FACTORS AFFECTING COMPUTING STUDENTS' AWARENESS OF THE LATEST ICTS

Submitted in fulfilment of the requirements for the degree of

Master of Technology

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20/08/2015

ABSTRACT

Education is constantly challenged by rapid technological changes both in terms of curriculum renewal and in terms of students' awareness of these new technologies. This is the reason why the aim of this study is to analyse factors affecting computing students' awareness of the latest ICTs. This aim is further divided into four research sub-aims: the selection of the relevant theories for this research; the design of an appropriate conceptual model to support it; the empirical testing of the above mentioned model; and finally, recommendations arising from the research results. The first research sub-aim is accomplished through selection of the Innovation Diffusion Theory (IDT) as the theoretical framework of this study after a review of different theories of technology adoption. The second research sub-aim is accomplished through the design of a conceptual model which is an adaptation of the relationship between the prior conditions construct and the knowledge/awareness construct of IDT. The prior conditions that were studied are students' perceived exposure to career guidance and students' perceived curriculum currency. These prior conditions were analysed as possible predictors of computing students' technology awareness. The third sub-aim is accomplished by means of a survey of 116 computing students from the four universities of the KwaZulu-Natal province of South Africa, the results of which validated most of the relationships hypothesized by the above mentioned model. Having knowledge/awareness as the main variable of the current study can be seen as its main contribution in view of the fact that only two studies from the reviewed literature on IDT are examining the awareness/knowledge construct. The fourth sub-aim is accomplished by means of some recommendations, one of which is that gender and ethnicity be considered when curriculating computing courses both at the high school level and at the university level.

Keywords: Technology awareness, ICTs, Curriculum, Education, IDT

DECLARATION

I hereby declare that this dissertation represents my work and that it has not been submitted in any form for another degree or diploma at any other institution of higher learning.

Information derived from published or unpublished work of others has been acknowledged in the text and a list of references is presented.

______________________________ _______________________

Oluwakemi D. Adegbehingbe **Date**

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Supervisor: **Date**

Prof S.D. Eyono Obono

DEDICATION

To God almighty, the omniscient, the beginning and the ending, and the immutable.

ACKNOWLEDGEMENTS

All honour and gratitude to God Almighty for giving me strength, the knowledge, and the inspiration needed to complete this research. I sincerely appreciate Him, my helper, my rock for His infinite grace and mercy through the duration of this study.

I appreciate my supervisor, Prof S.D. Eyono Obono, for his thorough supervision of this research work, and for his moral and intellectual support throughout the various stages of this study.

I sincerely appreciate the Durban University of Technology for the scholarship to pursue this degree and thereby making my dream come true. I will forever be grateful to this wonderful institution.

Thanks to my wonderful parents, Dr and Mrs Adegbehingbe for their prayers, financial and moral support throughout this program. You are the best parents I could ever ask for. All my siblings, colleagues, friends and loved ones too numerous to mention that have contributed in one way or the other towards the successful completion of this program, I thank you all.

Finally, my deepest appreciation goes to my loving husband, Mr Temitope Osuntokun, whose financial support, efforts and sacrifice towards the success of this research has been truly wonderful. Thank you my dear for the great support, love and understanding. I am so grateful.

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CHAPTER ONE

INTRODUCTION

The final objective of this study is to propose recommendations for the improvement of technology awareness within the higher education sector, especially through curriculum initiatives as this can contribute towards quality education. Therefore, it is imperative to begin this chapter by describing what quality education means and by highlighting the central role of curricula in quality education. This chapter defines quality education as the achievement of high academic standards, access to highly valuable educational resources, well-implemented educational policies, and well-designed curriculum. It also presents the aim, objectives, and the research method utilized to achieve the aim of this study.

1.1 What is Quality Education?

The quality of education is irregular across nations, and occasionally even in different regions in a given nation. In general, education is highly rated in advanced nations when compared to unindustrialized nations (Mingat and Tan 1998). But what is quality education? According to Redmond, Curtis and Noone (2008), quality education is the achievement of high academic standards and realization of the set learning goals. Also, quality education is having access to necessary educational resources such as teachers, learning materials, instructional amenities and equipment. Moreover, quality education is the use of well executed policies for the advancement of education; and high quality education cannot exist devoid of a well-made curriculum.

1.1.1 Academic Standards

High academic standards are realised when learners obtain and exhibit the expected capabilities (Redmond *et al.* 2008). A lot of factors have been known to influence students' academic performance. These factors can be classified into three kinds: educator, student and government related.

Educator related factors include teaching expertise, motivation and educational trainings (Goldhaber and Brewer 1997; Wößmann 2003; Rockoff 2004). According to Haycock (2001), students' academic performance is improved by educators' teaching expertise. These expertise can be picked up through training and research (Elmore 2002a). According to Contressas, Flores, Lobato and Macias (2003), eductors can also be inspired to nurture efficient graduates. In addition, motivations with use of cash benefits and rewards can be used to encourage teachers to devote additional period and to demonstrate more dedication to their responsibilities as educators. Additionally, Rockoff (2004) asserts that a relationship exist between educators' professional trainings and students' academic performance as teachers with educational credentials in a discipline are likely to have more understanding and skill to enhance students' attainment of high academic standards.

Student associated factors such as demographics and effort also influence students' educational achievement (Marks and McMillan 2001; James 2003; Rockoff 2004). A study by Marks and McMillan (2001) found that students' demographic characteristics such as parental academic qualification, affluence, and wellbeing affect their educational achievement. Students have a high chance of attaining high academic standards when they spend more period on their academic work and make use of the learning facilities accessible for their studies (James, 2003; Wirt, Chay, Rooney and Provanik 2005).

Government associated factors such as learning supports and education appraisal approaches also influence academic standards. Governments all over the world assign a considerable amount of their budget to education (Haycock 2001). This is to make sure that education is within the reach of the citizens and the whole nation (Cassel, 2003). Furthermore, governments use appraisal approaches to enhance the quality of education (Ewell,1987). For instance, in the United States of America, the National Centre for Education Statistics (NCES) uses various methods to assess the quality of education in schools. They usually carry out studies on the demographics of educators, institutions of learning, homes, and learners. They also carry out examinations on graduates, and they evaluate learners' records (Wirt *et al.* 2005). Additionally, they conduct reviews and appraisals in educational institutions (Ferguson, Ouston, Fidler and Early 2001; Glover and Levacic, 2003).

1.1.2 Educational Resources

Accessible and properly utilized instructional resources are some of the reasons why nations like China, South Korea and Finland attain a high status for the quality of their education. For this reasons, these nations are presently challenging “powerhouse” nations such as the United States of America (USA) and the United Kingdom (Shepherd 2010). According to Cheng and Tam (1997) educational resources include devoted and competent staff, suitable facilities and equipment, and accessible and well managed monetary resources.

Devoted and competent academic staff produces highly skilled students because such staff is able to use their expertise to ascertain the best instructional methods for imparting the necessary abilities into students (Goldhaber and Brewer 1997; Elmore 2002b; Wößmann 2003). For the purpose of achieving this, schools and governments try to employ qualified staff in order to ensure that students possess the needed knowledge and expertise.

Accessibility of suitable facilities and equipment is also important for the effective impartation of knowledge and skills into students (Daly, Witt, Marten and Dool 1997). Both facilities and instructional strategies should be current with regard to novel technologies. For instance, collaborative teaching should be accompanied by latest and novel facilities such as digital chalkboards, interactive videos and movable computers (Lyons 2001).

Accessible and properly utilized monetary resources also enhance the enrichment of the quality of education by assisting in getting and handling other educational resources such as educators and instructional facilities. For this purpose, governments all over the world assign a considerable part of their financial plan to education. In addition, these governments frequently check educational institution’s financial records to ascertain that the resources accessible to educational institutions are used effectively (Wirt *et al.* 2005).

1.1.3 Education Policies

National education policies are provided by governments to ensure control over problems of national interest in the area of education. These problems may consist of schools’ administration and funding, the taking on of new instructional strategies like outcome-based education or content-based education, and educators' training (Cohen and Hill 2000; Hearn and Longanecker 1985; Vidovich and Porter 1999).

The financing of educational institutions is generally controlled by governments all over the world from the sharing out of national financial plan to education to the description of standards for defining learners' worthiness for financial grants. They also control schooling fees for various categories of schools. Policies for schools' governance normally grant a certain level of independence to institutions of learning. For instance, governments may permit these institutions to define their own academic programmes and set plans for the successful execution of these academic programmes (Hopkins and Levin 2000).

The implementation of innovative educational strategies is also commonly determined by governments. For example, because of the growing education quality worries, governments may embrace policies that enhance their educational strategies (Sahlberg 2007).

According to Hanushek, Rivkin, Rothstein and Podgursky (2004), educators' professional training plans are normally given by governments with the purpose of improving the skill of educators. These policies are made to assist in giving the rules that must be followed for the hiring, promotion and retirement of academic staff.

1.1.4 Curriculum

According to Casey, Magrane and Lesnick (2005) high quality education cannot be attained void of a well-made curriculum that gives the appropriate strategy and direction for producing versatile graduates. The meaning of curriculum is embodied in its Latin derivation which implies "course" or "track to be followed". According to (Marsh 1988), the concept of curriculum can be explained in three dimensions. Firstly, curriculum comprises of comprehensive analysis of aims and objectives, learning experiences, syllabi and evaluation, and recommendations. Secondly, curriculum is comprised of planned or envisioned learning calling attention to unforeseen circumstances which unavoidably may occur in the classroom practices. Thirdly, curriculums are inextricable. A well-designed curriculum needs the contribution of all appropriate stakeholders and needs to keep up with technological changes in terms of content and teaching strategies; it must also be well executed and constantly evaluated. There are many strategies to design and develop a curriculum; these are called curriculum development models. A curriculum development model is a structured framework which directs curriculum planning and implementation based on learning and teaching theories. It is also a concrete guide that elucidates the processes to be adapted when executing any curriculum.

The involvement of these stakeholders is important for the making of an effective curriculum: faculties, government, industries, professional bodies, learners, and parents. These stakeholders are required to assist in the curriculum design process by communicating their wants and anticipations of the curriculum to be designed. These wants need to be considered when determining the desired aims of the curriculum (Hubball, Collins and Pratt 2005).

