I do have conversations with my family, my granddad has been very influential, he brings home cool stuff for me to play with like the VR stuff".* From the interviews of the students it was clear that many of the students, especially the girls had already chosen what they thought to be their pathway from education through to a career. The boys

however, many had not made their choice regarding their future pathway to a career. Student C suggested that *"From an education point yes – but not so much a career, as for ICT it's just that it's not what I want to do, but I am not sure on what I want to do".*

The company question was slightly different from the students in that they were concerned with how could industry help inform students regarding career information and future pathways. Employee B discussed when people choose a career path that is not generally associated with ICT; they also need to understand how ICT can be used in those career choices "*for example, if they want a career in radiography or something, how the ICT aspect of that could also, perhaps, be incorporated so they can use both"*. Employee H and I agreed with employee B when it came to ICT at school *"having passionate teachers and having a topic that let students engage with their creative side and what interests them".* Employee C discussed "*when I was at school we had work experience you offered a place up to allow students to come in and see what you do. If they have a great time they are going to go back and talk to their friends and say what a great time I had*". Whereas Employee E notice that students did not understand the opportunities available to them

> "*I was at a careers Expo last week and a lot of pure science students coming through, I explained that tech needs them there's a whole lot of environmental jobs – do you like maps, GIS this is a field, anthropology – user experience heard of that? Trying to join the dots for them. Every single student went away mind blown because they had never considered the ICT sector as a pathway".*

Employee G suggested it was promoting the industry better; students are not looking at ICT as a career; it is just something they use "*Encourage the teachers not to have a negative view of technology – because that does have a flow on to the students"*. Many of the employees believe it is about engaging the tutor and being passionate and educating the student in the diverse set of roles that ICT is made up of. All employees are passionate about ICT, however, from the comments it can been shown there is a really disconnect between the schools view and the the industry view of ICT.

6.5.3 **Parental expectation**

Many families have perceptions and expectations around what they want for their children when they grow up. This sub-theme came through very clearly from employees, as well as students.

Employee A thought that family members should have an understanding of technology "*It is also a responsibility within the family to share and promote good technology development"*, but the children are just playing with technology and not understanding the potential. Employee C suggested that many boys will follow in their father's footsteps in a career choice. Employee E showed a different angle talking about parents and whānau and the whole of society that will shape a student in terms of what they think their life is going to be like. Employee G, on the other hand, suggested that taking out parental expectations and bringing in other role models "*it would be easier to take it out- to go and bring other role models to the children"*. Employee C suggested that boys more than girls will look to family members for guidance and support when choosing a career path "*I mean so many boys just want to do what their dad did, things like that"*. The majority of students had an open dialogue with their parents regarding their future, however, most parents did not have much of an influence over the careers as Employee G suggested "*It's hard to change people's perceptions or parent's perceptions of their own career choice and what their children should do, it would be easier to take it out- to go and bring other role models to the children".* Student C said "*I think so, in terms of actually what I do, not so much, it is more like my personal – what I am interested in" and Student D*

> *"Yeah definitely all the time, we're always talking about what sort of things are changing because some of the stuff my dad works with is sort of very new research or new ideas that are coming out, so he's able to guide myself and my brother to what areas would be a good place to work".*

Student F also thought that their parents had been influential "*Yeah, my parents have had a kind of influence on my decision of what I want to do, they have been supportive on my study choice I've made".* Student H suggested the same as most of the other students "*Yep did talk to mum and dad quite a bit, my dad introduced me to IT*". This shows that the majority of student interviewees did seek guidance and spoke to family members about their future. However, some students had a clear vision by Year 11 of where their future career path lay. A couple of the male students were encouraged by family members to seek pathways similar to their parents, which included the ICT industry.

6.6 Perceptions of ICT

From the interview process, it is apparent that both students and employees had strong perceptions regarding what they think is important in ICT and what makes ICT attractive to future employees. Below in table 6-6 is a list of sub-themes that came out of the interpretations of the transcripts. Each of the sub-themes will be investigated in the following sections.

Table 6-6. Sub-themes for perceptions of ICT

Gender	Issues of the gender divide in the industry and at school
Generational factor	What problems different generations are facing and how to resolve those problems
Jobs	What perceptions do students hold when it comes to the jobs available and what employees think to change student's perception
Repetitive	Student perception of the industry is very repetitive and how employees are combatting this perception
Type of person	The problem of stereotypes and how to combat those stereotypes and perceptions

Created for the study

6.6.1 Gender

For many decades, there has been a perception that ICT is for the middle-class white male and when something is told to you multiple times over a long period it starts to become the fabric of what you believe. This has come through from the employees who shared that the perception of the industry is white middle aged males, employee G said:

> "*This is a chronic problem in ICT because a lot of the current workforce is white guys. Kids are not stupid if they look at a company that's 75% white males, 5% white females and 20% other and that would be pretty exciting even by itself, then they would go, it is all white males, they are not dumb."*

Employee F backs this statement from Employee G stating "*If you keep answering the problem the same way or doing the same thing to answer the problem you are going to get the same results"*. Some of the employees explored this not from a position of imbalance in the workforce but as a retention problem and how to keep the female staff from leaving. Employee B suggested "*Females are often the ones who are the primary*

care givers for children, the fact that you can work remotely and spend time with the children should be exploited more within companies". Employee E recognised that the problem of gender is an issue, and most ICT companies have this problem, and it has to be changed somehow "

> *I think it is a retention problem rather than a pipeline problem. I think there are enough women coming through into the job market, but that companies aren't retaining them, promoting them, rewarding them or supporting them in the right way to stick around. We are currently getting around 40% women through our internship programme, it's gone up from 25% 10 years ago and that's off a base of about 10%. The problem lays around senior talent and a lack of qualified people in those areas and the pool of talented people to select from is very small and full of white males 30 plus. We need to be serious about diversity and actually forcing that in the workforce and a place to do that is at the industry level".*

Many of the employees gave examples of how companies can attract more females into the workforce.

Employees believe in diversity and gender neutrality in the ICT industry and trying to bring new policies into companies that embrace the 21st century of thinking. However, some employees see this as a hard ask when they believe it is more of a societal problem first and an ICT problem second. Employee H pulls all these perceptions into one clear idea:

> *"This comes down to companies, in general, looking at their hiring policies again and about creating safe, comfortable work environments regardless of your gender. So, until that sort thing becomes the norm in the industry, I guess we have still got work to do."*

Students have a very different perception of why there is a lack of girls going into the ICT field than that of the employees, as revealed through the responses in their interviews. The student perceptions were based around confidence, lack of opportunities, and stereotyping. Student C picked on the stereotyping in the ICT "*I don't want to go into an industry where I'm so outnumbered",* also Student B agreed *"I think that if there were more girls, then it would be more appealing to them".* Student E

thought it was a confidence problem "*I guess it is related to what I said before in terms of a confidence thing". Whereas Student H suggested "Without saying it too bluntly, ICT was a subject more taken by boys. There is this stereotype that girls aren't this technological minded because they don't have the interest".* Student I thought the issue was down to people *"It's like a social problem".*

6.6.2 **Generational factors**

This theme has come from the perception that many employees and students believed there are differences in the way certain generations interact not only with technology but through their communication in school education and work. The different generations have such differing perceptions. For this study, all students are classified as Generation Z, born after 2003, and for the employees, there was a mix of Millennials/Gen Y, generation X and baby boomers. Each generation will have differing perceptions of what they believe and this will promote itself through background, social, culture, education and work.

Employee A revealed there is a generational problem "*The generational thing is trying, as for the baby boomers, again they are trying, but we most probably need them to die before it will get better one more time. Gen Z have no issues sharing stuff, say stuff that I think to myself, well I don't think I would say that.'"*. Employee B viewed the generational problem as replacing the older generations with newer generations such as generation X or Y "*I think it's a relatable issue, getting the cool people out in front of the students instead of any old fuddy-duddies. It's the old guys there is a lot of the older white guys – there just – no it's not the place for women, it's like these guys are at the top and you've pretty much got to wait for them to retire and go away"*. Employee E agreed with Employee B and C regarding the older generation

> "*I think it's a perception problem in the bias that it is with the current people who hold power in industry. I think it changing slowly. I think some organisations have a generational gap and my interpretation of this is that they have an aging workforce and they haven't replenished it. I think that there is an old school gap problem, if you look at the boards of companies, senior leadership teams, they are – no offense to old white guys – but tend to be older white male more male then others, so I think there is definitely a problem there"*.

Employee F also looked at the older generation or the baby boomer generation as the main issue and stated:

> "*There's if you have that bulge of older white males, then that's quite off putting if you turn up and you just see a big floor of, and it's like oh I've got to work with that lot. Hopefully in 10 years' time or so they will have retired anyway. In 15 years' time, there will suddenly be a whole lot less white middle-aged males in there anyway, so by attrition it will even up. The bigger the companies are just going to suffer or they'd be scratching to find more middle aged white people to replace the ones who have gone, and everyone else will be growing".*

Employee G suggested that the problem is not just a generational problem but a stereotype problem as well "*The big problem is that the people who hire people hire to type white males. Any amount of research will show you that this is true. What we need is people who are great at their jobs, not people who fit a stereotype but because of the people that train them, older white males – we get that stereotype".*

The students that were interviewed do not see the generational issues as a major problem. However, they do see a generational gap when it comes to using technology and some of the social stereotypes that are passed down from generation to generation. Student A thought that "*I feel like they could maybe make a bias of not wanting to hire younger people, because they don't see the exceptional creativity part of it and how it's changed so much in the last 70 years or so".* Student C sees it as a perception that it handed down *"You believe what you're told by the older ones than you, and so however far back it comes from it just gets passed down".* Student F stated that "*I reckon the stigma of the IT nerd has to go, some of the older generations do not understand; my grandparents are perfect examples of that".* Student E agreed that there may be a problem

> "*Yeah, so I think there's a problem, but I'm not sure if it's minor or major. Some parents may not let their kids take a subject like digital science or whatever, and they think that that may affect the future and the development of technology for the future and what's to come. Because obviously our generation are the ones that will be the new innovators and things like that"*

Student G also agreed with Student E and suggested:

"*Yes, I mean obviously from my dad working in the industry. We tend to hear lots of older people working in the industry, not necessarily a lot of younger ones. They don't want people fresh out of school. However, people fresh out of school tend to have the new and creative ideas and that is a problem. Sometimes you need new blood to come through a company to kind of elevate the status of the company".*

6.6.3 **Jobs**

Another theme that came from the interviews about ICT was jobs in the industry and what perceptions students had when it came to jobs in ICT. The employees viewed this from the perspective of what jobs are available to up and coming students and how they can be clearer on what those jobs entail in the IT sector.

The employees suggested pathway diagrams, such as the Microsoft pathways for certifications (see appendix G), and educating teachers and students about non-traditional roles within ICT.. Employees were also keen to see work experience brought back for students to spend a week or so in the workplace to give them first-hand knowledge of what to expect. Employee C suggested "*Yeah, I think it goes back to the understanding of the wide variety of jobs that there are – if you look out there, you will find plenty of jobs and high-powered women in IT. When I was at school, we had work experience, you know, offer your place up to allow people to come in and see what you do".* Employee D discussed the non-traditional jobs available in the ICT industry "*Yeah, there is I think a lot of non-obvious career choices in IT that may have more appeal to girls, rather than just straight coding. There are lots of design options"*. Employee G discussed getting industry more involved "*If we have to change how the industry is perceived, we have to change the industry"*. Employee H suggested educating people about the types of jobs available "*I think more can be done in terms of summarising the different career paths"*.

When discussing the types of jobs available in the ICT industry, the majority of the students, when pressed in the interview had little to no understanding, Student A suggested "*Yeah it is like working with computers and Stuff isn't it".* They had limited exposure to the types of jobs available to them, Student E thought "*I see ICT as some programming type of thing"*. Only a couple of students had a better understanding, due to having family members working in the IT sector. Student D suggested "*I've always*

considered ICT, so with AI coming in at the moment and that sort of thing, I'm actually unsure of where I want to go " and Student H "*I'd really like to be a software engineer* ". This shows the divide between industry and the schools and the lack of understanding around ICT and the multitude pathways that can be taken in the ICT industry.

6.6.4 **Repetitive**

This sub-theme emerged from the interviews based on the survey answers for the students and their perception of ICT being repetitive but, when pushed in the interview, both employees and students had similar views about the repetitiveness of jobs in ICT. Employee E talked about starting out in ICT and the repetitive nature "*Yeah, I mean, there is always going to be learning – potentially learning the basics of something is always going to involve repetition".* Whereas employee F suggested that ICT if failing if it is repetitive "*ICT internally is failing if it is repetitive, if it is based on the support like helpdesk, oh yeah have you rebooted? Is it solved? Have a nice day. Then yes, it is. So, it is always perceived as that".* Employee C did see some repetitiveness but that was in learning something new "*When you first get a job in ICT they are unfortunately, most likely going to be repetitive, that's the same in any job. I really liked the people I worked with so that's what makes a repetitive job do-able".* Employee G also thought that when students see people in ICT companies they perceive what that person is doing "*I think the programming image, I think that's what they are saying, they're seeing somebody sitting in front of a screen day after day, programming and that's all they're doing. That's not the way it works".*

From the student interviews, they explored their perceptions of the industry in two ways, what they did at school in ICT and what they thought they might do in an ICT job. Student likened this to writing documents as Student A suggested:

> "*Kind of, for me, how it's like write a report, put footnotes on it, send it in sort of thing. But I don't know, because I don't know anything about programming, I don't think it would be very repetitive. Yeah, so from high school perspective believing that if what you're doing is quite repetitive you're doing it over and over again".*

Student B also suggested the same "*Yea, because it is just always writing documents, go to google drive make a document, write whatever"* and Student H thought that programming would be repetitive if you were doing it has a job "*There are parts of it,*

like code, which I feel is repetitive". Student C and Student I did disagree suggesting "*I think it depends what exactly your job is, I can see that it – oh no, part of it that you wouldn't be able to just do the same thing over and over. Then again if you're like a specialist in one little area then maybe"* and *"No, I don't reckon it's repetitive, you're doing lots of different things, there's lots of different things you can do, but Yeah"*

6.6.5 **Personality**

One of the themes that have come out from the interview data was the type of person that employees and students perceived go into the ICT industry. This theme encompasses the stereotypical images that the majority of students and employees have been exposed to throughout their lives. However, many of the employees suggested that there is a role for every kind of person when it comes to the ICT sector. Employee F suggested that:

> "*I think there is a role for every kind of person in ICT. Everyone wants to solve a problem and make an impact and things better. We are still seeing the stereotypical math geek type of person, but I do think that is changing with the demand side – the vacancies that there are in technology – the need for different kinds of people."*

Employee A suggested that:

> "*I think it goes across the board. If you love breaking stuff, then you are going to love networking, if you're a good communicator then you are going to be a good business analysis, whereas if you're a bit of a theory then you're going to like building and designing".*

Whereas Employee H suggested that there was much more opportunity for people coming in the side door:

> *"There's more opportunities from coming in the side door. I have a friend and she worked for a company in the call centre. After being there a few years they said they were doing an upgrade to the call centre software, we need some people to come and help us test, so she became a tester. The company then said you know the system really well will you help us with this other project and she became a BA, she never went into IT, I cannot remember what she did,*

philosophy or something. So, lots of females are actually going into IT or ICT related jobs in their late 20's to early 30's".

From the interviews, all student information came under the stereotype theme and did not have any input into types of people that would go into the industry.

6.7 Social

From the interviews, another theme that came out from the conversations with the students and the employees was the social aspect and how these influenced students through interaction via media, peers, role models and stereotypes. Below is table 6.7 that shows each of the sub-themes that make up the social perceptions that each group thought had an impact on their attitudes towards ICT.