An efficient curriculum must be current with regard to technological changes based on its content and teaching strategies. Actually, change appears to be inevitable as life advances. Although new technologies are most times an improvement of other technologies, making learners aware of new technologies enhances the value of their curriculum. Even though it is difficult to forestall technology changes while designing a curriculum. This challenge can be overcomed by making sure that the curriculum designers continually consider the latest technologies while designing a curriculum, taking cognizance of the fact that these technologies are the ones that advance to new technologies. This necessitates the engagement of curriculum designers in higher research, not only as curriculum specialists, but also as specialists in the discipline for which the curriculum is being designed.

It is also vital for the curriculum to be appropriately executed and regularly assessed. The main concern in the enactment of a curriculum might be the suitable allotment of appropriate resources (Davis and Harden 2003). Likewise, it is essential that the execution of a curriculum firmly keep to the stipulations laid down by that curriculum. In addition, curriculum evaluation should all the time be done to measure the alignment of the implementation of a curriculum to its original stipulations. For the purpose of lucidity, it appears imperative to bring to light the dissimilarity between curriculum evaluation, students' evaluation, and students' assessment. Curriculum evaluation is the examination of a curriculum to ascertain its efficacy in attaining its set out goals, and its significance to the requirements of the education stakeholders. Curriculum evaluation is normally done with the aid of a survey of relevant education stakeholders. Student participation in the curriculum appraisal process is normally referred to as student evaluation of the curriculum. However, the term ‘student evaluation’ term should not be muddled with the term ‘student assessment’. Student assessment consists of examining the students to ascertain their attainment of the goals set by a curriculum.

1.2 Problem Statement

As previously specified in the preceding section, an effective curriculum must be current with regard to the advancement in technologies based on what it contains and based on instructional strategies that are utilized even though it is challenging to know these advancements in technology during the design phase of a curriculum. This is because the curriculum is expected to be the medium by which students can become more aware of new ICT trends such as Digital Switch Over (DSO), thereby enabling them to play a creative and active role in the design and adoption of new technologies.

According to the existing studies, education is continuously faced by constantly changing technologies, as shown by various studies from various academic fields including mechanical engineering (Latorre, Hatamura and Ohasi 1994), civil engineering (Grigg, Criswell, Fontane and Silver 2005), marketing (Goldsmith 2004), and information technology (Brewer, Hamper and Mendonca 2006; Lightfoot, 1999).

According to Latorre, Hatamura and Ohashi (1994: 129) “the challenge for mechanical engineering education is to develop an appropriate response to the rapid advances in technology and future engineering needs”. This is buttressed by Grigg *et al.* (2005) according to whom fast changes in information technology generate tasks for civil engineering educators and students. These variations in technologies necessitate curricula to be easily changeable, and for educators to gain competency and access to new equipment and software. Similar concerns are raised by (Goldsmith 2004: 10) in the following statement about the marketing discipline: “The practice of marketing management is continually changing as it reflects the organizational, scientific and technological, economic, and social contexts in which it is embedded”. As a constantly growing field, academic marketing need to be up to date with these changes. Marketing educators must not only teach learners unchanging marketing principles to learners, they must make them ready for the outside worlds that these advancements are taking place. Likewise, according to Becerik-Gerber, Gerber and Ku (2011: 414), “the rapid change from CAD (Computer Aided Design) to BIM (Building Information Modelling) has created several challenges for the architecture, engineering and construction educational programmes”.

Also, in the information technology discipline, as previously stated above, existing research shows that “keeping up with [new] information technologies and [with] their profound impact on IT education is perhaps the greatest challenge to the establishment of an effective and dynamic [IT] curriculum” (Brewer, Hamper and Mendonca 2006: 443). A related assertion is made by (Janicki *et al.* 2004: 1) that “educators in the fields of Information Systems (IS) and Information Technology (IT) encounter a continuing challenge to insure that their courses and curriculum stay up to date with the technological changes in the field as well as being relevant to the business community”. This is because the rate of technological changes makes it cumbersome to prepare graduates with the necessary skills for the future (Lightfoot 1999) as “changes taking place in technology and dependence on new technologies require that educators frequently make changes that affect curriculum content” (Gonzenbach 1998: 9).

Regrettably, the risk of inefficient and inexperienced workers is inevitable if the curriculum is not continually revised by integrating new technology developments into it, and if the students are not aware of these technologies. Therefore, the curriculum must be current in order to prepare graduates for the future and strategies must be put in place to ensure that students are aware of new technologies. For example, existing research indicates that the task of designing curriculum is more productive when a model is employed to give direction (Wiers *et al.* 2002; Dopson and Tas 2004). In addition, efficient curriculum models set standards for curriculum development which consider new technological trends and propose how these trends can continue or change in the future (Wallace 2002; Cotgrave and Kokkarinen 2010; Pasha and Shaheen Pasha 2012).

1.3 Research Questions, Aim, and Sub-aims

It can be seen from the previous section that high academic standards, good policies, available resources, and high quality curriculum are important for the attainment of high quality education. It can also be seen from the previous section that scientific disciplines such as ICTs must ensure the adoption of instructional and curriculum standards or principles so as to ensure that students become aware of new and rapidly evolving technologies in order to avoid producing graduates who are redundant to the current workforce. This section therefore presents the research questions, aim and sub-aims of the study, which focuses on the analysis of the factors affecting computing students' awareness of the latest ICTs.

1.3.1 Main Research Question

The main research question of this study can be stated as follows: What are the factors that affect computing students' awareness of the latest ICTs?

1.3.1.1 Research Sub-Questions

The above mentioned main research question is further expressed by the following listed research sub-questions:

a) Research question 1: Which theories can help to understand the factors affecting ICT students' awareness of the latest ICTs?
b) Research question 2: How can the above mentioned theories be shaped into a conceptual model of the factors affecting computing students' awareness of the latest ICTs?
c) Research question 3: How can the conceptual model of research question 2 be empirically validated?
d) Research question 4: Which recommendations can be suggested from the analysis of the factors affecting ICT students' awareness of the latest ICTs for the improvement of technology awareness in the education sector?

1.3.2 Research Aim

This section now presents the aim of this study, which is to examine factors affecting computing students' awareness of the latest ICTs. This aim is further articulated by following research sub-aims stated below.

1.3.3 Research Sub-aims

The following are the research sub-aims that assist in achieving the main aim of this study.

a) To select relevant theories that can help to understand the factors affecting students' awareness of the latest ICTs;
b) To design a conceptual model of the factors affecting students' awareness of the latest ICTs;
c) To empirically test the above conceptual model of the factors affecting students' awareness of the latest ICTs; and
d) To make appropriate recommendations for the improvement of technology awareness within higher education, especially through curriculum initiatives.

1.4 Rationale

This study is driven by the necessity of ensuring that computing students are aware of novel and latest technologies. This is due to the fact that technology changes frequently. Therefore, it is essential for faculties in the field of computing to keep up with these changes by designing curricula that put into account new technologies. Moreover, effective curriculum design is vital for preparing IT graduates with the necessary competence to design and manage the requirements of the new technologies. The task of equipping graduates with these essential skills can be achieved by ensuring that the curriculum is current with regard to novel technologies. An example of such technology is the digital switchover. Iosifidis (2006) defines digital switchover as the change from analog to digital television broadcasting for the attainment of better spectrum efficiency. This novel digitized network is anticipated to improve the global economy by providing new communication services. DSO will also offer a multitude of prospects for the IT sector in areas such as the development of new programmes that will enhance the usefulness of the new digitized network. The players within the the digital television field include: regulatory bodies, multiplex operators, manufacturers and suppliers of various hardware and software components, the technology itself, and lastly the users (Mackay 2007).

Presently, DSO has taken place in various nations around the world (see Table 1). Other nations have put aside the periods they anticipate that their DSO will take place. However, DSO has been mandated by the International Telecommunication Union (ITU) to occur by 2015 globally.

Table 1: DSO years for different countries

Country	DSO Year
Italy	2006
Finland	2007
Sweden	2008
USA	2009
Austria	2010
France	2010
Germany	2010
Spain	2011
Belgium	2012
Hungary	2012
Slovakia	2012
Slovenia	2012

1.5 Structure of Dissertation

This dissertation consists of five chapters. Each of these chapters is briefly introduced below.

Chapter 1 - Introduction

The first chapter presents the aim of this study towards analysing the factors affecting computing students' awareness of the latest ICT technologies. It highlights the need for curriculum to be current with regard to technological changes in order to ensure students become aware of these technologies and thereby able to effectively assume a creative role in the awareness and adoption of technologies in the education sector. It also briefly describes what quality education means.

Chapter 2 Theoretical Frameworks

Different theoretical frameworks that can help to understand the factors that affect students' awareness of the latest ICTs are presented. In addition, different curriculum development frameworks which can guide curriculum development processes are reviewed.

Chapter 3 Research Design

This chapter describes the research methodologies used for the achievement of the third objective of this research. This includes a description of the survey of computing students in the four universities of the KwaZulu-Natal province of South Africa.

Chapter 4 Research Results

In this chapter the descriptive and inferential results regarding the factors affecting the awareness of computing students are presented. This helps in the validation of the conceptual model that was designed in Chapter two.

Chapter 5 Discussion, Recommendations, Summary and Conclusion

This chapter presents a summary of the results of the current study in comparison with the results of the studies reviewed by this research. It also makes recommendations on the improvement of technology awareness and adoption in the education sector.

1.6 Summary and Conclusion

This chapter begins by describing quality education as achieving high academic standards, well utilized educational resources, well executed educational policies, and well implemented curriculum. The second section of the chapter presents the problem statement of this study, i.e. the challenges faced by various educational fields in being up to date with technological changes.

The next section of the chapter presents the aims, sub-aims, and research questions of this study. The aim of this study is to analyse the factors affecting computing students' awareness of the latest ICTs. This is further divided into four sub-aims corresponding to the following four research questions.

The next two sections of the chapter are respectively on the rationale and on the design of this research. In the research rationale section, the aim of analysing the factors affecting computing students' awareness of the latest ICTs is linked to the problem of ever changing technologies. In the research design section, it is announced that the first research sub-aim will be achieved through a selection of relevant theories that help to understand computing students' awareness of the latest ICTs, and the third research sub-aim will be achieved through a survey of computing students in the KwaZulu-Natal province of South Africa. Finally, the last research sub-aim will be achieved by making appropriate recommendations for the improvement of technology awareness within higher education, especially through curriculum initiatives.