Table 6-7. Sub-themes for Social factors

Media	How do students and industry employees perceive the media in all shapes and forms and are their attitudes different from other generations
Peers	Do students believe that their peers have a role to play in their future career
Role Models	Do role models play any part in today's society for students and employees
Stereotypes	Are stereotypes still an issue today for students and families, but also in the workforce and are they doing anything to combat this

Created for the study

6.7.1 Media

In the first phase of data collection, media and especially TV seemed to play a role of guiding students' perceptions about ICT and the role people have in the industry. However, after reviewing the transcripts of the students that were interviewed, only one student felt they had been influenced by certain TV shows. Student A had been influenced through crime dramas "*Yeah, my dream job is BAU, and that is because I watch Criminal Minds, watching them is very intriguing to me and makes me want to do it".* Also Student G supported Student A by suggesting "*A lot of like TV and stuff does show IT that way but I don't think it's that way in the real world is it".*

6.7.2 **Peers**

As a sub-theme, peers stood out when looking through the students' transcripts. Four out of the nine students recognised that peers had a direct impact on their decision on subjects they were taking at high school. Student A suggested that "*I had my friend also influence me* ", along with Student D "*So yeah, looking at friends as well definitely* ". Student F shared that peers had influenced their decision of subjects "*Mostly the influence that I have had that impacted on me to do ICT was my friend, and he is doing ICT elsewhere".* However Student E suggested "No none of my friends really persuaded me in any of my subjects". However, employees explored peers more in a mentoring style, such as working alongside students in work experience or through internships. Employee C talked about the program they have to engage with schools "*We used to have a gateway program where students interested in ICT would come and work with me for a morning a week"* and employee E talked about internships "*Internships are great, just because they can give somebody an idea of what they are getting into".*

6.7.3 **Role models**

One of the sub-themes under social fell into the role model status and how role models affected perceptions of students' attitudes towards ICT or whom they look up to when it comes to a role model. The majority of the students looked towards their parents first and foremost before looking further afield. Employees saw role models as someone that had a great influence on students and who could tell great stories, which could be relatable, was successful and students could engage with and be able to see certain traits within that person as some of their characteristics. Employee B said "*Make it relatable to them in terms of role models, bring in people that the students would see as influential and people that they want to copy*". Employee F said "*Role models and local examples are really important that I wish teachers could tap into more. I think it is about telling better stories and showcasing their diverse role models",* Employee F goes on to say *"If you have a girl seeing that here is a person just like me, who are succeeding in that career it might make them think about their future career path". Employee G suggests that "Bring diverse role models to the students".* It was suggested from Employee D that *"role models become less in your mind set the older you get as you have your career path and you start to think that you are the role model for the newer generations and hopefully can pass on that knowledge".*

Many students looked towards family first for their role models rather than to the wider population, including teachers and TV personalities. Students B "*Mum*", C "*'I don't want to be cringe and say my mum, but yeah, my mum"*, D "*My dad would be I suppose, with all the work that he's done"*, F "*Yeah, my parents have had kind of an influence"*, H "*My dad actually introduced me into ICT things, it would probably be Bill Gates and how far he's come with Microsoft"* and I "*Yes, mainly my grandfather, yeah, just seeing the work he brings home and thinking that stuff was cool and thinking I could do the same* ", all looked to family first for their role models, whereas Student E stated "*Jacinda Ardern is quite a role model"* and student G said "*My teacher, so if it were not for him, I would not be here right now".*

6.7.4 **Stereotypes**

The last sub-theme that came from the social theme was the perception of stereotypes in ICT. Employees are seeing the stereotypical middle aged white guy as the most problematic within the industry, Employee F stated that "*There is if you have that bulge of middle-aged white males, then that is quite off-putting if you turned up and just saw a big floor of, and it is like oh i.ve got to work in that lot"* and that was followed by Employee I stating that "*Because students see it as male middle class, white when they look at the industry that is what they perceive that is what they are seeing"* followed by the geek and nerd image as stated by Employee E "*We are still seeing the stereotypical math geek type of person pursuing their higher education aspiring to go into ICT"* that flows into the middle aged white guy. Students are seeing the geeky, nerd stereotype or the Gameboy as the major stereotype that they see as the main problem that their generation still has to overcome. Employee G had another alternative and suggested "*I think it comes from parents, who give boys ICT tools and girl's dolls. If you're a stereotype – and industry largely is a stereotype – well, then you've got to go and change yourself".*

Student A suggested that these stereotypes are still a problem that come from movies:

> *"I think it's just stereotypes, because in the 90's and stuff the boys had their video games and all the yeah, Gameboys. Girls were always given dolls and Barbie's and stuff like that. It's just like in the movies and stuff like that the IT guy is always this nerdy guy with big glasses. He's this string been type person*

I feel that's quite a big stereotype that people who are nerds do ICT and stuff like that".

Student C thought the stereotypical image had caused many girls to reject ICT "*I just think of people with glasses and long hair that they have not brushed for a week, it is a stereotype that I think when you say ICT"* and Student E looked at the social skills as a stereotypical problem *"Like anti-social, I guess – I do not know, but yeah – I see it as they do not have social skills and they do not talk to people",* as did Student D *"'It's someone quite introverted who doesn't like speaking that much".*

All students were asked by the researcher if this stereotype of geek and nerd is still a big thing for students today. All students agreed that this perception of ICT would have an impact on their attitudes towards ICT. Student F said "*Yeah, it is the male nerdy geeky kind of set up yep*:, Student G said "*Basement dwellers like on TV, they're kind of portrayed as like basement dwellers, a fat, greasy guy who doesn't really like sunlight and hides away from the rest of the world*", Student H said "*'Yeah, it's still you're seen as a nerd or something like that, yeah, there is a stereotype that girls aren't this technological minded because they don't have an interest in games or sitting in front of an Xbox or something like that".* This question could be considered to have a bias, as the researcher was middle class white male working in ICT. However, to try and reduce any bias, the interviews were conducted with a research assistant who was a Māori female.

6.8 **Structural factors**

The next major theme to come from the interviews and the data analysis was the structural factors that influence both employees and students. This framed the overall theme, but many sub-themes emerged such as creativity, education, information access, ICT industry and access to technology. Table 6-8 below shows each of the sub-themes associated with the overall main theme of structural factors.

Table 6-8. Structural factors

Creativity	How creativity is playing a significant part in ICT
Education	How educators are driving or not driving ICT at school and the impact on students
ICT Industry	How the industry is adapting to the new generation or not and what are they doing about the future of the industry

Created for the study

6.8.1 **Creativity**

Both employees and students believe that creativity plays an essential role in the perception towards ICT and being able to bring more creative aspects into education for ICT is a must to enhance the appeal of the industry. Employee G talked about how creativity is the key to ICT:

> "*People change the world and people who are innovative and forward-thinking and work well in teams and solve problems and are prepared to persist – they will invent the future for us, we had all hope to god that they are not only white males because that will be the future that we will get."*

Employee C thought these aspects of a person are essential "*it is not the logical person that changes it; it's the creative person who makes the change"* and Employee I agreed with Employee C *"Yeah to me it comes down the creativity, creativity is the root to the industry".* Employee B suggested that "*It's about opening your mind to what could be and not being afraid to give it a shot, building an app for something that might increase their confidence and be something fun, show them opportunities of what is possible".*

Students also perceived a creative side to the industry, but most of the students related to what they knew of the industry, such as web and programming. Student A thought *"I think they have to be creative because there are so many video games. You have to be original and stuff"* and Student C would have enjoyed ICT more if it was creativity *"I would have found it a lot more fun and interesting".* Whereas Student D thought that more cool tools would help "*Well maybe about using Raspberry Pi, just a tiny computer, I've got one of those at home, but actually being taught how to use those at school would be just amazing".* Student G thought that "*Probably more of a creative industry rather than a logical industry. So, user experience will play a big role in the future of ICT".*

6.8.2 **Education**

The educational theme covers a lot of sub-themes and the perceptions that employees had in regards to how it could be adapted to incorporate the new generation Z students. Employees suggested how to engage students, Employee D thought "*I think yeah, having better courses in schools and being compulsory would help"* and teachers having the skills in ICT subjects was what Employee C thought "*So really, quite frankly a teacher that has a passion for it is one of the best things that I think would encourage students. I do think having female ICT teacher may also help with the gender barrier"*, this was agreed by Employee A "*The schools have to get the right people in for the right jobs and ICT needs to be inclusive in all subjects."* having better resources, Employee E said "*I think that schools are often very time poor and resource-strapped",* making the subject more relatable to the new generation and removing the stigma and labels around ICT, Employee B suggested "*One major thing that could be done, I think it is that relatable issues, getting young female teacher that are cool people out in front of the students instead of some old fuddy-duddies"*.

Students saw education and the perception of ICT from a negative aspect and their interaction of the subject through high school. Student A was put off ICT due to stereotypes at school "*I think it is mostly guys; I do not know any girls that are in any of the ICT classes and it is programming stuff, I don't understand that. When we did computing at year 9 all we did was write computer code and stuff, it really was not what I thought we would be doing. I wanted to do stuff like music"*. Student B also agreed with Student A and said "*'Just your basics open up Word write stuff, making it compulsory I wouldn't enjoy it I don't think it would be my favourite class* ". The majority of students were put off the subject due to perceptions of stereotypical views of being nerdy and geeky, peers not taking the subject, being boring and a lack of interest in the subject. Student C's perception of ICT was the key that stopped them from taking ICT "*'I just found it boring, and I found the teacher boring and found what we did was irrelevant. I do not care about how it works"*. However there were a couple of students that did do ICT and disagreed with the other students, Student D said "*So, I wasn't really fully engaged because the stuff that I was doing we'd already been taught in primary school. Some of the teachers don't have the same knowledge about how it works as the students has"*, Student G said "*I took a filler subject. I was way ahead of everyone else, so the teacher gave me the stuff to do, so that's why I started to learn Python. We were*

not supposed to start that for another two years", and Student H really enjoyed ICT saying "*I did ICT – I started out in ICT and I didn't really like it, mostly, because I went in thinking it was all going to be coding. They said being able to program was the way to go, they didn't really say there's all these [sub areas] to building websites and things. Yeah, I think it would be a really good topic to have in school – I mean I see it more important than English but that's just my opinion".* Student E attitude towards ICT was very negative and said *"I don't believe that computing should be compulsory, as I found it to be very boring and a waste of time".*

6.8.3 **ICT industry**

The ICT industry sub-theme that came out of the interviews, especially from the employees, talked about how the industry needs to engage with education. The industry also suggested they should be able to show safe environments for the diverse cultures and understand that they need to get the right type of people to engage with the current generation. Employee B suggested that "*Just talk about the possibilities and opportunities, I think knowledge, what are the types of things that people can and do actually do relate to the ICT industry*". It also came through from the interviews that there are many avenues to exciting careers in ICT and not just programming and the use of internships and apprenticeships to promote the industry to generation Z students. Employee E thinks that it is all about engagement from industry into schools:

> "*High school level I would love to see more industry whether it is future in tech. There is an ITP industry initiative trying to get people to come and talk in the classrooms; I think that is a really good idea. The industry needs to sort out its toxic environment and culture and value hiring new people, having more diverse people talking about what they do, yeah, I do think it is a very strong role for the industry."*

Employee G thinks it about increasing diversity in the industry "*If we are serious about change and increasing diversity in ICT which we absolutely must be because ICT is designed for all of us"* and Employee H thinks that the industry is willing to help schools "*Within industry in my experience, everybody is willing to help you, but you need to show that you're willing to learn.*"

6.9 **Likelihood of studying ICT**

The final theme that came out of the interviews for both employees and students was the likelihood of choosing ICT as a career choice. The employees saw this as an opportunity to convince students early on in their educational life as stated by employee B "*I think to get them early because, by the time that a student is towards the end of their high school, a lot of them already have an idea about what they want to do"* and to consider ICT as a course of study. Employees also thought that making apprenticeships and internships more readily available to students would be a key to enticing more students into the industry, as stated by employee C:

> "*Internships are great, just because they can give somebody an idea of what they are getting into. I say maybe not just internships for ICT students, but I do not know if they still do it, but when I was at school, we had work experience or apprenticeships."*

Students had not made their mind up about careers as such, but most had strong perceptions regarding their career path based on their experience and attitudes of ICT through school and background. The majority of the students after thinking about ICT and a career in the industry still had negative perceptions regarding ICT and student B stated "*Probably not for me, it is not something that I am very interested in or wants to do"* and student C said *"I do not think that from this I am going to go into ICT, but, I think it is made me think about the stereotypes and the whole – I never thought about the gender then before".* Some of the students had already chosen to follow ICT, and student H summed it up the best "*I think yeah, it has reminded me of why I want to be on the ICT path."*

6.10 **Chapter Summary**

This chapter has presented the findings from the interviews held with employees and students across the Wellington region from April to May 2018. Each group contained nine interviewees that were asked a set of semi-structured questions based on the findings from phase one results. The semi-structured interview schedule contained six main questions with some of those questions having sub-questions based on the answers given within the interviews. Figure 6.2 represents the major themes found in the data and have been presented in this chapter.

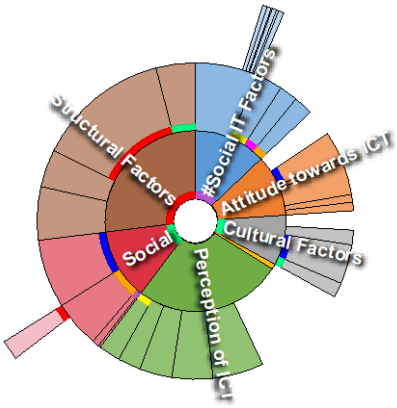


Figure 6-2. Major themes from the interviews with employees and students. Created for this study

Based on the main themes found from the data it is evident that students and employees are seeing the shift in nature of the industry towards more of a creative and innovative way of thinking rather than the stereotypical technical influence. These perceptions were mirrored across both phase one and two of the study, showing that some of the information in the industry is filtering down to the school level. Students and employees do see a change in the job market when it comes to ICT around automation and the types of jobs that will be available to students when they leave education. One of the significant findings from the interviews was this change in mentality of the industry to the essential skills and the more artistic skills such as creativity and innovation.

When it came to terminology, students had a hard time understanding terminology. Students' misconceptions of the terminology was shared with the employees. Both had a hard time trying to explain the differences between certain acronyms. Students reverted to stereotype, suggesting that ICT was about programming and technical things. The student understanding did not help their perception of the subject and of the industry. When it came to attitudes to ICT, students' perceptions were negative towards the

subject due to perceived perceptions around fun, confidence, and problem solving and not appealing to their generation. To try and make the subject more relatable the employees suggested that ICT at high school needed to appeal to generation Z students by allowing generation Z student's interests and activities to be incorporated into ICT subjects. These results came through from both phases, suggesting that ICT does need to be revisited for generation Z students.

Another strong indication that came from the interviews from both students and employees were that there is a lack of diversity within the industry. Students could not see like-minded people that they could look up to within ICT causing them to disconnect with the subject early on. Gender was also a stumbling block, especially for the girls as there was no exposure of female role models in the industry at school. This perception caused a disconnect for students when it came to career pathways and following ICT. Many girls from the interviews suggested that there role models did not come from school but from film, music or parents. Again the results from phase one also highlights role models, however from the interviews it has been shown that as you get older, role model becomes less important. The reasoning behind this was suggested by employee D, who talked about becoming a role model themselves and being able to pass down knowledge and insight into their career path and jobs in the ICT world.

The perception of ICT through school and industry showed that the majority of stereotypes that have been around for decades are still prevalent today in students' perceptions of ICT and the industry. This is also true for employees, but the main stereotype that employees discussed was the middle-aged white male working in the industry was the main problem that was putting off females and other ethnic groups. This stereotype of gender aligns with perceptions of generational issues, as many of the industry interviews talked about the older generation holding all the power and surrounding themselves with same type of people, mostly white middle to older men. This causes the perception that the baby boomers are promoting the wrong perception of the industry to students. When students look at ICT they see a very biased picture of white older men. Unfortunately this attitude has not changed within the industry and baby boomers do not believe that attitudes towards ICT need to change, however the student interviews suggested that they are being put off by these attitudes of the older generations towards ICT.

.Chapter 7 discusses the finding from phase one, the survey and from phase two, the interviews. The results have been synthesized and utilises the adapted framework set out in chapter 3 to frame those findings.

7 DISCUSSION

The need to undertake the current research arose because of the lack of high school students, especially girls, wanting to pursue a career in ICT. Moreover, a significant study into ICT gender disparity in New Zealand has not been carried out in over a decade (Hamilton-Pearce, 2009), and the changing landscape of ICT has produced a new generation of highly connected students who have a different way of thinking than the previous generations. Thus there was a significant gap in the research literature. The findings of the study will provide recommendations to address the main issues raised through the research. The following research question and sub-questions directed the thesis:

Primary research question - *What are the factors that discourage and encourage the participation of year 11 girls' ICT study and career path?*

Sub-questions -

e) Has the disruptive era changed girls' perceptions and attitudes about ICT?
f) How do girls' perceptions differ compared to those of boys when it comes to ICT?
g) What impact does technology have on attitudes and perceptions of girls towards ICT?
h) What are the generational effects that influence the participation of girls in ICT?

7.1 Introduction

This chapter has six sections based on the new framework proposed in Chapter 3. Each section will have data from both the survey and the interviews of both students and employees presented for discussion. Each section will include a discussion of student and employee data from both quantitative and qualitative phases. The last part of the chapter will summarise those findings from the surveys and interviews. Each of the questions asked in this study focused on understanding the factors that discourage and encouraged girls from pursuing ICT subjects. To address these matters, an adapted

version of the Bernhardt (2014) STEMCell framework was used to identify those critical areas of interest to the thesis. From each of these areas in the framework, questions were formulated. The results of the survey were then analysed, giving an insight into the types of questions that needed further investigation through the use of the interview. This chapter brings the results together and discuss those findings by comparing them with the literature.