CHAPTER TWO

THEORETICAL FRAMEWORKS

The aim of this study is to analyse the factors affecting computing students' awareness of the latest ICTs, and the first sub-aim of this study is to select relevant theories that can help to understand these factors. Moreover, the final sub-aim of this study is to propose recommendations for the improvement of technology awareness within the higher education sector, especially through curriculum. This is the reason why this chapter has selected theoretical models on technology awareness and on curriculum development as the ones that can help to understand the factors affecting computing students' awareness of the latest ICTs.

2.1 Selection of Theoretical Frameworks

There is much evidence from existing literature showing that technology awareness is one of the primary stages of technology adoption. In fact, a consumer is said to be aware of a given technology when he or she has acquired basic information about that technology, and possibly about its advantages and disadvantages; and many studies have shown that technology awareness is one of the first steps of technology adoption (Ewell 1987; Goldhaber and Brewer 1997; Elmore 2002b; Cassel 2003; James 2003). Indeed, according to Goldhaber and Brewer (1997: 20), awareness is a key prerequisite for the development of specific, positive perceptions which in turn leads to innovation adoption. In addition, James (2003) asserts that consumers' awareness of information technology helps to predict their intention to adopt that technology. A similar claim is made by Elmore (2002b) according to whom awareness and knowledge of a technology precedes adoption decisions. A study by Cassel (2003) highlights that adoption or rejection of an innovation begins with consumer awareness of that technology. In addition, according to Ewell (1987: 551), an important factor for adoption is creating awareness among potential users. It is evident, therefore, that technology adoption theories can be selected as a theoretical framework which can help to understand the factors affecting students' awareness of the latest ICTs. A more detailed description of these technology adoption theories is presented below. Readers are reminded that the aim of this study is to design an ICT curriculum renewal model from the analysis of the factors affecting ICT students' awareness of the latest ICTs. It is therefore important to also present existing theoretical frameworks or models that are used for curriculum renewal, in addition to the already above announced technology adoption models.

2.2 Technology Adoption Theories

Technology adoption theories help to understand how individuals reach the decision to accept or to reject a technology (Lee, 2004). Adoption can be defined as the acceptance to take up an innovation and non-adoption can be defined as the rejection of an innovation (Sahin, 2006). There are many theories that have been proposed to explain the reasons why individuals and organizations decide to adopt or not to adopt a given technology. Examples of such theories include the theory of reasoned action (TRA), the innovation diffusion theory (IDT), and the social learning theory, and the theory of planned behaviour. All these technology adoption theories have inspired important studies on the design of different technology adoption models.

2.2.1 Theory of Reasoned Action (TRA) and Related Models

The theory of reasoned action (TRA) (Figure 1) posits that the behaviour of an individual is driven by his or her intentions, and people's intentions depend on their attitudes and on their subjective norms. Even though, TRA gave a contribution on what drives behavioural changes in individuals, it does not propose the means of changing behaviour. In addition, many effective behavioural change techniques exist which doesn't affect intention, attitude or subjective norms. This means that changes on these beliefs will have very small effect on the behaviour of the individuals (Sneihotta 2009). The Technology Acceptance Model (TAM) (Figure 2) is the main technology adoption model which is based on TRA. It is was proposed by (Davis 1989), and it is one of most widely used technology adoption models (Mathieson 1991; Gefen and Straub 1997; Calantone, Griffith and Yalcinkaya 2006). According to TAM an individual will develop an attitude towards an innovation depending on how he or she perceives the usefulness of that innovation to him or her and depending on how he or she perceives that innovation's ease of use.

Thus, the attitude of an individual towards the innovation which leads him or her to develop an intention to use or not to use the innovation in question, and it is that intention which will ultimately lead to the acceptance or refusal to use the innovation.

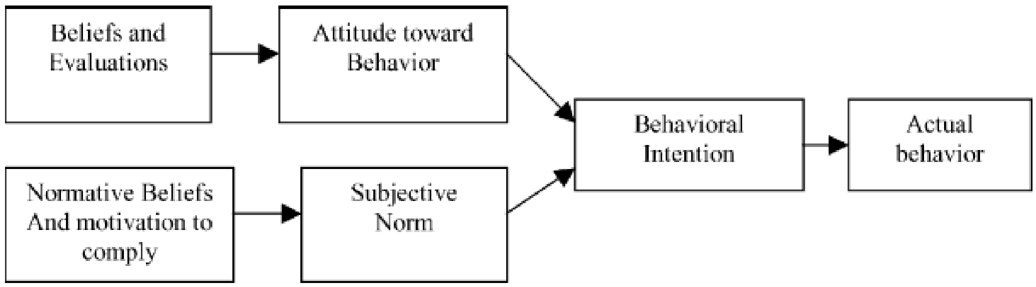

Figure 1: Theory of Reasoned Action

(Legris *et al.* 2003)

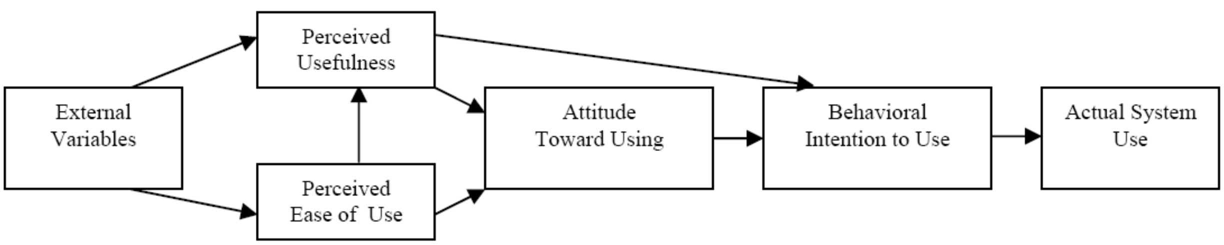

Figure 2: Technology Acceptance Model

(Legris *et al.* 2003)

2.2.2 Innovation Diffusion Theory and Associated Model

The innovation diffusion theory (IDT) (Figure 3) posits that, for a consumer to voluntarily accept or reject an innovation, he or she first of all must have knowledge of that innovation. It is that knowledge that will persuade him or her to decide to adopt or reject the innovation in question, either permanently or temporarily. Moreover, according to IDT, there are five attributes of an innovation: relative advantage, compatibility, complexity, trialability, and observability. Relative advantage is the degree to which an innovation is perceived as being better than its predecessors. Compatibility is the degree to which an innovation is perceived as being in line with existing values, with past experiences and with the needs of users. Complexity is the degree to which an innovation is perceived as being relatively difficult to use. Trialability is the degree to which an innovation can be experimented with, and Observability is the degree to which an innovation is palpable rather than abstract. The IDT finally posits that users' prior conditions such as their prior needs and previous practices as well as their personal characteristics such as their demographics and their socioeconomic conditions have an influence on their knowledge of innovations whose diffusion is propagated via relevant communication channels. IDT points out the main variables that increase or decrease the probability of a new idea, practice to be adopted. In addition,

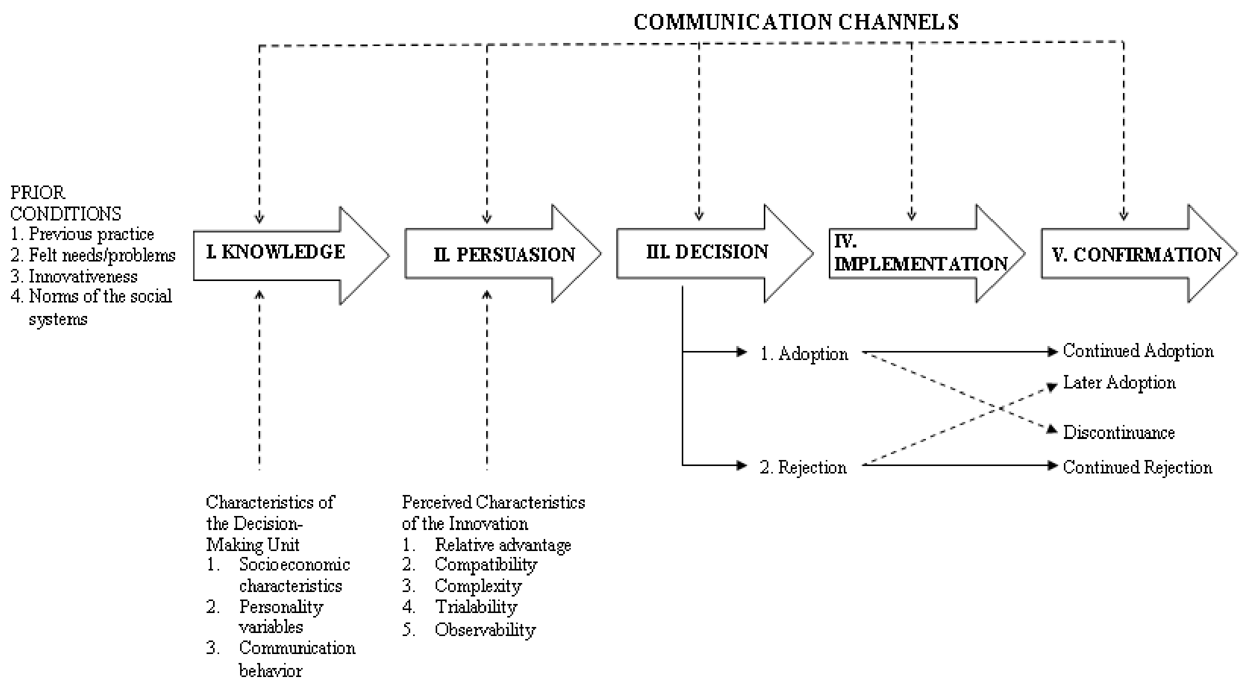

Figure 3: Rogers Innovation Diffusion Theory and model

(Sahin 2006)

2.2.3 Social Learning Theory and its Associated Model

Social learning theory (Figure 4) is grounded on the belief that the behaviour of a person depends on three types of factors: two personal factors which are cognitive and behavioural, and one collective factor which is environmental (Bandura and Adams 1977). A person's cognitive characteristics are expectations, and attitudes; while his or her behavioural characteristics are his or her skills, self-efficacy, and experience. Environmental factors which may affect the behaviour of a person are his or her social norms, the facilities accessible in his or her community, and his or her ability to influence others. This theory can be summarised by stating that people's behaviour depends on what they have learned from their own circumstances, from their personality, and from their past behaviour, as well as from what they have learned from the behaviour of others.

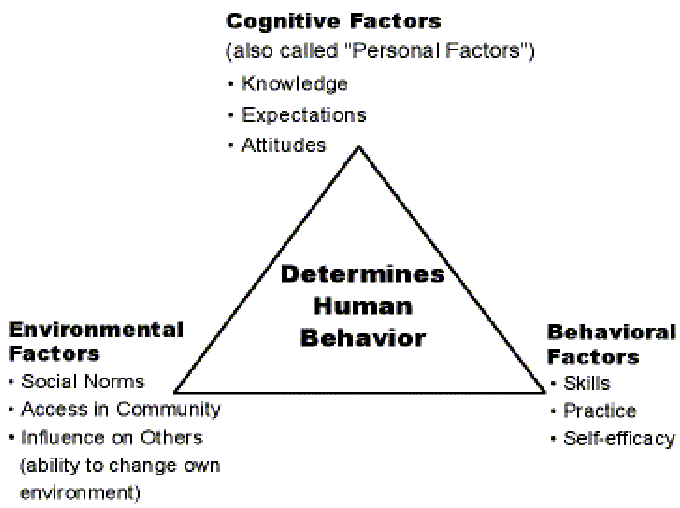

Figure 4: Social Learning Theory

2.2.4 Theory of planned behavior (TPB) and Associated Models

Theory of planned behavior (Figure 5) is an extension of TRA with perceived behavioural control as an additional construct or variable which is believed to directly affect peoples' intentions as wells as their behaviour. Perceived behavioural control refers to the degree to which a person feels that he or she is in control of a given situation (Dinev and Hu 2007).

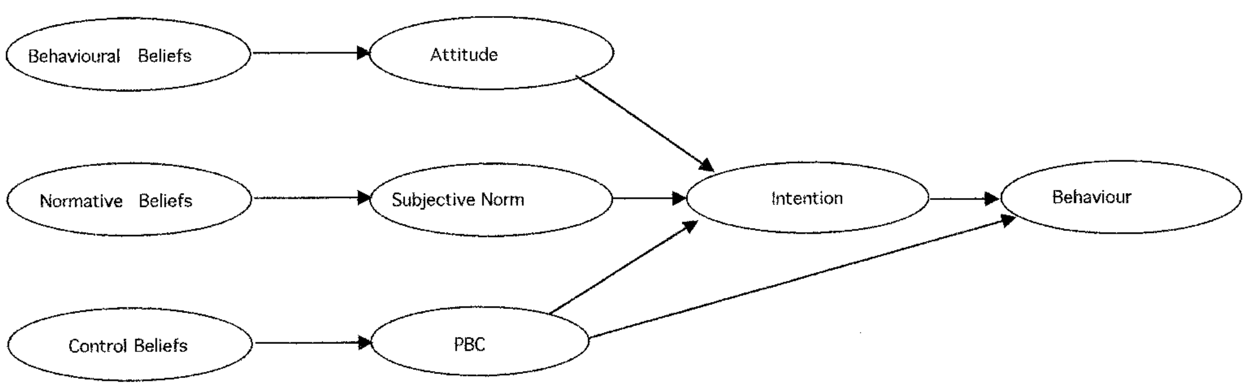

Figure 5: Theory of Planned Behaviour

(Armitage and Conner 2001)

2.2.5 Weaknesses of technology adoption theories

According to existing literature, each of the above technology adoption theories has some weaknesses. TAM is blamed for neglecting the collective, social and cultural aspects of behavioural change decisions (Bagozzi 2007). In addition, TAM only considers two possible factors that may affect the attitude of an individual towards a given behaviour, even though it is very likely that attitude towards a behaviour is affected by more than two factors (Chuttur 2009). As for IDT, it acknowledges that innovation decisions for complex innovations require the acquisition of how to knowledge on these innovations, but it does not indicate how this knowledge can be acquired (Dwivedi *et al.* 2009). Moreover, IDT doesn't consider the dynamics of technology adoption in situations where the adopter is part of multiple social systems. Concerning social learning theories, they see cognitive learning as an important prerequisite for behavioural change and for conflict resolution. However, it fails to recognize that many behavioural changes are not brought about through learning; and a change in beliefs, attitudes, and intentions does not necessarily lead to a change in behaviour (Muro and Jeffrey 2008). The main weakeness of TPB is that it suggests that behaviour change can be achieved by changing salient beliefs, but it doesn't suggest any particular cognition change techniques to modify behavioural, normative and control beliefs (Sniehotta 2009).

2.3 Curriculum Development Models

According to existing literature, curriculum development models can be classified into two groups: technical or scientific models and non-technical or non-scientific approaches of curriculum models (Maclean 1992; Grier 2005). Technical curriculum models are usually organized as a sequence of steps which are initialized by the statement of the objectives of the programme to be designed. Another common step to most technical curriculum models is the identification of teaching and evaluation strategies. According to O'Neill (2010), examples of technical curriculum development models are the ones from Bobbitt (1918), Tyler (1949), Taba (1962), and from Wiggins and Mctighe (1998). On the other hand, non-technical curriculum development models believe that curricula should not be started with the setting of precise objectives, but should be designed based on the continuously changing needs and perceptions of students and teachers. Non-scientific curriculum models are learner-centered and their teaching and learning methods are activity oriented. According to O'Neill (2010), examples of non-technical curriculum models are Alan Glatthorn's naturalistic model, Walker's deliberative model, and postmodern curriculum models such as the ones from Doll and from Slattery.

2.3.1 Technical Curriculum Models

These curriculum models consider that curriculum should be designed with the stating of the aims precisely. These aims can be followed in a linear fashion.

2.3.1.1 Bobbitt Curriculum Theory (1918)

Bobbitt's theory posits that curriculum developers should first analyze human general life experiences as well as their work life experiences in order to derive and select the learning objectives of the curriculum (Njogu 2012). Finally, curriculum developers should design a plan on how to attain the curriculum objectives (Kelting-Gibson 2013).

2.3.1.2 Tyler Curriculum Model (1949)

According to Tyler, the first step of curriculum development is the definition of the tentative objectives of the curriculum. These tentative objectives can be derived from three sources which include studies of the learner, the subject matter, and society. These tentative objectives are then adapted or modified according to the philosophy and the psychology of the school for which the curriculum is being developed in order to derive the precise objectives of the curriculum. Educational experiences that are suitable for the realization of these precise objectives are then proposed, as well as the design of their organization; and the evaluation methods for the students who will enroll into the curriculum in question (Desrosier 2011) (Figure 6).

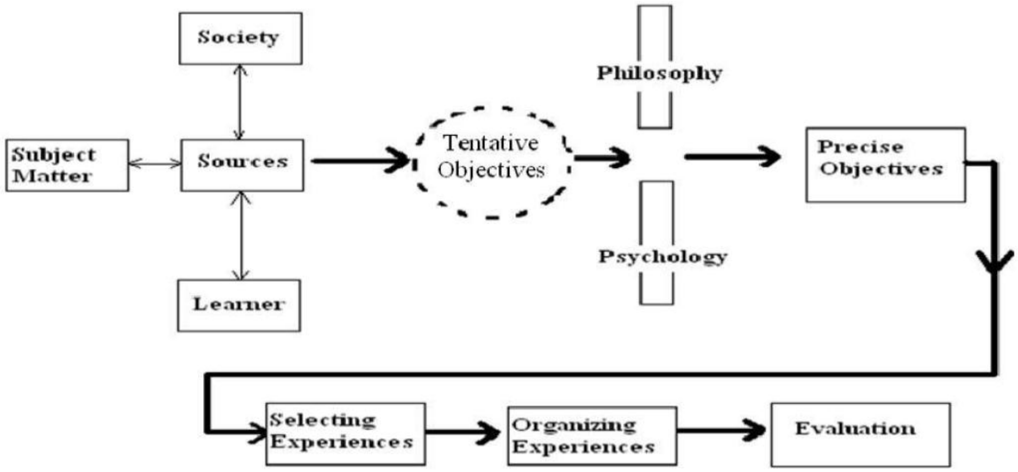

Figure 6: Tyler Model

(Dopson and Tas 2013)

2.3.1.3 Taba Curriculum Model (1962)

Taba's curriculum model is composed of five steps. The first step consists of the production of pilot teaching and learning units or courses for the identification of student needs, the formulation of teaching and learning objectives and goals, the selection of course content, the organization of course content, the selection of learning experiences, the organization of learning activities, and the design of students' evaluation methods. The second step is the testing of the validity of the above described experimental units or courses in terms of their adequacy. The third step is the revision of the above tested experimental units or courses in order to adapt them to existing conditions such as students' needs and abilities, resources availability, and teaching style. The fourth step is the encapsulation of all the revised units or courses into a curriculum framework with a draft rationale, and the final step is the implementation and dissemination of the new curriculum (Mucavele 2008) (Figure 7).