7.2 Family and culture

As children grow up, they base their perceptions and attitudes on the influences that they have through contact with their parents and from their surroundings (Adya & Kaiser, 2005; Dimitriadi, 2013; Lorber, 1994). These early life experiences form the foundation that these children will use to make decisions on their future. New Zealand is a young country with what is becoming a diverse population, including people from all parts of the globe and along with that comes all the different backgrounds; these include Asian, European, Māori, Middle Eastern and Pacifica. However, this is not an exhaustive list of all the different ethnicities residing in New Zealand. All of these cultures bring with them different values and beliefs (Hartnett, 2017).

The knowledge that is passed down from one generation to the next within a family enviroment can have an influence on a childs. Depending on the gender of that child can have an impact on their perceptions and attitudes towards certain information learnt through interactions with family or Whānau (Coser, 1978). The results suggest these cultural identities are much stronger with Māori and Pacific who put much more emphasis on culture than of westernised families. If Māori and Pacific girls identify more with their history and background they are more likely to be encouraged by the interaction with their parents through feminine traits, as mothers are normally the family member that looks after the children. This can have a posistive influence on the child when it comes to role models. However it also can have a negative effect and discourage especially girls to follow career paths that do not align with their role model (Hamilton-Pearce, 2009). For the majority of westernised girls culture does not seem to to have a major role in their decision making when it comes to careers and career pathways.

New Zealand European girls seem to choose role models outside the family unit. This finding disagrees with earlier litrature from Clayton (2006) which does suggest that New Zealand European girls as they get older do look outside the family for role models that they can associate with more than family members. The findings from the interviews regarding role models agreed with literature from Saleem, Hanan, Saleem, and Shamshad (2014) and suggested that popular culture and personal choice had more of an impact than parents for western cultures. It is an interesting finding that New Zealand European girls mostly reject their family and culture in favour of TV and film celebrities to look towards for their role models, as this goes against the literature (Clayton, 2006; Pau, 2009; Schwartz, 1999). This finding could be down to how accessible TV and film has become for generation Z, as the amount of application, such as Netflix, Amazon Prime, Disney + and many other that show content on multiple devices and are easy to access.

Saleem et al. (2014)also suggested that more of traditional cultures where parents usually have more influence regarding their children's career have more of an impact than that of popular culture. The implications of the findings suggested that New Zealand European girls are looking outside the parental home more for their role models and towards popular cultures, such as mass media and social media to fulfil that gap left by parents. However, from the findings the role model only has a short life span when it comes to encouraging pathways. Female employees suggested that once they were in work their really did not look towards other female role models. These finding add to the litrature from Dimitriadi (2013) and suggest that more emphasis is needed at high school to encourage role models that align with ICT and girls perceptions. Employees thought that students would relate more to someone whom the students could engage with, could see certain traits that they had, could tell good stories, were younger and could relate to their generations. These findings agree with previous research (McIntyre, Paulson, Taylor, Morin, & Lord, 2011) which found that women were more inclined to see people as a role model when they could perceive those role models as having similar traits and personalities.

The findings suggested from the study that girls have a better idea of their career path earlier in their lives. This evidence was backed up through the interview where the majority of the girls interviewed had already chosen their career direction, and from the

literature, it can be shown that girls' brain development is about two to three years more advanced at year 11 than boys' (Griffin, 2018). This suggests that at year 11 the majority of girls have already decided on a future career and maybe year 11 is too late to try and change their minds.

When it come to the effect that generations have on culture and family or whānau, it can be shown from the results of the study that Māori and Pacific girls are influenced by whanua and the community group and will be encouraged to follow Whānau role models. This can have a significant impact on their future career path. However, New Zealand European girls do not seem to utilise family members as role models or their culture and background does not play any major role in their decision making. Generational effect for family and culture has little to no impact on girls, but has a major impact on Māori and Pacific girls.

Culture does play a part in ICT and the perception of students. Students want to see people like themselves working in the industry. If students start to look around the ICT industries, they will probably see white middle-class males in their 40's and 50's. The perception that students have is that there are no people like myself in the industry, and they would be put off by the stereotypical view.

7.3 **Education**

Students' perception of ICT becomes distorted at high school and their attitudes towards the ICT industry changes, normally for the worst. When these types of perceptions are learnt from an early age at school it becomes very hard to change students minds. Allowing students to be able to study ICT at school should not be a discussion that people are having in today's society. ICT should be seen as a core subject or, if not, should be intertwined into every subject. However, the finding in this study suggested that girls did not want ICT to be compulsory in high school. It indicates that girls are averse to having to do ICT as a compulsory subject at school. Many factors could be the cause, such as the perceptions of the subject, the stereotyping and the lack of understanding regarding the subject. These findings agree with the literature (Bernhardt, 2014; Broadley, 2015; Clayton et al., 2012; Dimitriadi, 2013; Gorden, 2011; Lang, 2012;

Pau, 2009; Sáinz & López-Sáez, 2010) that those types of perceptions and attitudes are factors that discourage girls from studying ICT as a subject at school. A factor that does encourage girls to take ICT at school was making the subject relevant to the generation. From the interviews, girls thought that if ICT included areas that they enjoyed, such as music it would give a better perception and encourage them to engage more with the subject.

These perceptions of ICT weave themselves into the fabric of the subject and the industry, promoting ICT as a single variable, such as programming, being dull, boring or no fun and students cannot get past these perceptions. From the finding, it suggests that girls think the work they did in class reflected the type of work they would do in an ICT career. These findings agree with Dimitriadi (2013), who suggested that the lack of understanding about ICT and what was available could be an essential factor influencing girls away from ICT. It was also suggested that work carried out in the classroom did not reflect industry today and was based on an out-of-date information about ICT that does not allow the students to approach the problem of interest in a more agile fashion.

Gong, Lu, and Song (2018) suggested that having female tutors in traditionally male teaching roles such as STEM (Science, Technology, Engineering and Maths) subjects improves their mental status and social acclimation relative to those of boys. It also alters the girls' beliefs about commonly held gender stereotypes and increases their ability to learn. The findings demonstrated that girls more than boys wanted more female tutors in more of the technical subjects. Having younger female tutors in those stereotypically male-dominated roles could alter those perceived perceptions of the subject and the industry. However, this will then cause another problem of recruiting younger qualified ICT teachers. This finding of the study contradicts findings from Holmlund and Sund (2008) who could not definitively state if female tutors have a positive causal impact on student outcomes. The finding suggest that there could be advantages for girls with a younger female tutor that may help with the negative stereotypes for subjects such as ICT. The study also found that girls wanted people like them, who have the same passion and look like them to be teaching ICT. The generational issues arose for girls when they had teachers who could not engage with them as the girls could not see passed their perceptions of particular teachers that fitted those stereotypes.

Education has a role to play in changing the balance of the gender divide in subjects like ICT. It is subjects such as ICT that cause a multitude of stereotypes to be kept alive by the way they are taught in high schools across New Zealand. The initial perceptions revealed through the interviews from employees were that teachers should be better equipped to deal with generation Z students' needs. Teachers need to be skilled, better resourced and have the knowledge of future employment opportunities in the ICT industry. The employees went on to suggest how the curriculum needs to be flexible and relatable to the new generation, and the stereotypes and stigmas removed. To motivate students in particular subjects, teachers to need to get the students excited about the discipline. Teachers need to be passionate about what they teach and also be able to relate that through storytelling and links to the real world.

Most students found the class to be boring, repetitive, full of boys and not interesting. It does suggest that the work carried out in the classroom was irrelevant to those students, and the teacher did not engage with the students to create a fun atmosphere. Students also suggested that the ICT curriculum taught was out-dated and had been learnt by most students by year seven or eight. These perceptions have dogged ICT subjects for decades and still seem to be prevalent for generation Z students. These findings strongly agree with the literature, which goes back over a decade regarding these same issues (Bernhardt, 2014; Broadley, 2015; Clayton, 2006; Pau, 2009; Timms, Courtney, & Anderson, 2006). The findings suggested that ICT is too rigid to teach generation Z students, especially ethnic cultures, in this disruptive era. This can be shown from a report from the Ministry of Education, New Zealand that Māori students have the lowest retention at high schools across New Zealand with only 71.9% of Māori students going on to complete year 13, compared to non-Māori students whose retention sits at 84.9% (New Zealand Ministry of Education, 2018). The drop-out rate of ethnic groups, such as Māori at high school reduces the talent pool available to prospective employers. The industry can only employ people with the correct qualifications, which then promotes the stereotypical perception of the lack of diversity in the ICT industry.

As a society, ICT use has come a long way in a short period. For generation Z students to opt for a career in ICT, there is an intense urgency to change the way subjects such as ICT are taught. Presenting subjects that they can relate to and are creative will hopefully entice students into ICT related careers. Schools are always slow when it comes to

change, especially in ICT due to the red tape and having to conform to policies set out by the government (Advani, 2019). However, schools cannot change that quickly, which does not lend itself to business requirements causing a shortfall of young talented people in education (Jones et al., 2016). Students' attitudes may change towards ICT at school if the subject were flexible.

It can be suggested from the findings that high school was too late to capture the new generation and to concentrate on intermediate or even primary school was the place to start teaching the student about ICT (Vekiri, 2012). If there are to be more jobs in the ICT industry, schools must also fill teaching positions with the right people to teach ICT to the students. However, this is a problem that needs further investigation (Jones et al., 2016). New Zealand is finding it very difficult to recruit talented teachers in ICT positions due to the high salaries that the ICT industry pays for qualified people.

Both employees and students gave an insight into what they thought might make ICT appealing. The key was to make the subject more relatable to the new generation by utilising technology in ways that reflect how generation Z students use it. One of the students interviewed was doing just this. They were involved in an after-school IT club. They came up with a problem to solve, which was how to get rid of litter. The students collaborated with the robotics club to build and design a robot to pick up rubbish. The students found it great fun and found a passion for the subject.

7.4 **Industry**

Employees thought that there needed to be more engagement between industry and education to facilitate more students wanting to go into ICT. For the ICT industry to embrace generation Z girls through schools, both industry and schools must collaborate to find a workable solution. Companies need to work closely with the education sector by promoting ICT in a new creative way to generation Z girls. There needs to be a re-evaluation of what generation Z girls' interests are, and efforts to hold the imagination and exploit those relatable traits. Unfortunately the perceptions of the industry being no fun and full of white older men are very prevalent in the minds of generation Z girls,

however, the reality is changing and industry needs to get across to the schools that ICT is fun and exciting environment to work and does not lock you into one type of job.

Girls' perceptions of types of ICT jobs are far from clear. From the findings of the study, girls still thought that most ICT jobs would be technical and were not of interest. However, this perception changes with employees in the industry disagreeing that you have to be technical to succeed, as there are many different career paths in ICT. This finding agrees with previous research from Mansour (2018) who discussed girls not receiving prior hands-on technical knowledge, which often led the girls to think they must accomplish more than the boys to get their perceived level of understanding to that of the boys. This perception of having to be technical often puts girls on the back foot within the classroom environment, causing them to doubt their ability which in turn impacts their self-confidence and demotivates them

Employees saw a generational problem with the baby boomers as one of the main issues of the perceptions that people have of the industry. Generation Z girls need to see relatable people in front of them and not "*old fuddy-duddies*" who have their stereotypical views of society. Employees also thought that the newer generation would have to wait until the baby boomers retired before the industry could move forward. The industry is changing, but for generation Z girls not as quickly as needed. One reason that it will take time to change is that students believe that the ICT industry is the problem, and they need to change the way they look at hiring new people into the industry. Year 11 girls see this as an issue for them when it comes to looking at ICT as a career, as it would be enough to put them off following a career in ICT because of those stereotypes. From the results, European girls jumped from 40% at 16 years of age to over 80% at 17 years of age in answering stereotyping and would put them off working in ICT. These findings mirror research that have shown stereotyping to be a downfall for the industry (McLachlan, Craig, & Coldwell, 2010; Zimic, 2009).

Employees gave answers that provided suggestions about career and future pathways. From the interviews, it can be suggested that the industry needed to promote career pathways to students. The interviewees also discussed raising the profile of the industry and defining clear, simple pathways that students could understand instead of the stereotypical ICT perceptions that most people have. It was not only the industry that needed to change the way it promotes itself but also the schools and teachers who need

to be able to offer up-to-date information about the industry. It is about educating students that ICT is wide and varied and can be in any industry.

Opinions from the employees contrasted with the literature, suggesting there are not enough females coming into the industry. They believed it was a retention problem and companies were not rewarding, supporting and retaining females as much as males, which is similar to other STEM disciplines. The perception comes from a lack of senior qualified females at the top; those jobs come from smaller pools of talent, usually white middle-class males. Most of the employees felt that companies should embrace diversity and gender neutrality, but the companies themselves see it as more of a societal problem to overcome rather than their problem (Soper, 2019).

For people in the ICT industry, there are many avenues to follow when it comes to career development. However, students found it difficult to express what a job in the ICT sector was. One interviewee suggested that a roadmap such as the Microsoft road map for certification be implemented to help students understand there are many choices to follow (Microsoft, 2019). This initiative would be a good starting point for the industry to engage students, especially those students at high school. See Appendix G for the Microsoft ICT roadmap as an exmaple of what could be created for high schools.

Students have to understand that today all work is touched in some shape or form by technology and to think outside the box about non-traditional jobs rather than the stereotypical view of ICT. Students also have to be given the right information regarding their passions, their study and employment, and how to link the dots between them. Schools also need to inform and educate students by giving them enough information to become curious about a particular field or subject.

From the results of the study, creativity was a major skill that most employees thought would be crucial for generation Z students. Education must include creativity and imagination for the longevity of the ICT industry. The flair of someone creative and imaginative is what will change the industry. Being able to problem solve to find solutions becomes the skill of a good employee. Creativity is about opening the mind to what could be and exploring new opportunities. These traits are required to be successful in any industry, and it allows students to explore their potential. Allowing students to express their creativity and imagination at every level at school would increase the

potential of every student to have the skills necessary to pursue a career in ICT. These findings agreed with Forster (2012), who wrote that “creativity is something that hits the right note, rings true and is of recognisable quality” (p. 282), who then argued that the words ‘creativity’ and ‘communication’ are essential words in 21st-century education.

Students also saw creativity as a significant factor and agreed that more creativity needs to be present in the ICT subjects at school and its presence could have had a more favourable outcome to them choosing ICT as a career. Engaging students with technology that interests students such as music and social media would become easier. Gone are the days when people in the industry have to be just technical. In this new disruptive era, companies are looking for people that have soft skills (personal attributes that enable someone to interact effectively and harmoniously with other people ("Soft skills," 2019) and can be creative, imaginative and can solve problems. These qualities are not just good qualities to have in the ICT industry but for all industries. The findings from the study suggested that girls thought these were good qualities to have. That creativity and imagination play an essential role in the learning environment These findings agree with the research from Stolaki and Economides (2018, p. 197) who discussed involving students in more of an active role and making them feel “partner of the teachers” rather than just students. They also thought that game-based learning provides the atmosphere in which students would be “free to participate, form groups, collaborate, play with ideas and compete without the fear of penalties” (p. 197). Allowing the student to play re-enforces creativity and produces positive results.

Qualities such as creativity, imagination and problem solving are vital attributes that both female and male employees see as necessary skills that all students should have when it comes to a job in ICT but also any job. These soft skills are skills that students should be learning throughout their education. However, many subjects, including ICT, do not include these.

From the results, it appears that generation Z girls do not have the soft skills to problem solve or think outside the box when it comes to technology. Education needs to embrace soft skills and allow students to be creative, imaginative and enjoy what they are learning. Technology can be more than a tool if students learn these skills early and have new attitudes to what is possible with new and exciting technology.

7.5 Perception and attitudes

Girls more than boys at year 11 agree that the older generations are keeping the stereotypical images of what they perceive for people working in the ICT industry. These findings agree with the work of Master et al. (2016), where belonging plays a role in those stereotypes that many of the year 11 students discussed in the interviews. They discussed the stigma of the ICT 'nerd' and how some of the older generations do not understand how this affects generation Z students. Bernhardt (2014) stated, "if students had no preconception from the ICT industry then the results around students wanting to go into this field would be very different without all the stereotypical images that portray the industry" (p. 8).