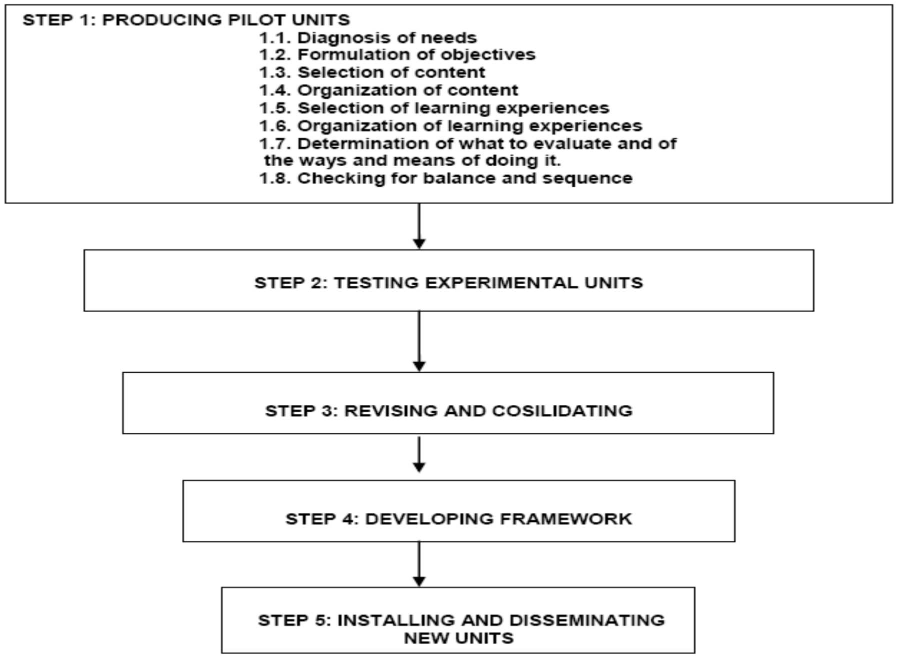

Figure 7: Taba Curriculum model

(Mucavele 2008)

2.3.1.4 Skilbeck Model (1984)

Skilbeck's curriculum model otherwise known as the situational model posits that curriculum design should start with the analysis of the curriculum projected context in terms of its societal expectations, employers' expectations, student profiles, teachers' profiles, resource availability, and its current status (Makeleni 2013). The purpose of this analysis is to derive the meaning or objectives of the curriculum, to select its programme content and to plan how it should be taught, learned, and assessed. The final two steps of Skilbeck's model consist of the design of how the curriculum should be organized, implemented, monitored, and evaluated (Figure 8).

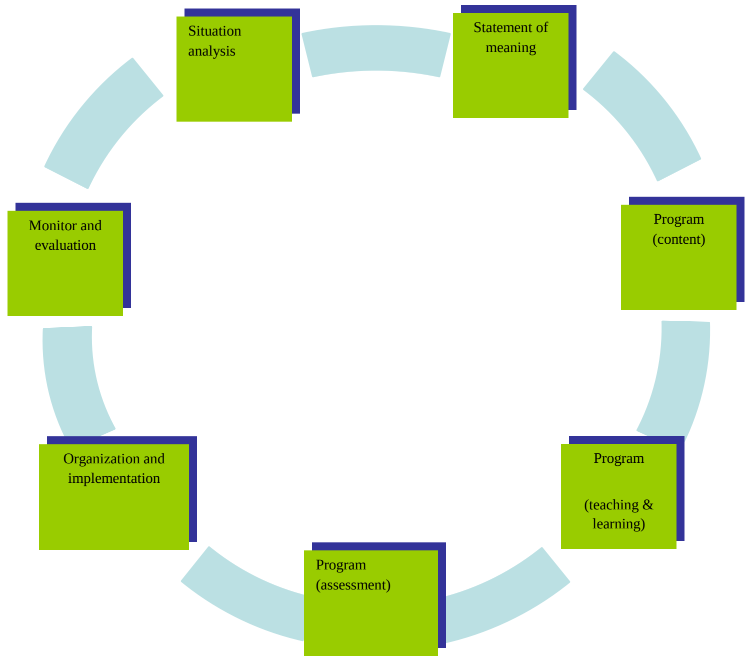

Figure 8: Skilbeck curriculum model (Harsono n.d)

2.3.1.5 Wiggins and Mctighe Curriculum Model 1998 (Backward Design)

Wiggins and Mctighe's curriculum model proposes three steps for curriculum development: identification of desired results, determination of acceptable evidence, and planning of learning experiences. They propose a backward design from identifying desired results to determining acceptable evidence and then planning learning experiences and instruction (Wiggins and Mctighe 2001). In addition, the method of accessing the curriculum is thought of at the beginning of the design, not at the end. The authors propose that it is very crucial to determine what will be accepted as proof that learners have obtained the desired understanding and expertise before planning the learning experience (Figure 9).

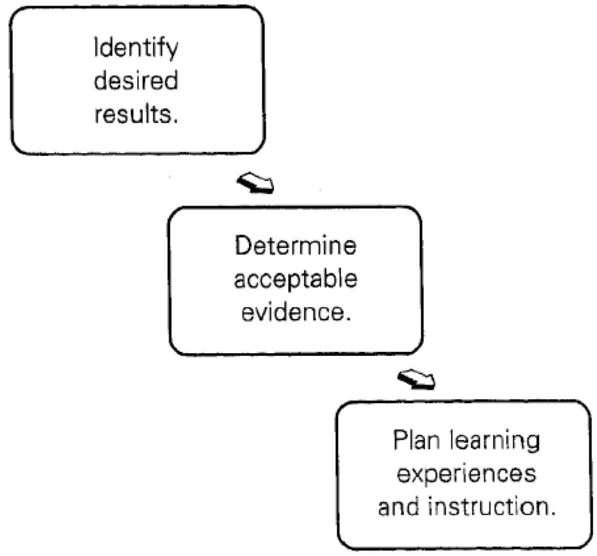

Figure 9: Wiggins and Mctighe Curriculum model
(Wiggins and Mctighe 1998)

2.3.2 Nontechnical Curriculum Models

This approach considers that curriculum design should focus on the learner. It prescribes that curriculum design should evolve rather than being planned precisely.

2.3.2.1 Walker's Deliberation Model (1971)

Walker's deliberation model posits that the curriculum development process in reality usually consists of three elements: platform, deliberation and design. (Walker 1971). Walker believes that the curriculum development process often involves the analysis of systems of belief, theories, as well as the personal agendas and perspectives of teachers. This system is what is known as a curriculum platform (John 2011). Deliberation involves the extraction of data from the curriculum's platform in order to determine the most suitable methods for the achievement of the desired objectives. As for design, it involves decision making about the selection of curriculum content, instructional strategies, and learning materials (Kafle 2010). Walker asserts that the curriculum development process should not be linear or predetermined, but rather dynamic and interactive. This means that, even though the platform is the first stage of curriculum development, there is no precedence order between the deliberation and design stages, and it is even possible for these two stages to occur at the same time (Figure 10).

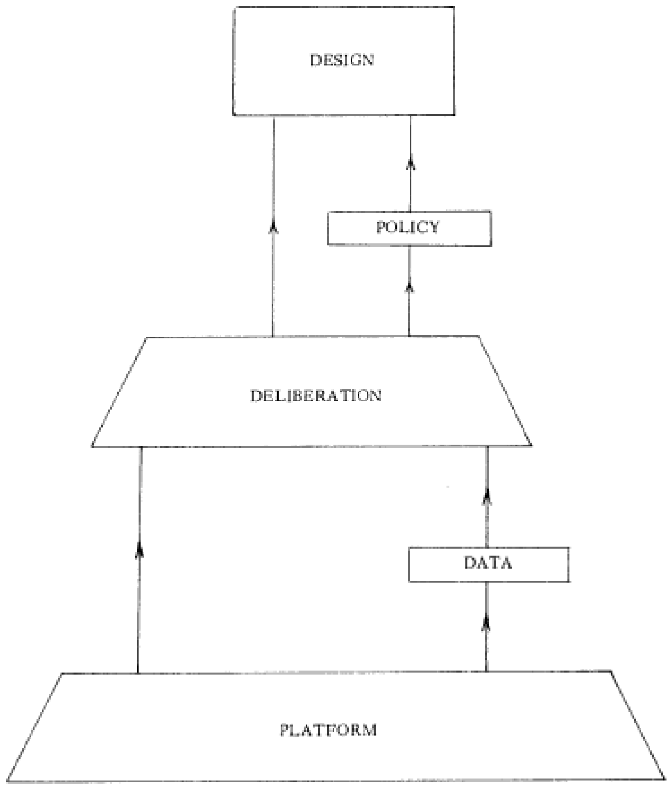

Figure 10: Walker's deliberation model
(Walker 1971)

2.3.2.2 Allan Glatthorn's Curriculum Model

Allan Glatthorn explains the strategies that can be utilized for effective curriculum development and renewal. They include a) examination of alternatives to the current curriculum b) definition of the learning audience and learning activities in order to develop temporal curriculum c) reassurance of the students, parents, school authority about the soundness of the program by curriculum developers d) building the content or knowledge base of the curriculum. e) determination of the nature and number of learning units in order to accommodate different interest and learning style f) planning of quality learning experience g) determination of the assessment methods by teachers and learners, and h) creation of learning scenarios rather than standard curriculum (Nsamba 1999).

2.3.2.3 Stenhouse Model (1975)

Stenhouse's model posits that curriculum should be designed with the aim of improving learning and teaching, and this requires the understanding of current or prevailing education practices, learners' needs, and teachers' perceptions. This is done in order to arrive at various curricular decisions on what students should learn, and one should properly plan how these decisions will be put into practice within a set of optimally conceptualized learning environments. Finally, these designed learning environments are implemented in the classroom, but their effectiveness must be continuously researched in order to improve future curricular (Makeleni 2013) (Figure 11).

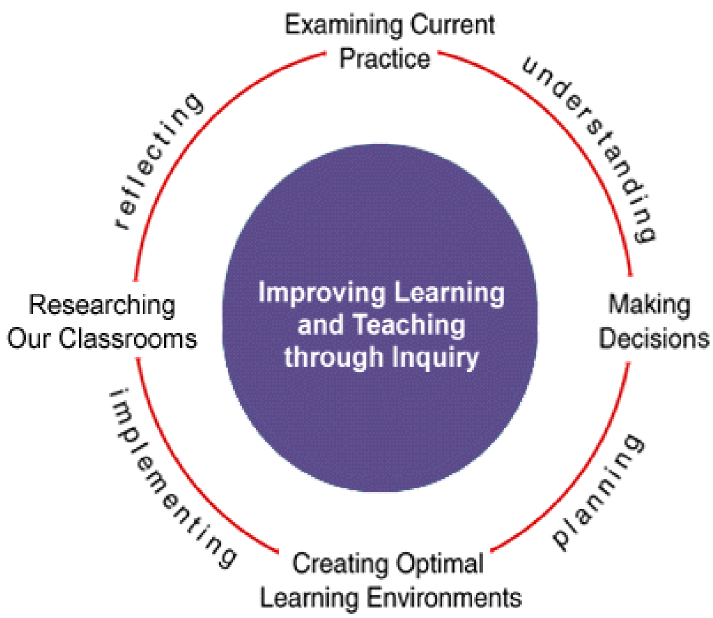

Figure 11: Stenhouse model

2.3.2.4 Doll Curriculum Theory

Doll (1993) posits that teachers and learners can develop a postmodern curriculum through interaction with each other, thereby allowing greater flexibility and diversity. He suggests four criteria to verify the quality of a postmodern curriculum, including richness, recursion, relationship, and rigor. Richness depicts how much the curriculum allows teachers and learners to interact and develop an appropriate content suitable for context. Recursion is a term which describes the nature of the postmodern curriculum as having no beginning and end. Relationship describes interactions between the curriculum and local and global context. Rigor describes the quality of the curriculum as being indeterminable.

2.3.2.5 Slattery Curriculum Theory

Slattery (1997) advocates that students and educators must understand the point that learning is a lifelong process that is not demarcated by completion of laid down courses or standards. He explains that teachers must help students uncover new talents and continuously create new knowledge in the ever changing world of technology by continuously criticizing the field. For this, teachers need to be trained to help students broaden their sense of fulfillment. The pupils would then be allowed to extend their analysis to their environment so that they can create the space they live in, rather than just fit in with a defined set of rules.

2.4 Design of Conceptual Model

Table 2 describes the analysis of the technology adoption models that were reviewed in this chapter. This was done to select the model that can assist in guiding the analysis of the factors that affect ICT students' awareness of the latest ICTs.

Table 2: Conceptual model design

Construct	Model	Closeness to awareness
Perceived Usefulness	TAM	No
Perceived ease of use	TAM	No
Attitude	TRA, TPB, TAM	No
Intention	TRA, TPB, TAM	No
Subjective Norms and environmental factors	TRA, TPB, social learning theory	No
Behaviour	TRA, TAM, Social learning theory	No
Knowledge	IDT	Yes
Persuasion	IDT	No
Decision	IDT	No
Implementation	IDT	No
Confirmation	IDT	No
Perceived behavioural control	TPB	No

Five theoretical models (TRA, TAM, Social learning theory, TPB and IDT) have been presented in this chapter on technology adoption. Seven constructs were identified from these models (perceived usefulness, perceived ease of use, intention, behaviour, knowledge, and perceived behavioural control) in order to select which ones are the closest to the concept of technology awareness (Figure 12). It appears that the knowledge construct from the Innovation Diffusion Theory or IDT is the closest construct to awareness. This is the reason why this study is choosing IDT as the main theoretical framework which can assist in the design of a conceptual model of the factors affecting ICT students' awareness of the latest ICTs. The IDT posits that person's knowledge on a given technology depends on their previous experiences, on their previous practices, and on their innovativeness. These previous experiences and practices are classified as prior conditions by IDT. Thus, IDT posits that technology knowledge is affected by prior conditions. One of the main hypotheses of the current study is, therefore, that technology awareness is affected by prior conditions, and this is directly inspired from IDT except that in this study, prior conditions refer to exposure to career guidance opportunities and perceived currency of existing curriculum, and awareness refers to students' awareness of latest ICT trends as well as their awareness of DSO. This study finally postulates that both prior conditions and awareness have a relationship with students' demographics (see Table 2).

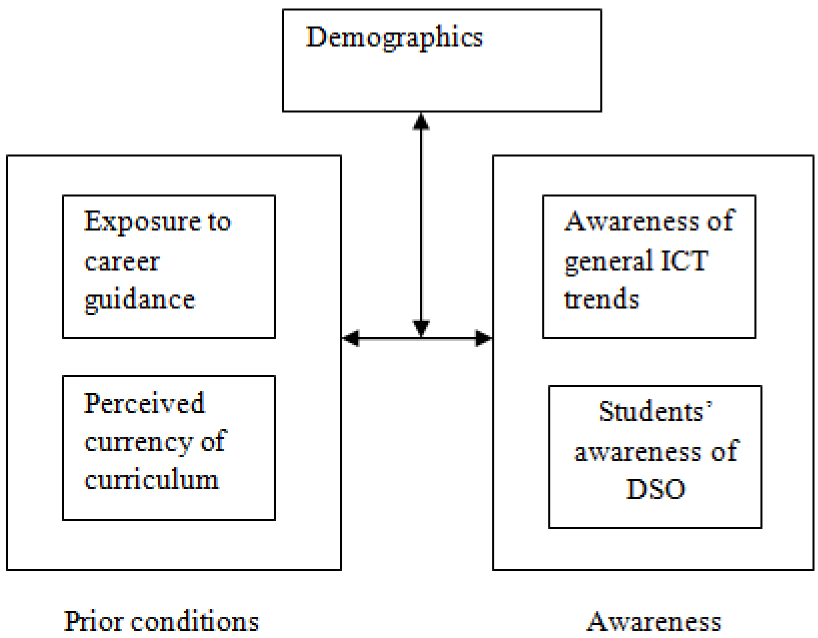

Figure 12: Conceptual Model

The model presented in Figure 12 represents the following hypotheses to be empirically tested by the third objective of this study:

Ha_0: The demographics of a student have a direct relationship with his or her perceived exposure to career guidance.

Hb_0: The demographics of a student have a direct relationship with his or her perceptions on the currency of his or her curriculum.

Hc_0: The demographics of a student have a direct relationship with his or her perceived awareness of the latest ICT trends.

Hd_0: The demographics of a student have a direct relationship with his or her perceived awareness of DSO.

He_0: A student's perceived exposure to career guidance opportunities has a direct relationship with his or her perceived awareness of DSO.

Hf_0: A student's perceptions on the currency of his or her curriculum have a direct relationship with his or her perceived awareness of DSO.

Hg_0: A students' perceived awareness of the latest ICT trends has a direct relationship with his or her perceived awareness of DSO.

Hh_0: A student's perceived exposure to career guidance has a direct relationship with his or her perceived awareness of the latest ICT trends.

Hi_0: A student's perceptions on the currency of his or her curriculum have a direct relationship with his perceived awareness of the latest ICT trends.

Hj_0: A students's perceived exposure to career guidance has a direct relationship with his or her perceptions on the currency of his or her curriculum.

2.5 Conclusion

This chapter presented the theoretical frameworks for this study, namely, technology adoption models and curriculum development models. Technology adoption models have been used to develop the main conceptual model of this study on the factors affecting ICT students' awareness of the latest ICTs. As for curriculum development models, they will be useful in the last part of this study on the proposal of ICT curriculum recommendations based on the identification of the factors affecting ICT students' awareness of the latest ICTs. The technology adoption models reviewed by this chapter are the theory of reasoned action, the technology acceptance model, the innovation diffusion theory (IDT), the social learning theory, and the theory of planned behaviour. On the other hand, the curriculum development models reviewed by this chapter are the ones from Bobbitt, Tyler, Taba, Wiggins and McTighe, Alan Glatthorn, Walker, Stenhouse, Doll, and Slattery. The final part of this chapter presents the conceptual model of this study; this conceptual model is based on the IDT because of its inclusion of the knowledge construct which is closer to the awareness concept. The methodology of the empirical testing of this new conceptual framework is presented in the next chapter of this study.

CHAPTER THREE

RESEARCH DESIGN

The second chapter of this dissertation was dedicated to the achievement of the first two sub-aims of this study. These are: the selection of relevant theories that can help to understand the factors affecting computing students' awareness of the latest ICTs, and the design of a conceptual model for the analysis of these factors. The current chapter focuses on the description of the survey conducted in this study to empirically test the conceptual model proposed by Chapter Two. This survey was conducted using computing students in the four universities in KwaZulu-Natal province of South Africa. Surveying computing students is certainly not the only way to validate this model; it is for example possible to directly examine the curricula of the above listed universities. However, this option is not pursued by this study mainly because universities hardly renew their curricula yearly.

3.1. Research Population

The target population for this survey is composed of third year students enrolled at the four universities of the KwaZulu-Natal province of South Africa in the 2012 academic year. These universities are located in three neighbouring towns: Pietermaritzburg, the administrative capital of the province; Durban, the economic capital of the province; and Empangeni, a small town in the northern part of the province. The reason for choosing third year students is that these are final year students and as such they are expected to have covered most of their curriculum. The four universities of the KwaZulu-Natal province are the Durban University of Technology (DUT), the University of KwaZulu-Natal (UKZN), the Mangosuthu University of Technology (MUT), and the University of Zululand (UNIZULU). The Durban University of Technology and Mangosuthu University of Technology are technikons or technical universities, as opposed to the University of KwaZulu-Natal and the University of Zululand which are comprehensive universities. Technical universities are vocationally oriented in the sense that their main goal is to produce graduates that are already ready to take up technical job positions available on the job market. The main aim of comprehensive universities is to extend the frontiers of human knowledge. Another difference between technical universities and comprehensive universities is that, after the first three years of study, technical universities award diploma qualifications to their students while comprehensive universities award degrees. The following is a brief profile of the four universities surveyed at the time when this study was conducted.

DUT had one campus in Pietermaritzburg, and it had five campuses in Durban. However, this survey was restricted to two DUT Durban campuses: the Ritson campus and the Steve Biko campus. These two campuses were selected because they were the ones offering computing related qualifications at DUT at the time of the study, including a diploma in information technology and a diploma in computer systems. At the time of the study, the information technology diploma was offered at DUT to around 300 third year students according to three specializations: financial information systems, business accounting, and software development. As for the computer systems diploma, it was offered at DUT to around 14 students at the time of the study.

UKZN had a campus in Pietermaritzburg and four campuses in Durban. However, this survey was limited to only two Durban campuses: the Howard College campus and the Westville campus. The selection of these two campuses was based on the fact that they were the ones that were offering computing related degree qualifications in computer science and computer engineering at UKZN at the period when this study was conducted. At the time of the survey, the computer science degree was offered to about 200 third year students, and computer engineering degree was offered to about 60 third year students.

MUT had only one campus situated in Umlazi, an area at the outskirts of Durban. At the time of this survey, MUT was offering a diploma qualification in Information technology to about 24 third year students.

UNIZULU had one campus in Empageni, and another campus in Richard Bay. However, the survey was limited to Empageni, the only campus offering computing related degree qualifications in computer science to about 21 third year students.