Everyone has stereotypical views of what a person looks like who works in the ICT industry. The words 'geek', 'nerd' and 'loner' come to mind first and foremost, then the mental image of that person who is male, white and 40 or 50 something. These are stereotypical images and views given in the literature (Adya & Kaiser, 2005; Akbulut & Looney, 2007; Clayton, 2006; Morton, 2013). These stereotypical views were also mirrored by the students that participated in the interviews, regarding the type of person that works in the industry. Employees as a whole saw the industry as being open to everyone. Employees expressed there is a role for every type of person who wants to make an impact or solve problems or be creative, and if presented with a stereotypical person as the face of the industry it would put many people off, especially girls.

It has become a societal problem where gender stereotyping has been ingrained into generation Z students from day one of their lives. As children grow up, stereotyping starts to influence their decision when it comes to career pathways. These stereotypical views agree with the literature from Master et al. (2016), and these perceptions of ICT have a significant impact on generation Z students' attitudes towards ICT. The dominant stereotype that the employees thought might put off the majority of people was the white, middle-class male that dominates the minds of not just generation Z but also Millennials/Gen Y people. From the findings, there was a strong connection from the girls that different generations had cause some of the perceptions that they believed about the industry. Boitnott (2016) agreed that the loss of the baby boomers from the

workforce would be a shock for many companies, and the loss of that wealth of experience and knowledge would be hard to replace.

These perceptions that have been around for years regarding the type of work people do in ICT have reduced the number of students wanting to work in the industry. Perceptions and attitudes, such as repetitive work, lack of fun, locking people into a career and working alone link to perceptions that put students off ICT. The findings suggested that girls' perceptions of repetitive work were strong with ICT and thinking that all employees did was programming in isolation. This finding backs up evidence from the literature (Bernhardt, 2014; Clayton et al., 2012; Dimitriadi, 2013; Gorden, 2011) where they discussed the lack of understanding about current jobs in the industry and that students thought that jobs in the industry were all based on programming. However, the students' perceptions have changed regarding working alone, which disagrees with Clayton et al. (2012). When it came to the fun factor of ICT and the job, students, especially girls, did not see ICT as being fun at all, but the boys found ICT to be fun and enjoyable. These findings agree with the literature, where Stern et al. (2018) noted that if the students looked to their teachers as a role model, their attitudes towards ICT would have a higher rate of success. The girls, on the other hand, did not see the teacher as a role model and lacked understanding about the subject which gave the perception that the subject was not fun for them, causing them to lose interest from an early age.

The perception of having to be technical to work in the ICT industry is a perception that still holds for generation Z students. Students cannot see past the digital device, a tool to help them achieve the desired outcome. This perception has altered the way generation Z students look at the industry. Their attitudes towards ICT are tainted by these perceptions, and ultimately impact careers in the industry.

One notable finding from the study was related to the diversity of the workforce in the ICT industry. Māori and Pacifica girls suggested that there was no place for them in the industry as they did not fit those stereotypical images. When Māori and Pacifica girls viewed the workforce, they could not see people from the same culture or even the same colour. Lack of diversity has become a significant influencing factor on them wanting to pursue a career in this field. Dele-Ajayi et al. (2018) agreed that this is one of the causes putting off females from entering into jobs in ICT and argued that in order to change these stereotypical preconceptions, companies need to expand people's image of

the industry and what it means to have a career in this industry. These stereotypical attitudes of the industry are very damaging, as the majority of the girls looking through this window will base their attitudes on what they see and not by what it can offer, causing them to shy away from satisfying and well-paid careers. The ICT field has been stereotyped due to the type of people that currently and in the past work in the industry, the middle-class white male who has dominated the industry. As recently as 2015, Fisher et al. (2015) wrote about the lack of interest in ICT from girls at high school because they cannot see like-minded people, people of colour or people that fit with their background working in the industry.

Employees would like to see diversity and gender neutrality in the industry and trying to bring new policies into companies that embrace the disruptive era. However, employees see this as a hard ask when they believe it is more of a societal problem first and an ICT problem second. It comes down to companies looking at their hiring policies and creating safe, comfortable work environments regardless of gender. Companies need to change their attitude towards diversity in the workplace and start to make it a normal occurrence to see a variety of colour and ethnicities in the ICT industry. They also might need to consider positive discrimination of hiring policies to make a real difference.

Generation Z students have grown up with either a smartphone or tablet in their hands, and it has become an integral part of their lives as was going to the library to find information for the baby boomers. Generation Z sees technology as an extension of their understanding and learning; they do not need to go the library to search for information, they can google it and have the answer within seconds; they do not have to know how to spell words as autocorrect does that for them. Students discussed not having to scribble things down and misspelling words. Technology is just a fingertip away for generation Z students; they have come to accept it, rely upon it and see it as a tool to get a result. It is integral to everything generation Z students do in their lives.

However, students, especially girls, lack confidence when it comes to ICT and have attitudes of letting the boys take over and watching from the back of the classroom (Abbiss, 2005; Barron, Maxwell, Broadbridge, & Ogden, 2007; Clayton, 2007; Clayton et al., 2012; Clayton et al., 2009; Coldwell-Neilson, Craig, Gorbacheva, & Beekhuyzen, 2014; Dimitriadi, 2013; Pau, Hall, & Grace, 2011). Engaging students, especially girls

by allowing them to pursue what interests them by creating solutions to problems that girls have would allow the girls to be involved in the classroom experience, changing their attitude of the subject and giving them confidence in the subject. These outcomes tart to strengthen the evidence from the literature that girls struggle with self-confidence when it comes to ICT subjects at school based on their perceptions and attitudes towards ICT (Dele-Ajayi et al., 2018; Mansour, 2018). From the results of the study it can been shown that girls attitudes showed a lack of confidence, lack of opportunity and negative stereotyping. These attitudes align with a recent study by Hatlevik et al. (2018), who suggested that self-efficacy in females was one of the issues to overcome regarding ICT. Also, Kolyvas (2015) discussed these stereotypes being still alive today for many females in the ICT industry, which reinforce the attitudes of the latest generation. from the results it showed that girls did not want to go into a career where they are outnumbered and felt in the minority. All these attitudes and perceptions negatively impact on students, especially girls regarding the industry.

The older generation does struggle with how quickly technology moves and have difficulties in understanding what the younger generation do with this latest technology (Wiedmer, 2015). The findings from the study suggested that girls feel the older generations' attitude towards technology can be seen as an issue when it comes to ICT.

These findings from the study agreed with research from Shatto and Erwin (2017) who suggested that baby boomers often struggle with changing landscapes of technology and the use of such technology compounds their conflict with active learning style. It does appear that negativity towards ICT from the older generations could be a contributing factor on generation Z students and have an influence on their attitude towards ICT.

7.6 **Social**

Many social factors can influence students' perceptions and their career choices during their childhood and into adolescence (Clayton et al., 2009), and these expectations contribute to girls' decisions to follow specific pathways. Many of these social factors have been examined to try to understand what puts girls off ICT (Berg et al., 2018; Hatlevik et al., 2018; Master et al., 2016).

In our modern society, through access to media, be it from the TV, film or online, people every day see these stereotypical images of what people should do, should wear, should shop and buy for each gender. However, these influences are being propagated through online media much more today than from traditional terrestrial media and, with generation Z being the most connected generation, these influences are having much more of an impact on them and their career choices based on these stereotypical images (Saleem et al., 2014).

From the study it can be suggested that women in TV or on film show stereotypical images. The findings agreed with the literature that perceptions and influences from TV and film ingrain these stereotypical views of the ICT industry (Saleem et al., 2014). Clayton et al. (2009) discussed different TV shows showing stereotypical images of the geek or the nerd playing the role of the IT person. Gorden (2011) suggested the negativity of these visual images impacts upon teenagers, giving them an unrealistic perception of the industry. All the visual imagery that students see through online media is having an impact on the number of students contemplating going into the ICT sector or even going on to further education to study ICT. Unfortunately, these stereotypes of people in the industry are prolonging these perceptions and causing the industry to miss out on talented students. The influence of TV, film and media for employees suggested that females agreed that those stereotypical views seen on the screen have an impact on their perceptions towards ICT (section 5.4.1). These perceptions, based on viewing TV shows and films that are associated with ICT, will hurt the industry and prolong those stereotypical imageries of the type of people that work in ICT. The imagery that girls see through mass media and traditional media has added to their perceptions about the industry and those stereotypes, which discourages them to even contemplate ICT as a career choice. Everything is stacked against the girls to encourage them towards ICT. Media has an impact on generation Z students and influences them every day, from TV adverts, film trailers to social media, which is on their smart devices 24/7. The literature has shown that generation Z students are the most connected generation, and these influences through media are reaching more people than ever before (Pangrazio & Selwyn, 2018). However, the results of the study suggested that this might not be the case as only two of the interviewees felt as if they had been influenced through media such as TV. Also, students did not think that TV and film depicted ICT in the right light and seemed to disagree with what they watched as being a regular ICT job. However

their perceptions ultimately have been changed through those pictures in a negative way, thus discouraging girls to pursue ICT.

Bernhardt (2014) suggested that peers can have a powerful influence on a teenager's beliefs and behaviours. Also, Gardner et al. (2014) thought that peers influenced attitudes towards ICT. When it comes to the New Zealand European students, the findings from this study disagreed with both authors, suggesting girls were not persuaded by peers to take a subject; however, when it comes to Māori and Pacifica students, the findings agreed with Bernhardt (2014) and Gardner et al. (2014). More than 80% of Māori and Pacifica students suggested that they were persuaded by peers to take specific subjects. It was also found from the results that Māori and Pacifica girls were more likely to be put off ICT because of the stereotyping and the imagery of the industry. Māori and Pacifica girls really struggle to identify with people in the ICT industry as their perceptions of the sector never show people like them. This discourages Māori and Pacifica girls more than some of the other stereotypes, such as the type of work. This gender perception is a big problem that does discourage girls wanting to go into ICT and needs to be a focus of creating a different culture that girls from all walks of like can feel comfatable in a working enviroment.

Facebook, Instagram, Snapchat, Messenger or Twitter are all social media applications that are used on a day-to-day basis by millions of generation Z students around the world. However, do students see these applications for more than just apps on their smart device? From the findings, girls' use of social media was around connectivity and connections to friends and family and about collaborating with school friends on homework. Girls see these applications as just a tool to allow them to communicate. This evidence has not unearthed any new insights into social media applications and has not changed over the past decade, which supports previous research (Pangrazio & Selwyn, 2018). Generation Z students disagreed with employees and said that social media did not change their perceptions regarding the industry. The findings suggested that the majority of the employees in the ICT industry thought that social media has, to some degree, been influential for students and their future. They also thought that social media was viewed by students as just a tool and students did not think about a particular social media tool than something to use to complete a certain task. The employees also agreed that students might not really associate social media with ICT jobs and careers.

For girls there are too many perceptions that they are shown that discourage them from wanting to go into the ICT industry at any level. These perceptions that cause the most harm for the industry include the stereotypical imagine of the sector, the gender imbalance all the way up the corporate ladder, the lack of diversity within the sector and the perception of the type of jobs available. No girls from the study could show any positive encouragement from what they see as the ICT industry today.

7.7 Future of ICT

Students need to understand that the pace of technology changes rapidly and affects the types of jobs that are available to them when they leave school or higher education. These jobs will seem very different from the traditional types of jobs that have been around for many decades. The findings of the study, suggested that girls' minds are more open to the prospect of new and exciting ICT jobs being available. At year 11 girls do seem to be more open to the idea of these new types of jobs. These findings are supported by literature from Griffin (2018), who suggested that girls brains develop around two to three years faster than boys, which allows them to comprehend more complex ideas better than boys.

The findings from the study also suggested that females agreed that there would be opportunities for school leavers in the coming years regarding the number of available jobs. Employees also agreed that they are finding it hard to fill ICT jobs from the pool of candidates that they are presented with. Companies in New Zealand are finding it challenging to recruit domestic employees and are having to go global to fill ICT related positions (New Zealand Immigration, 2019). However, the literature does appear to show a lack of ICT graduates to fill ICT positions across the globe. From an Australian and New Zealand perspective, companies will need approximately 81,000 extra people to cover the shortfall of ICT jobs by the year 2022 (Barker, 2019). Students do not understand the importance of how technology will change the landscape of everyday jobs, such as repetitive jobs that will be replaced through automation.

The employees could see a divide happening with the lower level ICT jobs and the middle to higher level jobs when it came to technology and the future of jobs. Employees

agreed that certain low level or low paid jobs would be automated and new exciting avenues will exist through the use of artificial intelligence (AI) and machine learning (ML) and it is more important that students poses the essential skills to becoming a good employee. The students could also see this happening and discussed automation being everywhere, along with technology and the number of jobs it would generate. One central fact that came across strongly from the employees was that education needs to re-think the approach to teaching ICT at school and that the linear approach of the curriculum, does not fit with generation Z students and how they learn. Rata (2012) suggested that the European model that has been adopted by New Zealand is a problem for the learning preferences of indigenous cultures. It has become one of the factors why indigenous students struggle when it comes to ICT and general education. This discourages Māori and Pacifica girls from education and from learning ICT. It becomes another barrier for many students, especially generation Z students from taking up ICT at high school. Schools need to start to re-think their approach to teaching ICT and the linear way it is presented. Generation Z students are not being allowed to express their creativity and imagination to a topic or subject that they could really enjoy if only it could accommodate their passions.

As technology becomes more efficient and effective at carrying out more complex tasks, the systems become more intuitive to use. Having technology becoming more intuitive makes it easy to use; however, it starts to build a divide for the industry. People start to look at technology as a tool to complete a task, and unfortunately, generation Z has been brought up in this environment, not understanding what is behind the scene or not even caring how the tool does what it does. As automation takes hold of the future of ICT, the landscape changes towards more jobs that require soft skills rather than being technical as technology will handle the mundane tasks. Taking away the chance of understanding what is behind the scene of how ICT things work starts to produce a generation that does not understand the complexity of the ICT world. The future for students will be different from today, however, students must be able to have the right knowledge and understanding to be able to fit into the future of ICT. Students already see the results of these changes, such as Amazon's smart home devices in automation and the automated Amazon shop, and these areas are only going to get a lot more diverse in the next few years.

The ICT industry is at a tipping point; there are more jobs available than people to fill them ("Global skills index report," 2018). The job problem will start to increase as generation Z students are being put off ICT at school, leading to more unfilled jobs. New Zealand companies have a responsibility to look at ways they can increase the entry-level ICT jobs to secure more graduates. Employees agreed and discussed how they could change the way an ICT career looks by making it more available and appealing to all students and that the curriculum needs to be able to adapt to the changing landscape of ICT, by being more agile in its approach to technology and its use*s*. The future of the ICT industry needs to starting looking at diversifying, embrace change and promote other cultures to the possible career choices available to girls.

7.8 **Chapter Summary**

This chapter has presented the discussion based on the findings of the study that have been drawn from the previous chapters. Each of the sections discussed the findings based on the factors that discourage or encourage girls' participation in ICT education.

It is evident from the results that Māori and Pacifica girls identify strongly with their whānau's history and culture a lot more than that of New Zealand European girls and Māori and Pacifica girls look to whānau more for their role models. However, this can also have a negative aspect as it is more than likely that whānau will be in other sectors or careers than ICT and girls will follow career paths that align with their role models. New Zealand European girls seem to follow role models that are outside of the family unit and from popular culture, rejecting their family and culture in favour of TV, music and film celebraties. It is interesting that employees suggested that role models only have a very short shelve life when it comes to encouraging careers, as once a person is in a career the emphasis of role models becomes less. It was also shown that girls at year 11 had already chosen their career pathway and it would be better to approach career identity earlier in their schooling as it becomes a lot harder to change their minds.

One of the factors that was found to encourage girls wanting to do ICT at school was to make the subject relevant by making the subject flexible and aligining with the passions of generation Z student. Girls felt that it would encourage them more into ICT at school

and they thought that to do this they needed teachers and people in industry to look like they did, showing the diversity and show relevance to their generation. The girls also thought at year 11 it was too late to change their minds about ICT and the industry and it would have more of an impact if changes were to happen at intermediate or even primary school. Another factor that should be used to encourage students, especially girls is creativity and imagination in ICT subjects. This will allow girls to engage in their own interests when it comes to ICT.

Employees also agreed with the students that the teaching of ICT does not align with the thinking and future of the sector. Attitudes need to change and the approach of ICT at school needed to be more agile in its approach to the subject, allowing the schools to be more accomodating to change. The employees also thought that the generational problem needed to be tackled by the way industry approach hiring of new employees and move to more of a diverse and gender balanced community. The stereotypical perceptions of the ICT industry is still alive with the new generation of students. They see white males dominating the sector. Girls do not get to see people like themselves working in the industry and the geek and nerd image is still in the forfront of their minds when it comes to people in the ICT industry. Girls also holding onto the perception that you have to be technical to work in the industry, this again taints their perception and attitude of the industry and certain career pathways.

TV, film and music industry are also still promoting stereotypical imaginary of the ICT sector to generation Z students, giving more weight to those negative perceptions. From these perceptions it is more than likely Māori and Pacifica girls will not follow a career path in ICT based on thes stereotypes, this ultimately causes a circular issues or a catch 22 problem, as girls can not see like minded people or same colour as them in the industry, which inturn does not give them the role models in the whānua. The gernational effect has more of an impact to Māori and Pacifica girls than that of New Zealand European girls. This down to the culture and role models for Māori and Pacifica girls which aligns closer to whānau rather than that of outside influence.

The future of the industry and ICT education does have to change as ten's of thoudands of jobs at the lower end of the job market will be automated. So education and industry needs to start now in re-thinking their approach to teaching ICT at school. The way ICT is taught at school is one of the biggest factors that is putting off many students,

especially girls. Generation Z students need to be able to express their creativity, imagination and innovation in ICT subjects, if they are allowed to express themselves and are allowed to utilise these skills the subject becomes more enjoable and fun for all students which inturn allows them to show passion for ICT.

The final chapter bring together the results from the discussion and concludes by answering the the main question and sub questions from the study. It also brings together the limitations and future work that can be completed from the results of this study.

8 CONCLUSION

8.1 Introduction

This research has explored the current perceptions and attitudes that either discourage or encourage year 11 girls from taking ICT as a subject in school and as a career choice. Research over the past decades has investigated the low and declining participation of women and girls in ICT education and the industry (Abbiss, 2005; Adya & Kaiser, 2005; Camp, 1997; Clayton, 2007; Outlay et al., 2017; Timms, Moyle, Weldon, & Mitchell, 2018). However, there has been a lack of literature globally and specifically in New Zealand investigating the problem of Generation Z students having been subjected to lots of negative perceptions and attitudes towards ICT through stereotypes which have been passed down from generation to generation. Because of these perceptions and attitudes, many students are rejecting ICT occupations. ICT at an educational level is being rejected by generation Z students, and as a result, ICT companies are not seeing students coming through school and university who are interested in following a career in ICT.

In this chapter, the research questions are reviewed, and recommendations from the findings are presented. The findings described in Chapter 7 in terms of the research problem are summarized for each of the sub-questions and the main question. The last section of this chapter concentrates on the limitations of the study and the contribution to knowledge, as well as where future research would enhance the body of knowledge in the ICT field.

8.2 Research Objective

The research investigated the perceptions and attitudes towards ICT among high school girls and the effect it had on their career intentions. A mixed methodology approach using quantitative and qualitative methods was used to elicit information from year 11 students at high schools and employees of ICT companies, both in the CBD of Wellington, New Zealand. The overarching research question for this study was:

What are the factors that discourage and encourage the participation of year 11 girls' ICT study and career path?

To answer the research question, there are far more factors that discourage than encourage girls to participate in ICT study and follow a career path. Many of the factors that discourage stem from ICT history and have been an issue over many decades. Stereotypes of the industry, such as the people, gender imbalance, jobs and what they do are all negative in the opinion of year 11 girls. Year 11 girls were also discouraged by the subject, being dull, boring and no fun. The also could not see people like them in the industry and again this discouraged them from entering an industry that was populated with white males. There were a couple of encouraging signs from the year 11 girls that suggested if the subject was made more interesting by allowing them to utilise their passions for other areas, then it would be fun. They also suggested that making ICT more creative and innovative would hold their interest in the subject. However the positives do not even come close the negatives. It can be concluded that certain factors can be influential towards a perceptions that discourages and encourages students to pursue ICT at school are as follows in Table 8-1:

Table 8-1. Factors that discourage or encourage girls to pursue ICT at school

Discourage	Encourage
Technical	Wide range of job opportunities
Stereotypes	Soft skills such as creativity, imagination, innovation and communication
Image of the industry	Family involvment at an earlier age
Diversity and gender	Younger female role models
Popular culture	Use of social media
Technology is just a tool	Femal ICT teachers
Confidence in their abilities	

This has to change if the industry wants to entice more diverse cultures and young females into the sector.

Through the investigation and the development of a framework arcitecture, perceptions and attitudes were identified and grouped into Cultural factors, Social factors, Structural factors, Generational factors and individual factors. Each of these factors was taken into consideration when answering the research questions. Students being affected by

culture, (i.e. from their upbringing through to popular culture and family values), the Social factor (i.e. stereotypes, gender, peers, role models and media and how it effects students' outcomes), the Structural factors (i.e. home, schools, teachers and the ICT industry and how they affect students' decisions on their future careers), SocialIT factors (i.e. the future of ICT, the landscape of ICT and the disruptive era including social media) all have an effect on students and the likelihood of students following an ICT career. The generational factor (i.e. different generations and their attitudes and perceptions regarding ICT) will have an impact on students and the effect that the other generations have upon the latest generation through all the other factors. The individual factor (i.e. the self-belief the individual has in their own ability) will have an impact on their decision regarding ICT and future career.

A contribution from this study is the development of the adapted framework (STEMCell2.0) developed initially from the work of Bernhardt (2014) and inspired by the work of (Clayton, 2007). The addition in the research to the framework of the generational factor allows for the other factors and their relationship to be combined to form a better understanding of the effect on generation Z students and what impact it will have on their perceptions and attitudes of ICT and the industry.

To guide the research for this thesis, four sub-questions were developed (a - d), and are shown below. These questions are answered in the following sections of this chapter.

a) Has the disruptive era changed generation Z girls' perceptions and attitudes about ICT?
b) How do girls' perceptions differ compared to those of boys when it comes to ICT?
c) What impact does technology have on attitudes and perceptions of girls towards ICT?
d) What are the generational effects that influence the participation of girls in ICT?

8.2.1 Has the disruptive era changed girls' perceptions and attitudes about ICT?

The disruptive era has changed the landscape for the ICT sector forever and the way people carry out business. One of the perceptions that hold for students, especially girls, was that ICT was not appealing; it was uninteresting. To be able to accomplish this,

schools need to take into account how quickly technology and the industry changes. Being more agile in its approach will entice, inspire creativity, imagination and problem solving that relate to generation Z.

Students were open-minded when talking about the future of ICT and job prospects. Furthermore, girls could see new and exciting jobs on the horizon in the industry, which supported their views of their self-understanding. Girls still thought that most of the future jobs in the industry would require technical ability and, if this were going to be the case, it would more than likely put them off entering into an ICT career. However, the girls did agree there would be more opportunity in this disruptive era than ever before. Working in this disruptive era, girls also thought that the soft skills such as creativity, communication, imagination and problem solving would be essential if they wanted to follow a career in ICT. The girls suggested that these skills need to be integrated more into subjects at school.

8.2.2 How do girls' perceptions differ compared to those of boys when it comes to ICT?

The early life experiences that children are exposed to through home and school start to shape their attitudes and perceptions and self-efficacy, which will guide them to certain career pathways. Boys, more than girls, sought guidance from family members when it came to their future career paths. However, girls were more inclined to follow their own decision rather than parents' opinions, as they thought that parents' opinions were not that important to them at this age. Even if girls did see parents as role models, at year 11 girls were still inclined to look outside the parental home for career information. Suggesting that parents need to expose girls to different careers such as ICT a lot earlier than the boys. It also suggests that girls become a lot more focused on their career journey at an earlier age than boys and factors such as family and school do not impact so strongly on their personal career choices for New Zealand European girls, however, for Māori and Pacifica girls, whānau and school has much more of an impact on their personal career journey.

Girls have a perception that people who work in the ICT industry fit the stereotypical perception of a white male, and this perception would influence their career path options. Girls perceive that there are not people like them in the industry and cannot relate to

what they see through this window that they have on the industry. However, this perception had no real bearing on the boys and their choice of careers. The company employees agreed with the girls' perceptions and that companies need to do a lot more to make females feel included within the company environment through diversity.

Self-confidence was significant when it came to ICT. Girls felt that they did not have the belief in their skills needed when it came to ICT at school and from that their self-confidence in ICT became none existence and they rejected or dismissed ICT as a subject early on in their education. Girls also believed that they had to be technical to succeed in the industry, and the subject did not relate to their passions. These perceptions then reinforced the stereotypes of 'not enjoyable' as the subject did not excite them because they could not relate to the topic and could not see the opportunities available in the ICT sector.

The stereotypical imagery was a significant difference between girls and boys when it came to ICT. Some of the stereotypical wording such as 'loner', 'geek' and 'nerd' was very predominant in girls' perceptions of the subject and the industry. These stereotypes alone were enough to put off many girls from following a career choice in ICT. It became significant for New Zealand European girls the older they got, by the age of 17, 80% of the girls dismissed the entire ICT industry purely on stereotypical perceptions. Diversity was also a significant difference between girls and boys. Māori and Pacifica girls could not see a place in the industry for themselves. When Māori or Pacifica girls looked at the ICT industry, they noticed a lack of diversity, which had an impact on their influence as they could not see people of the same culture or colour, promoting these stereotypical images that they have of the industry. Generational perceptions showed a difference in perceptions between girls and boys. Girls believed that the older generation are keeping those stereotypical images and stigmas of the industry alive and how it effects generation Z students' perceptions

Popular culture holds a significance for girls over boys when it came to perceptions of ICT. Girls believed that popular media such as TV or film showed stereotypical images of the type of people that work in the industry. Role models also showed significant differences between girls and boys. Girls did not look towards their teachers as good role models; or even to family members in the survey. However there was some contradiction between the survey and the interviews, where girls from the interviews

looked to family members as their role models and looked up to them but they did not want to follow in their families footsteps when it came to their career. Girls also showed a difference in perception to ICT when it came to younger role models. Girls wanted to see younger female role models in the ICT sector that they could relate to, as the girls found a real disconnect between ICT at school and the ICT industry.

School work in ICT showed a difference between girls and boys. Girls were adamant that ICT should not be a compulsory subject at school. This comes down to the perception that girls have about ICT and the industry, which was mostly negative. Girls also suggested that they would like to see more females in technical roles such as ICT teachers. It suggests that seeing a female in a typically male-dominated role would dispel stereotypes and perceptions that it is only males that can do the job and persuade more girls that ICT could be a viable career choice.

8.2.3 What impact does technology have on attitudes and perceptions of girls towards ICT?

Technology is having an impact on girls' perceptions and attitudes, both positively and negatively when it comes to ICT. The findings from the research suggests that schools should be looking to integrate technology within all subjects for all high school students and make it relatable to this generation. Girls felt that they needed to embrace technology more than they do now, and it must hold their imagination and creativity to allow them to relate to the subject. Girls also thought that engaging students in ICT related subjects would be a lot easier if the work they carried out was of interest to them, and they could become passionate about ICT subjects.

Many students, especially girls, see technology as a tool that helps them achieve an outcome. This perception has added to the problems that not only schools face but also industry when trying to attract more females into the sector. Also, from the findings, it can be suggested that girls need to embrace technology and see it as more than a tool. With technology, students can create amazing artefacts if given the right skills that make it relatable to their passions. However, this cannot be completed in isolation, schools and teachers must also embrace technology, by using tools and applications, allowing for mobility for every subject to promote creativity, communication, imagination and problem-solving.

Generation Z underestimate the importance that technology will play in their lives and into the future. The perceptions that girls have regarding technology being just a tool to use needs to be addressed sooner rather than later. Generation Z is the most immersed generation when it comes to technology use. However, generation Z students do not care about how the technology works. They know if they press the icon on the screen, the application will load. Girls have a perception that the use of technology is a means to an end; they are not curious about how or why it works. This problem is being compounded by technology becoming smarter and better at carrying out complex tasks, making it easier to use but this is building a divide, where an entire generation is not caring about why technology works because it is a tool to use and generation Z student do not understand what to do when technology goes wrong. However, there might be a silver lining. Promoting a new landscape for the sector that relies on soft skills, creativity, innovation and imagination is more essential for the industry than just technical abilities and needs to be promoted by the ICT sector with help from the schools.

Girls saw technology use at school as frustrating, repetitive and problematic as they were asked to complete technical tasks that they were not confident with. Many girls opted out of ICT subjects because they perceived they did not have the right skills or enough self-belief in their skills to carry out those tasks. Girls felt they did not have the same confidence as the boys in the subject and were not prepared to have a go and see what happens. All these factors build upon the perceptions they have on the subject, which in turn triggers their dislike for the subject and promotes the dull, boring and uninterested attitude towards ICT.

8.2.4 What are the generational effects that influence the participation of girls in ICT?

Many influences promote either a positive or negative attitude toward ICT. One of those influences is generational factors. Generational includes all generations from Millennials/Gen Y through to the Baby Boomers. Most of the perceptions of ICT and the industry have come from the older generations and have had an impact on the latest generation Z students. Unfortunately, the majority of those perceptions that generation Z students have about the industry and the subject are seen to be negative towards ICT.

One of the main issues that have faced the ICT industry over the past couple of decades is their image. Image perception for ICT has always been a white male, and this image has dominated the corporate world of ICT and also in the media. The main imagery that has been portrayed in the media over the last two decades has been by people, such as Bill Gates of Microsoft, Steve Jobs from Apple and now Tim Cook of Apple and Mark Zuckerberg of Facebook. When girls, especially Māori and Pacifica look through the window into the industry, they are faced with this stereotypical image. This image has been passed down from generation to generation due to the lack of diverse talent that companies have to hire from because of this image problem. When girls of colour from different cultures look through that window, they cannot relate to what they see, giving the perception that they do not belong in this industry, which in turn steers them away from a career in the industry. As this is happening for generation Z students, it promotes those stereotypes that females do not belong in the industry. Girls also believe that some of these stereotypes are being kept alive by the older generations by hiring to type. However, it becomes a vicious circle for companies because of the perception that females have of the industry. This stereotype takes them away from entering into either higher education in ICT or the ICT industry. The talent pool that companies utilise becomes a lot smaller and eventually ends up with white males, fuelling the cycle for the next generation to see.

Generation Z students have been immersed in technology all their lives. Technology will have an impact on their school work and how they accomplish tasks. Baby Boomers would have been brought up in the industrial era, where work ethic and loyalty to employers were top of the list of perceptions when it came to the working environment. However, today, generation Z students are working in a very different landscape with the disruptive era and rapidly changing technological space. The old perceptions that Baby Boomers had do not have the same impact on generation Z. The smaller companies in New Zealand are starting to embrace this change, which works well with generation Z, however, this is taking time to accomplish. The smaller companies are often companies made up of Millennials/Gen Y and X people who have adapted more quickly than the Baby Boomers and are starting to embrace gender and diversity into these companies. However, the stigma of the white male stereotype is still at the forefront in many larger ICT organisations.

Media can be a good influence for generation Z students, especially girls and the ICT industry. Positive stories and images can entice and promote creativity, capture imagination and highlight the diversity of the industry to generation Z. Generation Z are connected 24 / 7 to a smart device or tablet, so applications such as social media can be used to inform and promote role models that are relatable to generation Z girls. Understanding the way generation Z uses social media, and the influence it could have maybe a starting point to turn around the gender diversity problem.

Schools also have a part to play when encouraging generation Z students, especially when it comes to ICT. The teacher is often from the older generation when it comes to high school because the profession is finding it very difficult to entice Millennials/Gen Y to become teachers (Salam et al., 2018). Generation Z students are normally faced with teachers that have been teaching for 20 or 30 years and are from the older generations and do not have a contemporary background in ICT. Students want to see ICT teachers that they can relate to; they want diversity in the classroom with female ICT teachers and a subject that allows them to express their creativity, imagination, communication and problem-solving abilities. Having teachers that do not understand generation Z and how they work will promote those stereotypical views of ICT persuading many students to look at other subjects than that of ICT.

To try to influence generation Z students to become more interested and involved in ICT subjects at high school the older generations need to embrace generation Z attitudes towards technology, replace fear with understanding and be adaptable to generation Z needs. It is about re-educating the older generation teachers about the needs of the latest generation of students and engaging industry to promote ICT in schools and show a different face rather than a white male. It is about collaboration with Millennials/Gen Y employees that can be seen as great role models for generation Z, especially girls. It is not about disregarding the older generations but getting them to open up to this new generation and not paint the same picture that people have of the industry over the last couple of decades. The older generations need to work with the latest generation to allow them to create a new picture of the industry that all generations can be proud of.

8.3 Contribution to knowledge

This research intended to provide a contemporary view of the research problem through a fresh examination and using a framework based on six different factors; Cultural, Structural, Social, SocialIT , Generational and individual and to clarify perceptions and attitudes that discourage and encourage year 11 girls' ICT study and career choice. The culmination of this research is the finding of STEMCell2.0 framework architecture (Figure. 8.1) based on Bernhardt's STEMCell conceptual model. The key themes from the literature were used to create the survey for phase one of the data collection. This produced the data set that was used to guide the design of the semi-structured interview in phase two.