It can be seen from the above statements that the total population for this survey is comprised of about 619 third year computing students from the four universities of the KwaZulu-Natal province of the Republic of South Africa, especially for the computing fields of information technology, computer systems, computer science, and computer engineering.

3.2 Sampling Method and Size

The sample size of this research was calculated using the formula proposed by Naing *et al* (2006) for finite populations as shown in the equation below. The values of the different parameters for this sample size equation are Z=1.96, P=0.05, d=0.034, N=619; and this gives a survey's sample size n of 126.

$$n = \frac{Z^2 P(1-P)}{d^2(N-1) + Z^2 P(1-P)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

As explained above, the population of this survey conducted in this study was made up of computing students from six campuses of the four universities of the KwaZulu-Natal province of South Africa: The DUT Ritson campus, the DUT Steve Biko campus, The UKZN Howard campus, the UKZN Westville campus, the MUT Umlazi campus, and the UNIZULU Empageni campus. The intention of the design of the survey was to have approximately an equal representation of all the above listed six campuses in the selected sample. This was achieved by simply assigning a sample size of 21 for the population of each campus. However, it is important to note that the sample sizes of small campuses could be complemented by the sample sizes of big campuses as shown in Table 3.

Table 3: Sampling method and size

Campuses	Population size	Initial Sample size	Final sample size	Sampling Method
UNIZULU Empangeni	24	24	24	Systematic
MUT Umlazi	21	21	21	Systematic
DUT Steve Biko	14	14	14	Systematic
UKZN Howard	60	21	21	Random

UKZN Westville	200	21	21	Random
DUT Ritson	300	21	15	Random

Table 3 shows that for the campuses with a population approximating a size of 21 third year computing students, the entire population was systematically considered as the research sample. However, for campuses with large populations, 21 students had to be randomly selected from each campus. Finally, a sample of 122 students participated in the study by filling in the survey questionnaire. But, only 116 of the questionnaires were used because six questionnaires from the DUT Ritson campus were not properly filled in and as a result they were excluded from the study. Survey questionnaires were distributed during lectures with the permission of the lecturer in charge and this took place over a period of three weeks for all the six campuses surveyed.

3.3 Data Collection Instrument

The questionnaire of the survey conducted in this study consisted of 50 items grouped into five research variables: students' demographics, students' exposure to career guidance opportunities, students' level of awareness of general ICT trends, students' perceived currency of their curriculum and students' awareness of Digital Switch Over. Apart from the 10 demographic items, all the other 40 items from the other four research variables consisted of the following five Likert scale items: strongly disagree (1), disagree (2), neutral (3), agree (4), and strongly agree (5). Each of the questionnaire variables consisted of ten items as briefly described below.

3.3.1 Demographics

This section of the questionnaire required the respondents to provide data on the following demographic attributes as further described below. The attributes are age group, gender, ethnicity, university, programme of study, mode of study, year of study, high school maths option, high school location, and high school computing course.

- A1. Age group: This questionnaire item was designed for the identification of the age of the students. These students could choose one of the following age ranges: less than 20 years old, between 20 and 22 years old, between 23 and 25 years old, between 26 and 28 years old, and more than 28 years old.

- A2. Gender: This questionnaire item was designed for the identification of the gender of the students. These students could choose either the male or the female gender.

- A3. Ethnicity: This questionnaire item was designed for the identification of the ethnicity of the students. These students could choose any of the following ethnic groups: African, White, Indian, Coloured, but they could also indicate that they didn't belong to any of these four ethnic groups.

- A4. University: This questionnaire item was designed for the identification of the university where the students study. These students could choose either DUT, UKZN, MUT or UNIZULU.

- A5. Programme of study: This questionnaire item was designed for the identification of the students' programme of study. These students could select any one of the following programmes: IT, Computer Systems, and Computer Science.

- A6. Mode of Study: This questionnaire item was designed for the identification of the students' mode of study and students could indicate either they were full time students or part time students.

- A7. Year of Study: This questionnaire item was designed to give to students the opportunity to confirm that they were third year students even though they were two other options, first year, and second year for this questionnaire item

- A8. High School Maths Option: This questionnaire item was designed for the identification of the option chosen by students in high school for the mathematics subject, between the 'soft option' which is called maths literacy, and the 'hard option' which is called core maths.

- A9. High School Location: This questionnaire item was designed for the identification of the location of the high school where students spent the final year of their secondary education. These students could choose their high school location either as urban or as rural.

- A10. High School Computing Course: This questionnaire item was designed for the identification of the high school computing course of the students, either end user computing or programming.

3.3.2 Students' Exposure to Career Guidance Opportunities

The aim of this section of the questionnaire is to identify channels for informing students on career guidance.

- B1. Career guidance from parents and relatives: This questionnaire item was designed to assess whether or not students are receiving career guidance from their parents and relatives.
- B2. Career guidance through the university counseling center: This questionnaire item was designed to assess whether or not students are receiving career guidance from the university counseling center.
- B3. Career guidance through lecturers and teachers: This questionnaire item was designed to assess whether or not students are receiving career guidance from lecturers and teachers.
- B4. Out of campus seminars and industry professionals: This questionnaire item was designed to assess whether or not students are receiving career guidance from seminars, out of the campus and industry professionals.
- B5. Career guidance from campus seminars, workshops and presentations: This questionnaire item was designed to assess whether students are receiving career guidance from campus seminars, workshops and presentations.
- B6. Career guidance through the mass media: This questionnaire item was designed to assess whether students are receiving career guidance from the mass media such as the internet, TV, radio, newspapers, and magazines.

- B7. Career guidance through friends, role models and mentors: This questionnaire item was designed to assess whether or not students are receiving career guidance from friends, role models and mentors.

- B8. Career guidance through organizations specialized in career advice: This questionnaire item was designed to assess whether or not students are receiving career guidance from organizations such as South African Career focus, and PACE career center.

- B9. Career guidance through participating in voluntary work: This questionnaire item was created to assess whether or not students are receiving career guidance from internships, apprenticeships.

- B10. Career guidance through professional associations and societies: This questionnaire item was designed to assess whether or not students are career guidance from their involvement with organizations like the Engineering Council of South Africa (ECSA) for engineering students and The Institute of Information Technology Professionals South Africa for IT students.

3.3.3 Students' Awareness of General ICT trends

The aim of **t**his section of the questionnaire is to identify students' awareness of general ICT trends.

- C1. Awareness of Cloud Computing: This questionnaire item was designed to assess whether or not students are aware of cloud computing technologies used for accessing computing resources as services over the internet (e.g. online storage, online collaboration, and online transaction).

- C2. Awareness of Grid Computing: This questionnaire item was designed to assess whether or not students are aware of the use of grid computing technologies (i.e high processing and data intensive computations in high bandwidth communications) to solve complex computing tasks.

- C3. Awareness of Virtualization technologies: This questionnaire item was designed to assess whether or not students are aware of the virtualization of computing resources so that the remote access to these resources can become more convenient (e.g. storage virtualization, desktop virtualization, server virtualization).

- C4. Awareness of Mobile Wireless Technologies: This questionnaire item was designed to assess whether or not students are aware wireless data communication technology generations and standards (e.g. 3G, 4G, and GPRS).

- C5. Awareness of Radio Frequency Identification (RFID) technologies: This questionnaire item was designed to assess whether or not the students are aware of RFID technologies which are used for the transmission of the identity of objects and people wirelessly using radio waves for up to hundreds of meters (e.g. security tags, tracking tags, and identification tags).

- C6. Awareness of Global Positioning System (GPS) technologies: This questionnaire item was designed to assess whether or not students are aware of GPS technologies used for providing information to users on the location and times for places of their choice anywhere on or near the earth, for example for applications such as traffic congestion control systems, navigation systems, and mapping systems.

- C7. Awareness of Artificial Intelligence based technologies: This questionnaire item was designed to assess whether or not students are aware of Artificial Intelligence technologies aiming at increasing computers' ability to perform more and more tasks which traditionally require human skills (e.g. speaking, hearing, smelling, seeing, touching, understanding, etc.).

- C8. Awareness of Biometric Technologies: This questionnaire item was designed to assess whether or not students are aware of biometric technologies which use people' physiological attributes (e.g. iris, face, fingerprints, and voice) to identify computer users.

- C9. Awareness of Social Media Technologies: This questionnaire item was designed to assess whether or not students are aware of social media technologies such as online communities, blogs, and internet forums, which are centered around user generated content and are mainly disseminated through internet via mobile phones.

- C10. Awareness of Voice over Internet Protocol (VoIP) technologies: This item was designed to assess whether or not students are aware of VoIP technologies (e.g. video conferencing, internet phone, and podcast) which are used for transmitting voice over the internet instead of using analog phones.

3.3.4 Students' Perceived Currency of Curriculum

The aim of this section of the questionnaire is to assess students' perceptions on the currency of their curriculum.

- D1. Regular Review of Curriculum: This questionnaire item was designed to assess whether or not students perceive their curriculum as being regularly reviewed and updated.

- D2. Regular Accreditation of School Curriculum: This questionnaire item was designed to assess whether or not students perceive the accreditation of their curriculum as being regularly renewed.

- D3. Relevance to Workplace Demands: This questionnaire item was designed to assess whether or not students perceive their curriculum as being relevant to workplace demands.

- D4. Regular Update of School Textbooks and learning materials: This questionnaire item was designed to assess whether or not students perceive their learning materials and textbooks as being regularly updated.

- D5. Inclusion of new ICT trends in Curriculum: This questionnaire item was designed to assess whether or not students perceive their curriculum as current with regards to the inclusion of new ICT trends.

- D6. Favorable comparison of school curricula with other schools: This questionnaire item was designed to assess whether or not students are of the opinion that their curriculum is as good as curricula from other universities.
- D7. Catering for students' diversity: This questionnaire item was designed to assess whether or not students perceive their curriculum as having the ability to cater for human diversity, for example in terms of the sensitivity to disability and foreign cultures.
- D8. Applicability to real life situations: This questionnaire item was designed to assess whether or not students perceive their curriculum as being applicable to real life situations such as the ones relevant to the workplace.
- D9. Professional Training Opportunities: This questionnaire item was designed to assess whether or not students are of the opinion that their lecturers have regular professional training opportunities.
- D10. Use of Technology for teaching and learning: This questionnaire item was designed to assess whether or not students are of the opinion that their curriculum encourages the use of technology for teaching and learning.