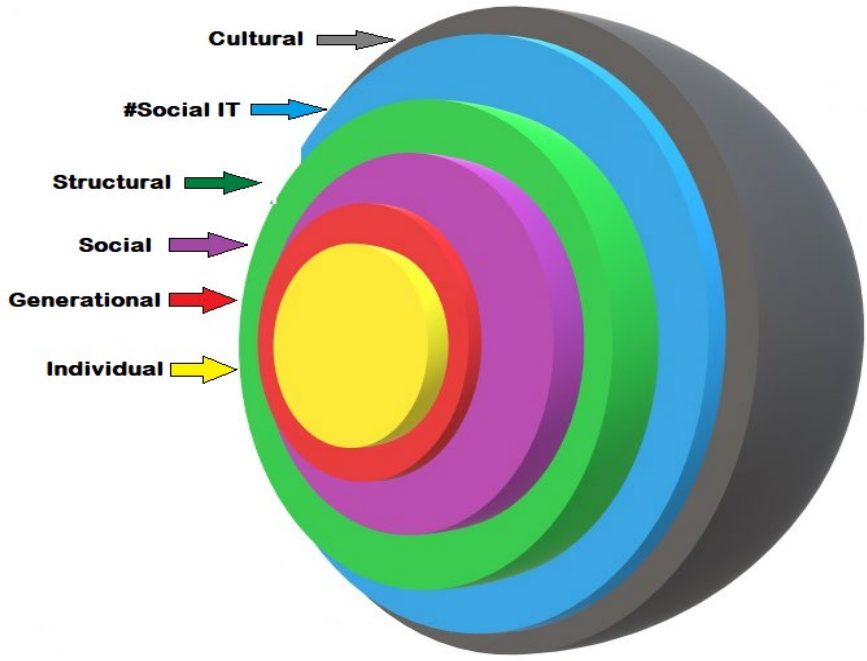


Figure 8-1. STEMCell2.0 Framework architecture. Created for this study

It is believed that this new framework architecture along with the STEMCell2.0 classification model (Figure. 8.2) will assist researchers, schools, teachers, parents or Whānau, governments and industry to have a better understanding of the perceptions and attitudes that discourage and encourage year 11 girls' ICT study and career choice. The model itemises many of the perceptions and attitudes based on each of the factors

that can discourage or encourage students, especially girls, for following ICT as a career option. The arrows between each of the STEMCell2.0 classification model factors do not imply a causal effect but rather a relationship between each of the factors. The arrows also show the directional flow of information between the factors and the influence each of the factors has upon another. Furthermore, it can be suggested that most of the factors, perceptions and attitudes identified through the use of the framework and model also apply to boys.

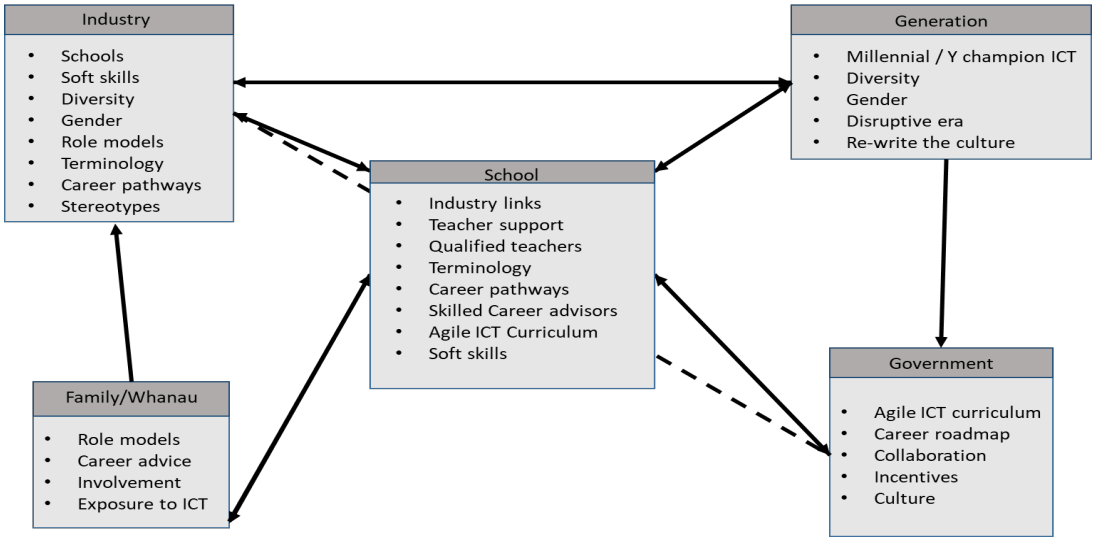


Figure 8-2. STEMCell2.0 Classification Model of perceptions and attitudes that encourage or discourage girls from ICT. Created for this study

The model was created from the discussion chapter and used the factors that may encourage or discourage girls' choice when it comes to ICT and ICT careers. The family/Whānau factor encompasses family involvement in their children's upbringing and culture based on the amount of influence family/Whānau have through parents being role models or how much input parents have into their children's perceptions and attitudes towards ICT and ICT career paths.

The industry factor refers to the climate that the industry finds themselves today; this includes diversity and gender-related issues facing the ICT industry. It also refers to the types of skills required for ICT careers, pathways that are available in the industry for students and breaking down misconceptions of terminology and finally the gap between industry and schools and the lack of role models that students have access to from industry. The industry context is assumed to influence school, family, government and generation.

The school factor includes collaboration, imagination, problem-solving, qualified teachers, industry support and many more. School can influence family, industry, generation and government based on these characteristics. Allowing schools to follow an agile approach in ICT would entice the ICT industry to be open to collaborating with school, and the utilisation of ICT employees to fill gaps in the education sector where schools find it hard to recruit qualified ICT teachers.

The government factor brings together culture and collaboration, which could have an influence on family and school and generations. Also, from the government factor, the curriculum, roadmap and incentives could have a significant influence on schools as this becomes the cornerstone of change for ICT education. The key for government is the change that must be made to entice more diverse teaching in ICT and allow for a multi-cultured approach to education.

The final factor, generation embraces the disruptive change that is being felt not only at a school level but all the way through to a governmental level. The change of gender, diversity, generation, and re-writing the future all play a role in influencing family, school, industry and government. The older generations need to understand that the disruptive era has become a major turning point across all sectors, including education. The disruptive era must be embraced, but to do this government, education and family must realise that will mean a big change in how and why we do many things, including teaching generation Z.

Each of the areas based on the perceptions and attitudes in each of the factors has been identified from the findings of this study. These key areas under each factor need to be addressed for generation Z students, especially girls. If the recommendations are taken seriously from family/Whānau, school, industry and governments then action can be taken to make a change to create a diverse, gender neutral ICT environment where both girls and boys want to work. Each perception is important in the own right, however, if there is to be an uptake in more girls wanting to follow an ICT education and career path then school, industry and government need to collaborate. The more perceptions that can be changed through education and collaboration will entice more students towards ICT. Perhaps targets are required to reduce the gender imbalance and pay equity problem that females face in the ICT industry. As of 2018, only 28% of the workforce in ICT was

female; government and industry should be looking at increasing that percentage over a period of years to reduce the imbalance.

This research also sought to add weight to the current opinions, as well as contributing to the insight from year 11 at high-school and the industry in the CBD of Wellington, New Zealand, while addressing the literature about year 11 students' perceptions and attitudes towards ICT study and career choice. Early research investigated girls' lack of interest in ICT subjects concentrated around the Social and Structural influences; more recent research has indicated that generation Z students' perceptions are linked to the landscape that they live in and to other generational influences (Advani, 2019; Bernhardt, 2014; Stern et al., 2018). However, more work was required to clarify these claims, and this research provides clarification based on SocialIT factors and Generational factors that influence year 11 girls' ICT study and career choice.

To date, there is no known research into generational influences on year 11 girls' ICT study and career choice in the CBD of Wellington, New Zealand. It can also be said that due to the ever-changing landscape and the rapid change of technology for ICT, the results from this thesis will become out-of-date very quickly and will need to be revisited regularly.

8.4 **Recommendations**

Many factors discourage and encourage Year 11 high school students from taking certain subjects. ICT is one of those subjects that has negative stereotypes and perceptions placed on it by external factors. Interest is one key factor for year 11 students in wanting to continue with ICT after the end of year 11. This research has shown by the time the majority of students reach year 11 of their studies; they have lost interest in ICT. In this research, there were many reasons identified that discourage and encourage students, especially girls, from pursuing an ICT pathway. The factors that discouraged and encouraged students included: family, peers, role models, popular culture, school, teachers and such influences as family life. The cultural background of parents and occupation of parents and their expectations all played some role in their children's perceptions and attitudes towards ICT. From this study, recommendations have been

suggested. These recommendations are organised around the factors from the classification framework.

8.4.1 Recommendations for family and Whānau

- Generation Z students need to look to teachers, family members and industry (Millennials/Gen Y and X) for guidance, information and career advice.
- Māori and Pacifica families more than New Zealand European families are influential over their children. Māori and Pacifica families should expose their children more to technology and the right information regarding career paths or role models that they can look to allowing them to make an informed decision on their future.
- Parents need to be involved in their children's discussion about future study early in the education process. Girls' brain development is two to three years ahead of boys the same age. By year eight girls are starting to decide on their future career path.

8.4.2 Recommendations for the industry

The ICT industry, as a collective need to be putting into place targets and incentives to entice more females into the workforce. These incentives could range from flexible work environment to more maternity leave and a staggered return to work for mums coming back into the workforce. They should also be proactive in reducing the pay gap and reducing the gender and diversity gap by setting achievable targets. It should be possible by 2050 that the ICT industry sees a gender neutral environment. Below are some of the key recommendations found that could make an impact if implement:

- Companies need to promote the soft skills that are required and not just concentrate on technical abilities.
- Companies need to expose students to a gender-neutral and multicultural workforce, where students can see people from their own culture and gender working in the industry. They also need to promote themselves in a much better light to attract generation Z students, utilising what appeals to generation Z students such as social media and making it relatable to all so they can see their passions within the industry.

- Companies need to work much closer with schools increasing work experience opportunities for students to negate those stereotypical images that students have of the industry.
- For the ICT industry to move forward in the disruptive space, baby boomers need to embrace generation Z traits to allow other generations to take on generation Z ***(generational factor).***
- Millennials/Gen Y need to re-write the image associated with the ICT and the industry ***(generational factor).***
- More young female role models are needed that can relate to generation Z students. These young female role models should have the same type of background, culture and ethnicity so girls can relate to them on a personal level. Furthermore, these role models must have a presence that can be easily reached by girls, such as through popular culture, TV or social media.
- Industry needs to work with the media and marketing to change the old perceptions of the ICT industry. Utilising social media, such as YouTube, Snapchat and Instagram, will help deliver new up-to-date messages about the ICT industry.

8.4.3 Recommendations for education

Schools should be looking to government to create incentives for new teachers who are qualified in ICT by reducing costs around student loans for graduates. Schools also need to partner with ICT industries to create the support links required for teachers to be able to teach the latest technologies to generation Z students. This would allow the industry to show that girls they belong in the industry by promoting female role models. Below are some of the key recommendation that should be implemented to increase gender equality in school:

- More support or interventions is required for girls from year eight onwards when thinking about ICT, as this is a pivotal time in their career selection process. The use of mentoring, camps, or after school clubs are crucial.
- Schools need to employ teachers that have qualifications in ICT. It becomes a lot easier for the girls to relate to someone of the same gender and ethnicity, allowing those teachers to spark girls' interest in ICT.

- Schools need to address the terminology when it comes to ICT, as labelling the subject brings perceptions based on attitudes already learnt by the students that are mostly negative towards ICT.
- Millennials/Gen Y teachers should be championing ICT and the industry rather than the older generation of teachers ***(generational factor).***
- Re-educating generation X and Y teachers about the needs of the latest generation of students and generation Z attitudes towards technology and be adaptable to generation Z needs.
- Schools should allow students to collaborate across subjects to incorporate ICT. This will promote creativity, imagination, soft skills and problem solving, creating a fun environment for the students. Create a learning environment that allows students to collaborate, play with ideas and compete without the fear of penalties.

8.4.4 Recommendations for government

The government needs to collaborate with schools and industry to revise the way ICT is taught through schools and put a five year plan in to action to change the thinking around ICT based on foundational needs in ICT and future requirements from the ICT industry. Allow ICT become agile in its approach will help schools keep up to date with technology that changes very quickly. The government must also increase awareness of the shortage of qualified ICT teachers and create incentives for new graduates to follow ICT pathways in teaching by reducing the cost of higher qualification that is required for ICT teaching. Below are some of the key recommendations that must be carried out to increase the awareness of the ICT to generation Z students and make it applicable to this disruptive generation:

- Create a road map that shows students the different avenues available to them and all the opportunities that the ICT Industry can offer.
- Governments need to put incentives in place to entice younger people to take up ICT teaching. Having educated teachers in ICT that are closer to the age of the students would promote the subject and entice more people to take ICT at a higher level.
- The curriculum for ICT is always going to be out-of-date, as the sector is always changing. The government needs to create a general ICT curriculum that will

allow schools to adapt quickly to any changes in ICT and allow them to embed the subject into all areas. This also would address some of the stereotypes around ICT. Making the curriculum work for a multicultural environment would also help in retaining Māori and Pacifica students.

8.5 Study limitations

This study has progressed the research on the perceptions and attitudes that discourage and encourage year 11 girls' ICT study and career choice. However, the context of the study also plays a role in limiting the study. Firstly, the number of participants in both the survey and the interview stage reflect the limited access available to the researcher. While there are a large number of high schools in Wellington and the greater Wellington region, only six schools from the region were able to participate in both phases due to the timing of the survey. Although attempts were made to include many more schools, many schools were not willing to participate in the study.

Secondly, it may have been advantageous to include other years within the study. It would have given a different insight into how perceptions and attitudes may change across different years. Having more schools participate by making the pool of participants larger may also have given better results. From a logistical standpoint, arranging access to students within school time limited the number of students that could take part in the interview phase. Furthermore, it was outside the scope of this research to include teachers, career advisors or other years of students at high school.

Thirdly, as shown in the findings and discussion and confirmed in the literature, parents, Whānau or family play an essential role in the lives of their children in New Zealand. Incorporating participating students' families in the interview stage to gain an insight and understanding into background, culture and environment would have produced a rich set of data that would have added to the overall findings. However, this would have created much more work for the researcher and issues around consent and privacy made this not a feasible option for this study.

Finally, the mix of ethnicities that participated was biased towards New Zealand European. It would have been informative if there were more of an even mix of

ethnicities allowing for a better insight into Māori and Pacifica students' perceptions and attitudes. Due to time constraints and non-participating schools, the research did not allow for this.

8.6 Future research

Some areas for future research have emerged from the results of this study. Firstly, being able to run the survey with more input from schools that had a higher representation of Māori and Pacifica students would allow the research to highlight critical issues that address those ethnic groups and could not be formally generalised from the findings of this study.

Secondly, being able to deliver the survey across more centres in New Zealand, such as Auckland, Hamilton, Christchurch and Dunedin would allow this research to acquire a better cross-section of the population, increasing the accuracy of the findings. It is also recommended that for each of the leading centres, rural areas be included in the results. It would allow for a comparison to be made regarding the impacts on the difference in perception and attitude of students high school experience in ICT, but also the family culture, especially for Māori and Pacifica students to see if there are any significant differences between rural and city students

Thirdly, having access to teachers that are teaching students in ICT would be valuable to gain an insight into how teachers approach ICT subjects and how they work with the current curriculum. Many students have commented that their perception of ICT is 'unfulfilling and unexciting' and they lacked interest in the subject. Being able to interview teachers regarding the way they approach the subject to make it fun and exciting would give light to some of the findings from the study.

Further research into perceptions and attitudes of teachers teaching ICT could be conducted, for instance, investigating how influential teachers are when it comes to ICT at school. It would involve interviews with ICT teachers to answer a question such as: What is the relationship between the levels of ICT knowledge of the teacher on year 11 students' interest in ICT?

Finally, other missed opportunities included interviewing female employees that did not take ICT at school but are now working in the industry. This study would involve finding out what changed their mind on the ICT industry, using a question such as: What changed your perception and attitude towards ICT to make you change careers? Many of the female interviewees from companies fell into this category, which does suggest there is more than one pathway into an ICT career rather than just through studying ICT.

8.7 Chapter summary

This research has identified that many factors will influence the decision of high school students, especially girls, to pursue an ICT career and provides the foundation for further research. Data were collected through two phases from year 11 students at high school and employees working in the ICT industry. The first phase was through an online survey and the second phase through a semi-structured interview. Almost all the year 11 students that completed the survey had already rejected a future career in ICT, but some students interviewed were considering carrying on their studies in the area of ICT It is believed that the framework and the STEMCell2.0 classification model has helped identify those influences that discourage and encourage girls from studying ICT and following ICT into a career. Understanding these influences will help develop new initiatives at increasing girls' involvement in ICT at an educational level and then on towards a career in the ICT industry.

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Appendix A. Self-Concept and Occupational Preferences

Table 9-1. Summary of four stages in the development of Self-Concept and Occupational Preferences (Gottfredson, 1981)

Stage 1	Orientation to Size and Power: "During, most children do not have stable coherent concepts of male and female roles, but they are laying the groundwork for such development" (p. 559). Age range 3 to 5
Stage 2	Orientation to Sex Roles: "Children's occupational preferences in Stage 2 reflect a concern with doing what is appropriate for one's sex" (p. 560) Age range 6 to 8
Stage 3	Orientation to Social Valuation: "They begin to recognise prestige differences among jobs as well as social class and ability differences among people" (p. 561). Age range 9 to 13
Stage 4	Orientation to the Internal, Unique Self: "The next stage of development is to carve out a personal identity and to arrive at more specific occupational choices" (p. 566). Age range 14 and over

Appendix B. Data Collection and analysis tools

Table 9-2. Summary of data collection and analysis

Research Question	Data preparation	Collection	Data analysis technique
What are the generational effects that influence the participation of females in ICT?	Data Screening	Surveys On-line Surveys Interviews	Frequency Analysis Cross Tabulation between significant variables, such as gender responses
What role, if any, has the social era played in changing male and female perceptions and beliefs about studying ICT and the ICT industry?	Data Screening	Surveys On-line Surveys Interviews	Frequency Analysis Cross Tabulation between significant variables such as gender responses Deductive approach
How do the perceptions of females differ compared to those of males when it comes to studying ICT?	Data Screening	Surveys On-line Surveys Interviews	Frequency Analysis Cross Tabulation between significant variables such as gender responses Deductive approach
What impact does access to technology and its use have on attitudes and perceptions of young females toward ICT?	Data Screening	Surveys On-line Surveys Interviews	Frequency Analysis Cross Tabulation between significant variables such as gender responses Deductive approach
How applicable is the framework for young females studying ICT and career aspiration in ICT?	Data Screening	Surveys On-line Surveys Interviews	Cross Tabulation – a snapshot of many variables at a single point in time

Appendix C. Student Survey

This short questionnaire has been developed to gather data as part of my research into: ***What are the generational effects that influence participation of females in ICT, technology or computing?***

Responses will be completely anonymous; no identifying information will appear anywhere on the questionnaire.

Your participation in this project is entirely voluntary and anonymous. If you do not wish to take part you are not obliged to. Please note, if you wish to withdraw from the project after you have submitted your responses, the researcher is unable to remove your data from the project. Completing the questionnaire will give your consent for the data to be used in the project.

To complete this short questionnaire it should take approximately 15-20 minutes.

Section A: Demographics

Questions about you and where you come from

A1. Gender

- ☐ Female
- ☐ Male
- ☐ Do not wish to respond

A2. Age

A3. Ethnicity, please choose the one you associate with from the dropdown list

Note - European includes persons from Europe or the UK and New Zealanders of European or UK herritage

- ☐ European
- ☐ New Zealander
- ☐ Maori
- ☐ Pacific peoples
- ☐ Asian
- ☐ Middle Eastern, Latin America, Africa
- ☐ Other (please specify)

Other (please specify)

A4. **What industry are you thinking of going into when you leave education**

Section B: Cultural Factors

Factors that influence you from within your family and background.

B1. **I have access to a computer technology at home**

Note - computer technology includes desktop, laptop, tablet or phone

- Yes ☐
- No ☐

B2. **I have access to the internet at home**

- Yes ☐
- No ☐

B3. **Having shared computer technology in a place where everyone in the family home can use it is a good idea?**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

Note - Computer technology indicates desktop, laptop or tablet

- 1 ☐
- 2 ☐
- 3 ☐
- 4 ☐
- 5 ☐

B4. **My parents/guardians are influential when I think about my future career:**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

B5. **I am aware of the different jobs available in ICT, technology or computing**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

B6. **ICT, technology or computing is just programming**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

B7. **My parents/guardians encouraged me to take ICT, technology or computing at secondary school**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

B8. **My parents/guardians influenced my decision on the career path I will take**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

B9. **My parents/guardians view of ICT, technology or computing will have an effect on me choosing computing as a career**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

Section C: Social Factors

Are the factors that may influence your perceptions through stereotype, friends, Social Media, Gender, Role models and mentors.

Sterotypical means: men and women involved in ICT, tech or computing are viewed as geeks or nerds

C1. **I believe there is still a problem with stereotypes within ICT, technology or computing**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

C2. **Would this stereotypical view be enough to put you off ICT, technology or computing as a career**

Yes ☐
No ☐
Don't know ☐

C3. **Stereotypical views are being kept alive in ICT, technology or computing by the older generation (people older than approximately 50 years).**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

C4. **Film and TV show women and men in a stereotypical view (geek or nerd) when it comes to ICT, technology or computing**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

C5. **TV and film show ICT, technology or computing as being unrealistic**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

C6. **My ICT, technology or computing teacher is a woman**

Yes ☐
No ☐

C7. **My ICT, technology or computing teacher is a great role model**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

C8. **There should be more younger role models (people in their 20s or 30s) in ICT, technology or computing**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

C9. **Role models play a big part in me choosing my career**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

Section D: Structural Factors

External factors that influence you, from home, education, industry and the support you get from teachers or career advisors.

D1. **ICT, technology or computing should be a compulsory subject at secondary school**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

D2. **The work we do in our ICT, technology or computing course reflects the type of jobs available in the computing industry**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

D3. **ICT, technology or computing work, means working on your own.**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

D4. **I am more likely to choose a subject which my friends are taking.**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

D5. **There should be more women ICT, technology or computing teachers**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

D6. **It is important that my school keeps computer equipment and software up to date**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

D7. **I have met with the school career advisor at least once**

Yes ☐
No ☐

D8. **The school career advisor was very up to date about ICT, technology or computing jobs**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

D9. I get career advice from:

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

	1	2	3	4	5
Family	☐	☐	☐	☐	☐
Friends	☐	☐	☐	☐	☐
Teachers	☐	☐	☐	☐	☐
Career Advisor	☐	☐	☐	☐	☐
Media - including Online, TV, Magazines and Newspapers	☐	☐	☐	☐	☐

D10. Indicate your level of agreement with these statements towards ICT, technology or computing?:

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

	1	2	3	4	5
ICT, technology or computing is more for men than women	☐	☐	☐	☐	☐
Studying ICT, technology or computing locks you into one specific job	☐	☐	☐	☐	☐
ICT, technology or computing work is fun	☐	☐	☐	☐	☐
ICT, technology or computing involves repetitive work	☐	☐	☐	☐	☐
ICT, technology or computing means working on your own	☐	☐	☐	☐	☐
ICT, technology or computing is not necessary to a future career	☐	☐	☐	☐	☐

Section E: #Social IT Factors

Factors affecting your perceptions of what the future holds for the ICT, tech or computing industry

Social media includes any social apps or sites such as Facebook, Twitter, Instagram, Tumblr Linkedin, GIT, Slack, etc..

#SocialIT is about persuing passions, creating amazing things with others using existing, evolving and future technologies, how we can adjust quickly in an ever changing tech world.

E1. The jargon / language used for ICT, technology or computing at school does not reflect what I use outside of school. The jargon / language used in school is out of date

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

E2. The type of jobs that will be available to me when I leave school in the ICT, technology or computing industry have not been invented yet

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

E3. Having an ICT, technology or computing qualification will enable me to work in any industry

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

E4. **You have to be technically minded to succeed in the ICT, computing or technology industry**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

E5. **Creativity and imagination are qualities sought in students entering into the ICT, technology or computing industry**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

E6. **Social media and social networking allow me to interact with like minded people, when it comes to school work and outside activities**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

E7. **Collaborative social media allows me to share school work related problems amongst fellow students and on-line friends**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

Collaborative # working together with other people. This can be from all around the world, when social media is used as a tool.

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

Section F: Generational Effect

The effect and influence of older generations upon your understanding of computing (Older generation for the purpose of these questions is any one over 50 years of age)

F1. **Attitudes of the older generation (anyone older than 50 years) are negative towards ICT, technology or computing**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

F2. **There will be more women in the ICT, technology or computing industry in the next 10 years**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

F3. **There will be a change in attitude towards ICT, technology or computing when the older generation (current over 50's) retire from the workforce**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

F4. **The older generation (current over 50's) understand how important ICT, technology and computing is today**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

F5. **The older generation (current over 50's) understand how social media can enhance productivity**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

F6. **Instructors or teachers in their 20s or 30s will have a better understanding of the way I think and be able to help me more than older instructors or teachers (older being 50 +)**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

F7. **Thinking about your perception and attitude towards ICT, technology or computing from all the questions answered.**

ICT, technology or computing could be the right career choice for me

Yes ☐
No ☐
Don't know ☐

F8. **Is there anything else you would like to add that has not been covered within the questionnaire**

If you have any concerns or complaints about the ethical conduct of the project you may contact the University of Southern Queensland Ethics Coordinator on (07) 4631 2690 or email ethics@usq.edu.au. The Ethics Coordinator is not connected with the research project and can facilitate a resolution to your concern in an unbiased manner.

Thank you for your time to complete this survey

Appendix D. Employer Survey

This short questionnaire has been developed to gather data as part of my research into: ***What are the generational effects that influence participation of females in computing?***

Responses will be completely anonymous; no identifying information will appear anywhere on the questionnaire.

To complete this short questionnaire it should take approximately 15-20 minutes.

Section A: Demographics

Will ask questions based around you and where you come from

A1. Gender

- Female ☐
- Male ☐
- Do not wish to respond ☐

A2. Age

- 17 - 19 ☐
- 20 - 29 ☐
- 30 - 39 ☐
- 40 - 49 ☐
- 50 - 59 ☐
- 60 + ☐

A3. **Ethnicity, please choose the one you associate with from the dropdown list**

Note - European includes person from Europe or the UK and New Zealanders of European or UK heritage

- ☐ European
- ☐ New Zealander
- ☐ Maori
- ☐ Pacific peoples
- ☐ Asian
- ☐ Middle Eastern, Latin America, Africa
- ☐ Other

Other

A4. **What industry were you thinking of going into when you left education**

Section B: Cultural Factors

Factors that influence you from within your family and background.

B1. **Growing up I had access to a computer**

- ☐ Yes
- ☐ No

B2. **Growing up I had access to the internet**

- ☐ Yes
- ☐ No

B3. **Having computer technology in a place where everyone can use it is a good idea?**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

Note - Computer technology indicates desktop, laptop or tablet

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

B4. **My parents / guardians were influential when I thought about my future career:**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

B5. **Think back to when you were at school.**

My parents / guardians knew about ICT, technology or computing and the jobs available.

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

B6. **I think that students still believe that ICT, technology and computing is all about programming**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

B7. **My parents / guardians encouraged me to take ICT, tech or computing at secondary school**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

B8. **My parents / guardians influenced my decision on the career path that I chose**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

B9. **My family's view of ICT, tech or computing had an effect on me choosing computing as a career**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

Section C: Social Factors

Are the factors that may influence your perceptions through stereotype, friends, Social Media, Gender, Role models and mentors.

Stereotypically women and men involved in ICT, technology or computing are viewed as geeks or nerds

C1. **I believe there is still a problem with stereotypes within ICT, technology or computing**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

C2. **Would this stereotypical view be enough to put you off ICT, technology or computing as a career**

Yes ☐
No ☐
Don't know ☐

C3. **Stereotypical views are being kept alive in ICT, technology or computing by the older generation (people older than approximately 50 years)**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

#Note this is a general view not just within the ICT, technology or computing industry alone

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

C4. **Film and TV portray women and men in a stereotypical view (geek or nerd) when it comes to ICT, technology or computing**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

C5. **TV and film depict ICT, technology or computing as being unrealistic**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

C6. **When I was at secondary school my ICT, technology or computing teacher was a great role model**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

C7. **When I was at school my ICT, technology or computing teacher was a women**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

C8. **There should be more younger roles models in ICT, technology or computing**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

Young will equate to Generation Y or Millennial, anyone born mid 1980's to 2000

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

C9. **Role models played a big part in me choosing my career**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

Section D: Structural Factors

These are the external factors that influence you, from home, education, industry and the support you get from supervisors or bosses.

D1. **ICT, technology or computing should be a compulsory subject at secondary school**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

D2. **When I was at secondary school, ICT, technology or computing course reflected the type of jobs available in the computing industry**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

D3. **ICT, technology or computing work is a solo pursuit**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

D4. **I was more likely to choose a subject which my friends took when at school**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

D5. **There should be more women ICT, technology or computing teachers**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

D6. **It is important that my company keeps computer equipment and software up to date**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

D7. **I met with the secondary school career advisor at least once**

Yes ☐
No ☐

D8. **The secondary school career advisor was very up to date about ICT, technology or computing jobs**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

D9. **I got career advice from:**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

	1	2	3	4	5
Family	☐	☐	☐	☐	☐
Friends	☐	☐	☐	☐	☐
Teachers	☐	☐	☐	☐	☐
Career Advisor	☐	☐	☐	☐	☐
Media - including Online, TV, Magazines and Newspapers	☐	☐	☐	☐	☐

D10. Indicate your level of agreement with these statements towards ICT, technology or computing?:

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

	1	2	3	4	5
ICT, technology or computing is more for men than women	☐	☐	☐	☐	☐
Studying ICT, technology or computing locks you into one specific job	☐	☐	☐	☐	☐
ICT, technology or computing work is fun	☐	☐	☐	☐	☐
ICT, technology or computing involves repetitive work	☐	☐	☐	☐	☐
ICT, technology or computing means working on your own	☐	☐	☐	☐	☐
ICT, technology or computing is not necessary to a future career	☐	☐	☐	☐	☐

Section E: #Social IT Factors

Factors affecting your perceptions of what the future holds for the ICT, technology or computing industry

Social media includes any social apps or sites such as Facebook, Twitter, Instagram, Tumblr Linkedin, GIT, Slack, etc..

#SocialIT is about persuing passions, creating amazing things with others using existing, evolving and future technologies, how we can adjust quickly in an ever changing tech world.

E1. The jargon / language used for ICT, technology or computing confuses potential students, which pushes them away from a career in this sector

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

E2. **The jobs that secondary school students will take up in the ICT, technology or computing industry do not exist yet**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

E3. **Having an ICT, technology or computing qualification will enable me to work in any industry in the future**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

E4. **You have to be technical minded to succeed in the ICT, technology or computing industry**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

E5. **Creativity and imagination are qualities sought in students entering into the ICT, technology or computing industry**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

E6. **Social media and social networking allow me to interact with like minded people, when it comes to work and outside activities**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

E7. **Collaborative social media allows me to share work related problems amongst colleges**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

Section F: Generational Effect

The effect and influence that the older generations have upon your understanding of computing (Older generation for the purpose of these questions is any one over 50 years of age)

F1. **Attitudes of the older generation (anyone older than 50 years) are negative towards computing**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

F2. **There will be more women in ICT, technology or the computing industry in the next 10 years**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

F3. **There will be a change in attitude towards ICT, technology or computing when the older generation (current over 50s) retire from the workforce**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

F4. **The older generation (current over 50s) understand how important ICT, technology and computing is today**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

F5. **The older generation (current over 50s) understand how social media can enhance productivity**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

F6. **Generation Y or Millennial instructors/mentors will understand the way generation Z students think and be able to help better than Baby Boomers**

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

Baby Boomer generation born between 1946 - 1964

Generation Y / Millennials born between 1980 - 2005

Generation Z born after 2005

Note - Generation Y and Millennials can be counted as one generation depending on research

1 ☐

2 ☐

3 ☐

4 ☐

5 ☐

F7. **Thinking about your attitude towards ICT, technology or computing from all the section questions answered.**

ICT, technology or computing has been the right career choice for me

Yes ☐

No ☐

F8. **Are there any other comments you would like to add that have not been raised within this questionnaire**

If you have any concerns or complaints about the ethical conduct of the project you may contact the University of Southern Queensland Ethics Coordinator on (07) 4631 2690 or email ethics@usq.edu.au. The Ethics Coordinator is not connected with the research project and can facilitate a resolution to your concern in an unbiased manner.

Thank you for your time to complete this survey

Appendix E. Student Interview

Questions for Student Interviews

Q1 – Basic question to getting the ball rolling in the interview, this should be a simple easy to answer the question to start to get the trust of the participant.

- Tell me a bit about you and what you like and dislike about school and what you think you want to do as a job?
- If you know your career path, when did you decide?
- Have you changed your mind or did advice from other people to change your mind?

Q2 – Go in a bit deeper about school and background influences

- Tell me about IT at school, why do you perceive it that way; why did you or not take ICT?
- Can you explain in your words want your understanding of IT means?
- Tell me about why you think the perceptions and attitudes differ from girls and boys in ICT
- Do you have conversations about your career with your family, if so tell me about that, is that a big influence on you or was there something else that influences you such as friends or teachers?
- When I mention a role model what comes to mind and would a role model influence you when deciding on your career?
- What are your thoughts on computing becoming compulsory, like English and math?
- Does culture come into play when you think about our future?

Q3 – Talk about technology home and school

- Tell me about your use of technology, with all the technology and software available to help you has it changed your attitude towards IT or even changed your perception of the industry?
- What do you think when I mention IT and stereotypes? Moreover, can you think of any stereotypes about IT?
- Do you believe that you have to be technically savvy to work in the IT industry and why to think that way?

Q4 – The future of IT and the landscape of what it will become

- Tell me about how Social media and has that changed your perceptions or attitude towards IT?
- What does the future of IT look like to you and do you believe there is space for you in the industry?

- Is computing fun if so why if not, why?
- Do you think IT work is repetitive if so, why and if not, why?
- Do you think that IT work locks you into a specific job and if so why?
- What type of person do you think go into IT?

Q5 – The generational problem if it does really exist

- Tell me about what you perceive as a big problem that the IT industry has to overcome to become gender neutral?
- Do you perceive a problem of a generational gap in IT and if so, why?
- Tell me what you think IT will look like in the future?

Q6 – Summary question, summarise for the student what they have discussed

- From just this talk about IT and the industry, has it in any way changed your attitude or perception towards IT or the industry?
- Are you more likely to think about IT and a possible role in the future and maybe a possible career choice, if so, why or if not, why?
- Is there anything else you would like to talk to me about that I have not brought up in this talk?

Thank you for your time today, it has been incredibly insightful, thank you for answering my questions. I will be collating the information, and once the transcript has been put together, I will send you a copy to make sure that you are happy with the information and I have not missed anything important.

Appendix F. Employer interview

Questions for Employee Interviews

Q1 – Basic question to getting the ball rolling in the interview, this should be a simple easy to answer the question to start to get the trust of the participant.

- Tell me how in today's society, what schools should be doing to promote ICT and the industry to make it more attractive to students?

Q2 – Go in a bit deeper about school and background influences

- What could the schools be doing to help promote ICT as a great career choice?
- Do you believe that the schools are teaching the right information when it comes to ICT?
- Tell me about why you think the perceptions and attitudes differ from females and males in ICT
- How could industry help regarding career information about the industry? Students need a clear understanding of future career paths. However, ICT is a minefield of acronyms and unknowns.
- Males, more than females, look to family members as role models when deciding on their career path. How can industry strengthen the links with a diverse set of role models to encourage more female students?
- What are your thoughts on computing becoming compulsory, like English and math?
- How can the industry entice a diverse culture into the ICT workforce?

Q3 – Talk about technology home and school

- Technology is cheap and everywhere. How can industry change the perception and attitudes of students that technology is not just a tool to help but something more?
- Students still look upon the industry with stereotypical views, what can the industry do to change these views?
- Students believe that you have to be technically savvy to work in the IT industry. What can the industry do to help change their minds?

Q4 – The future of IT and the landscape of what it will become

- Has Social media changed perceptions or attitude towards ICT and did you believe this will have an impact on students career paths?
- Students still believe that ICT work is not fun; what are you doing that could change those perceptions, now and for the future?
- Students also still believe that ICT is repetitive, again what are you doing to change these stereotypical views?
- What type of person do you think go into ICT?

- How can schools prepare students for jobs that have not been invented yet in the ICT industry?

Q5 – The generational problem if it does really exist

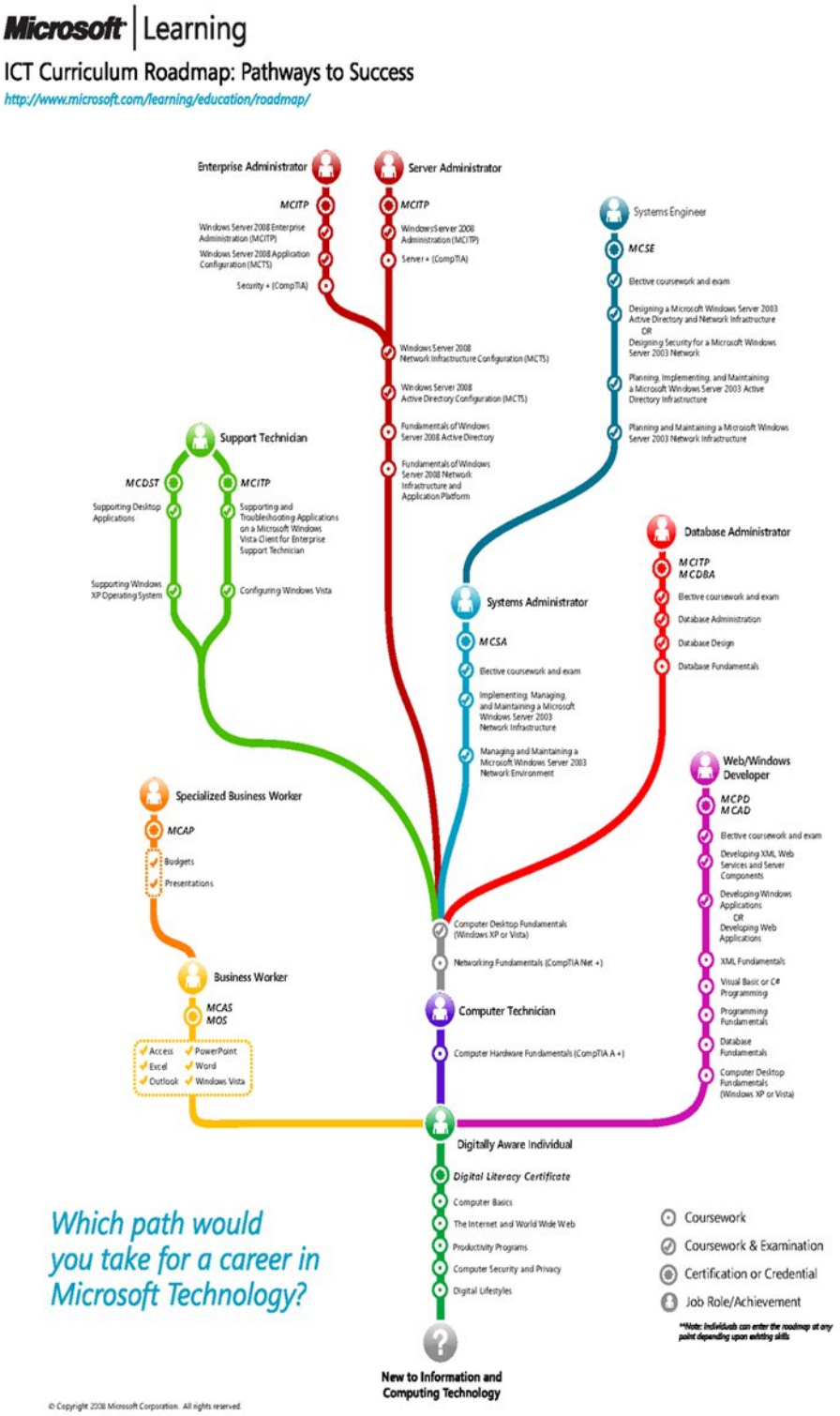
- Tell me about what you perceive as a big problem that the IT industry has to overcome to become gender neutral?
- Do you perceive a problem of a generational gap in IT and if so, why?
- What does the future of IT look like to you, and how will this impact on students at school think about a career in ICT?

Q6 – Summary question, summarise for the student what they have discussed

- How can industry change the attitude or perception towards ICT or the industry for potential school leavers?
- In your own words, what needs to change in the next five years to increase the number of students (including more females) to opt for a career in ICT?
- Is there anything else you would like to talk to me about that I have not brought up in this talk?

Thank you for your time today, it has been extremely insightful, thank you for answering my questions. I will be collating the information, and once the transcript has been put together, I will send you a copy to make sure that you are happy with the information and I have not missed anything important.

Appendix G. Microsoft ICT Roadmap



Appendix H. Updated survey questions based on Factor Analysis

B1	I have access to computer technology at home
B3	Having a shared computer in a place where everyone can use it is a good idea
B4	My parents/guardians are influential when I think about my future career
B5	I am aware of the different jobs available in ICT, technology or computing
B7	My parents/guardians encouraged me to take ICT, technology or computing at secondary school
B9	My parents/guardians view of ICT, technology or computing will have an effect o me choosing computing as a career
C1	I believe there is still a problem with stereotypes within ICT, technology or computing
C3	Stereotypical views are being kept alive in ICT, technology or computing by the older generation (people older than approximately 50 years).
C4	Film and TV show women and men in a stereotypical view (geek or nerd) when it comes to ICT, technology or computing
C5	TV and film show ICT, technology or computing as being unrealistic
C7	My ICT, technology or computing teacher is a great role model
C9	Role models play a big part in me choosing my career
D1	ICT, technology or computing should be a compulsory subject at secondary schoo
D2	The work we do in our ICT, technology or computing course reflects the type of jobs available in the computing industry
D3	ICT, technology or computing work, means working on your own.
D4	I am more likely to choose a subject which my friends are taking.
D5	There should be more women ICT, technology or computing teachers
D9	I get career advice from (Choose three, one being the best)
A	Family
B	Friends
C	Teachers
D	Career Advisor
E	Media including online, TV, Magazines and Newspapers
D10	Indicate your level of agreement with these statements towards ICT, technology o computing? (Say yes I agree or no I do not agree)
A	Studying ICT, technology or computing locks you into one specific job
B	ICT, technology or computing is more for men than women
C	ICT, technology or computing work is fun
D	ICT, technology or computing means working on your own
E	ICT, technology or computing is not necessary for a future career
E3	Having an ICT, technology or computing qualification will enable me to work in any industry
E4	You have to be technically minded to succeed in the ICT, computing or technolog industry

E5	Creativity and imagination are qualities sought in students entering into the ICT, technology or computing industry
E6	Social media and social networking allow me to interact with like-minded people when it comes to school work and outside activities
E7	Collaborative social media allows me to share school work related problems amongst fellow students and on-line friends
F1	Attitudes of the older generation (anyone older than 50 years) are negative toward ICT, technology or computing
F2	There will be more women in the ICT, technology or computing industry in the next 10 years
F3	There will be a change in attitude towards ICT, technology or computing when th older generation (current over 50s) retire from the workforce
F5	The older generation (current over 50s) understand how social media can enhance productivity
F6	Instructors or teachers in their 20s or 30s will have a better understanding of the way I think and be able to help me more than older instructors or teachers (older being 50 +)

Appendix I. Student newsletter (Survey)

Notice for inclusion in school newsletter:

Questionnaire: What are the generational effects that influence participation of females in ICT?

Information Communication Technology is one of the leading employers across the globe. There is only a very small percentage of females entering this affluent market that has great job prospects and fantastic opportunities. This research is looking at why this is the case in today's society. As part of this research, students in Years 11 in the Wellington region are being invited to fill in the questionnaire. Information from all the questionnaires will be used to help understand why the gender gap has risen dramatically over the past 10 years. This questionnaire will ask students about participation in ICT and their perceptions about technology. All information will be treated confidentially and no schools or individual students will be identified in the final report.

Appendix J. Student and Employee information sheet

Participant information

This short questionnaire has been developed to gather data as part of my research into *What are the generational effects that influence participation of females in ICT?*

If you wish to take part, all you need to do is complete this short questionnaire, which should take approximately 15-20 minutes. Responses will be completely anonymous; no identifying information will appear anywhere on the questionnaire.

Your participation in this project is entirely voluntary and anonymous. If you do not wish to take part, you are not obliged to. If, however you decide to take part and later change your mind, your answers are anonymous and will have no identifiable information attached and will not be able to be taken out of the pool of answers. Please note, if you wish to withdraw from the project after you have submitted your responses, the researcher is unable to remove your data from the project.

Your decision whether to take part, or not take part, or to take part and then withdraw, will in no way impact your current or future relationship with the University of Southern Queensland. There are no anticipated risks associated with your participation in this project.

All comments and responses will be treated confidentially. The names of individual persons are not required in any of the responses. Any data collected as part of this project will be stored securely as per University of Southern Queensland's Research Data Management policy.

If you have any concerns or complaints about the ethical conduct of the project you may contact the University of Southern Queensland Ethics Coordinator on (07) 4631 2690 or email ethics@usq.edu.au. The Ethics Coordinator is not connected with the research project and can facilitate a resolution to your concern in an unbiased manner.

Thanks for your participation.

Scott Morton

u105362@umail.usq.edu.au

Appendix K. Student and employee information (Interview)

Participant Information for USQ Research Project

Interviews

What are the generational effects that influence participation of females in ICT?

The main aim of this research is to find out What are the generational effect that influences participation of females in ICT? This research will look at many aspects associated with why females are not going on to pursue careers in this field, such as social, family, schooling and perceptions.

As part of this evaluation the first phase we look at a questionnaire seeking the opinions of participants from high schools in the Wellington region. The second phase will be to interview both male and female participants that completed the first phase and ask more directed questions based on the answers from phase one.

The interview will be carried out by Scott Morton and will take approximately half an hour. It will take the form of a semi-structured interview which can be done face-to-face, via the phone or online via video conference with the interviewer working through a prepared list of questions as prompts for discussion. The interviewee can bring a support person if desired. It is recommended by the researcher that a parent or guardian accompanies them to the interview to make them feel comfortable. With your permission, the interview will be recorded for later transcription. Only the researcher will have access to the recordings or transcriptions.

Your participation in this project is entirely voluntary. If you do not wish to take part, you are not obliged to. If you decide to take part and later change your mind, you are free to withdraw from the project at any stage. You may also request that any data collected about you be destroyed. If you do wish to withdraw from this project or withdraw data collected about you, please contact the Researcher (contact details at the bottom of this form).

Your decision whether you take part, do not take part, or to take part and then withdraw, will in no way impact your current or future relationship with the University of Southern Queensland

It is expected that this project will not directly benefit you. However, it may benefit staff members once the results are published.

There are no anticipated risks beyond normal day-to-day living associated with your participation in this project.

All comments and responses will be treated confidentially unless required by law.

All interviews with permission will be audio recorded. Below is the information regarding the recording of the interview:

- You will have the opportunity to verify your comments and responses prior to final inclusion.
- The audio recording will be kept for a maximum of seven years and then destroyed.
- The recording will not be used for any other purpose.
- Access to the recording will be Scott Morton and may include another staff member transcribing the recording. (At present this person has not been named due to not knowing at this stage).

Any data collected as a part of this project will be stored securely as per University of Southern Queensland's Research Data Management policy.

We would like to ask you to sign a written consent form (enclosed) to confirm your agreement to participate in this project. Please return your signed consent form to me prior to participating in your interview.

If you have any questions, please contact the researcher directly at u1053262@umail.usq.edu.au

If you have any concerns or complaints about the ethical conduct of the project you may contact the University of Southern Queensland Ethics Coordinator on (07) 4631 2690 or email ethics@usq.edu.au. The Ethics Coordinator is not connected with the research project and can facilitate a resolution to your concern in an unbiased manner.

Thank you for taking the time to help with this research project. Please keep this sheet for your information.

Appendix L. Student and employee consent (interview)

What are the generational effects that influence participation of females in ICT?

Declaration of Consent to be interviewed

I have had the scope and nature of the research fully explained to me. Any questions about the research have been satisfactorily answered, and I understand that I may request further information at any stage. I accept and note that:

My participation in this research is entirely voluntary.

I may withdraw from participation in the research at any time without explanation, disadvantage or disincentive.

The information given during the interview is being utilised solely for the purpose of the specific research project and will not be disclosed to any other person or agency without my express consent.

The interview will be recorded for later transcription.

This information may be incorporated into the research report but actual names or other characteristics that may lead to identification of individuals or schools will not be disclosed, nor appear in any subsequent report, presentation or publication.

I may at any time request to view any completed drafts or sections of the research report to which I have contributed.

A copy of the completed research report will be made available to me, on request, at the conclusion of the research.

DECLARATION

I have read and understood the information set out on this form, and give my informed consent to be interviewed in accordance with the stated terms and conditions.

Name_____

Signature_____

Date_____