3.3.5 Students' Awareness of Digital Switch Over

The aim of this section of the questionnaire is to assess students' awareness of the main issues surrounding the ITU decision to migrate television technologies from analog to digital (Digital Switch Over or DSO).

- E1. Awareness of DSO deadline for South Africa: This questionnaire item was designed to assess whether or not students are aware of the fact that the DSO final deadline for South Africa was initially set for December 2013.
- E2. Awareness of DSO deadline for the World: This questionnaire item was designed to assess whether or not students are aware of the fact that the DSO final deadline for the entire world was initially set for June 2015.

- E3.Awareness of Television's Hardware Requirement after DSO: This questionnaire item was designed to assess whether or not students are aware of the hardware needed for the installation and functioning of digital television in households.
- E4. Awareness of Television's Software Requirement after DSO: This questionnaire item was designed to assess whether or not students are aware of the software needed for the installation and functioning of digital television in households.
- E5. Awareness of Transmission Medium for receiving Digital Television (DTV) signal after DSO: This questionnaire item was designed to assess whether or not students are aware of how digital television signals are transmitted between signal senders and signal receivers.
- E6. Awareness of Government plan and policy: This questionnaire item was designed to assess whether or not students are aware of the government's strategies for the smooth transition from analog television to digital television
- E7. Awareness of Advantages of DSO: This questionnaire item was designed to assess whether or not students are aware of the benefits of digital television compared to analog television.
- E8. Awareness of Disadvantages of DSO: This questionnaire item was designed to assess whether or not students are aware of the drawbacks of digital television compared to analog television.
- E9. Awareness of DSO implementation bodies: This questionnaire item was designed to assess whether or not students are aware of the different institutions in charge of the management of the different processes related to the migration from analog to digital television.
- E10. Awareness of the Television payment implication after DSO: This questionnaire item was designed to assess whether or not students are aware of the cost implication of the use of digital television compared to analog television.

3.4 Data Analysis

The data collected for this study on the factors affecting computing students' awareness of DSO was analyzed using version 22.0 of SPSS (Statistical Packages for Social Sciences). The first step of the data analysis process consisted in the testing of the reliability and validity of the data using Cronbach alpha coefficient. These tests were conducted on all the four Likert scale research variables, namely, student's perceived exposure to career guidance, their perceptions on the currency of their curriculum, their perceived awareness of the latest ICT trends, and their perceived awareness of DSO. The second step of the analysis process consisted in the descriptive analysis of the data, and during the final step, inferential tests were conducted on the different variables in order to establish the existence or not of relationships between these variables. The two main statistical functions that were used for the descriptive analysis were the calculations of frequencies and the calculations of means. As for inferential statistics, the four main statistical tests used were ANOVA, ANCOVA, Pearson correlation tests, linear regression equations, and MANOVA; and the confidence level of 95% was set for all these tests, with a significant p-value between 0.00 and 0.05.

3.5 Conclusion

This chapter described how the third objective of this study was achieved through a survey of 116 third year students selected from a population of 619 third year computing students from six campuses of the four universities of the KwaZulu-Natal province in South Africa. Three of these campuses were so small that their entire population of third year students hardly exceeded the size of 21; therefore all third year computing students from these small campuses were systematically sampled, as opposed to the big campuses where a sample of about 21 third computing students were chosen. This chapter also describes each of the 50 items of the questionnaire used in this study, according to their research variables, starting with the demographic variable and followed by the four Likert-scale research variables. These Likert variables are: student's perceived exposure to career guidance, their perceptions on the currency of their curriculum, their perceived awareness of the latest ICT trends, and their perceived awareness of DSO. The end of this chapter is dedicated to the identification of the statistical methods used for the analysis of the data of this study: descriptive statistics in the form of mean and frequency analysis, and inferential statistics in the form of ANOVA tests, Pearson correlation tests, linear regression equations. All these statistical findings are presented in the following chapter.

CHAPTER FOUR

RESEARCH RESULTS

In the previous chapter, it was announced that the data collected by this study would be analyzed in SPSS using both descriptive and inferential statistics. The results of this statistical analysis are presented in the current chapter, starting with the results on the data validity and reliability tests. It seems important to recall that these statistical results were conducted in order to fulfil the third objective of this study, which is to empirically test the conceptual model proposed in Chapter Two on the factors affecting computing students' awareness of the latest ICTs.

4.1 Data Validity and Reliability Results

According to Table 4 all the variables from the research questionnaire have high reliability for each of their 10 items. Therefore, all the data collected by this survey are reliable based on the fact that all the Likert scale variables have a Cronbach's alpha (α) coefficient greater than 0.7.

Table 4: Reliability and validity tests coefficients of research variables

Variables	No of questionnaire Items	Cronbach's Alpha coefficient (α)
Exposure to Career guidance Opportunities	10	0.755
Awareness of general ICT trends	10	0.836
Perceived currency of the curriculum	10	0.869
Digital Switch Over (DSO) awareness	10	0.948

4.2 Descriptive Statistics

Table 5 shows that some demographic items are dominated by certain groups, but other demographic items are almost balanced. The demographic items that are almost balanced are: A4 (programme of study), A7 (high school location), and A8 (high school computing option). For example, it is interesting to note that almost half of the students surveyed received their high school education in a rural school, so of course the other half received their high school education in an urban school. On the other hand, the demographic item A6 identifying whether or not student took core maths or maths literacy in high school is clearly dominated by students who took core maths (98.3%). The same applies for the demographic item A5 identifying whether or not a student is studying on a full time basis or on a part time basis, which is clearly dominated by full time students (94.8%). As for demographic item A3 on the identification of the racial origin of students, it is dominated by students from African origins (80.2%). The same applies to gender item with 71.6% of male students, and to the age item with 66.4% of students aged between 20 and 22 years old.

Table 5: Descriptive statistics for demographics

A		Percentage
A1	Less 20	10.3
	20-22	66.4
	23-25	14.7
	26-28	6.9
	Above 28	1.7
A2	Male	71.6
	Female	28.4
A3	African	80.2
	Indian	17.2
	Coloured	0.9
	White	1.7
A4	DUT	25.0
	MUT	18.1
	UKZN	36.2
	UNIZULU	20.7
A5	Computer System	24.1
	Computer Science	42.2
	Information Technology	33.6
A6	Full Time	94.8
	Part Time	5.2
A8	Maths Literacy	1.7
	Core	98.3

A9	Urban	54.3
	Rural	45.7
A10	End User Computing	52.6
	Programming	37.1
	Others	10.3

4.2.1 Students' Perceived Exposure to Career Guidance

Figure 13, Figure 14 and Table 6 indicate that the popularity of most career guidance mechanisms (7 out of 10) is rated as average by students. However, students are of the opinion that they hardly receive career guidance from voluntary work, internships, WIL, apprenticeships, etc. (average value of 2.47 out of 5); but on the other hand, they receive much helpful career guidance from the media (average value of 3.97) and from the teachers (average value of 3.51 out of 5). It is interesting to note that the students rate their overall exposure to career guidance opportunities as average (average value of 3.13 out of 5).

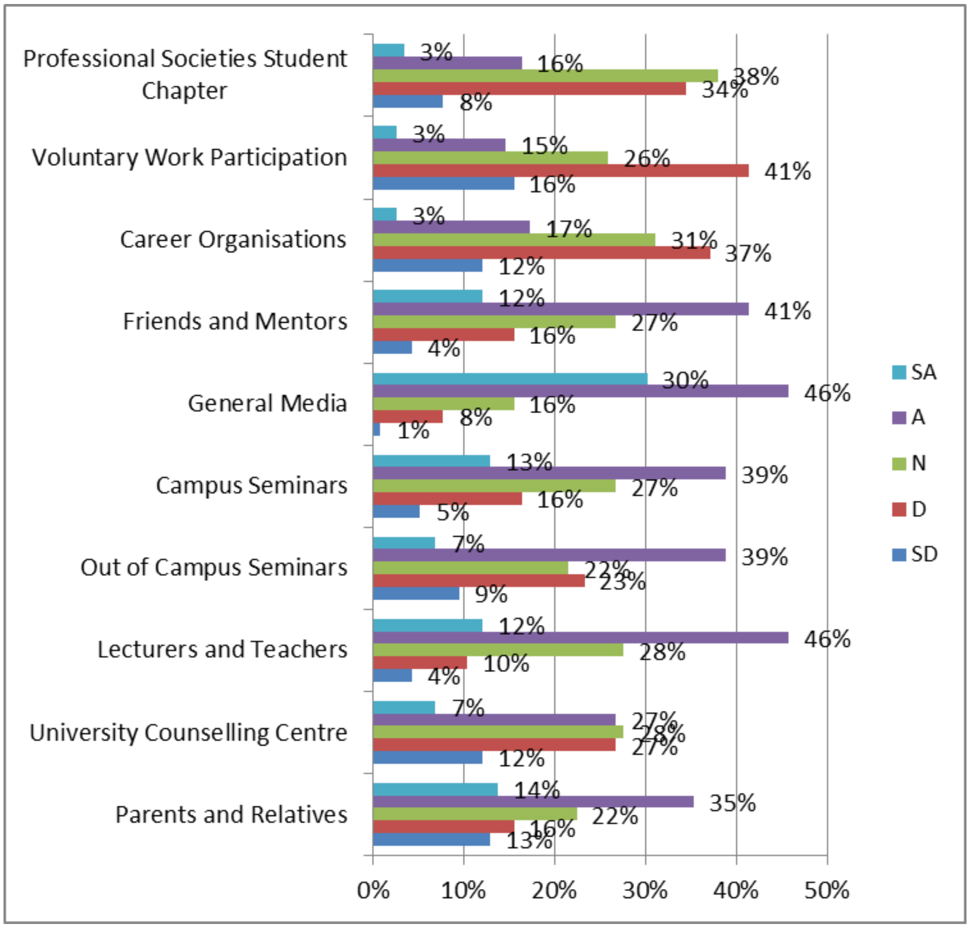

Figure 13: Students' perceived exposure to career guidance

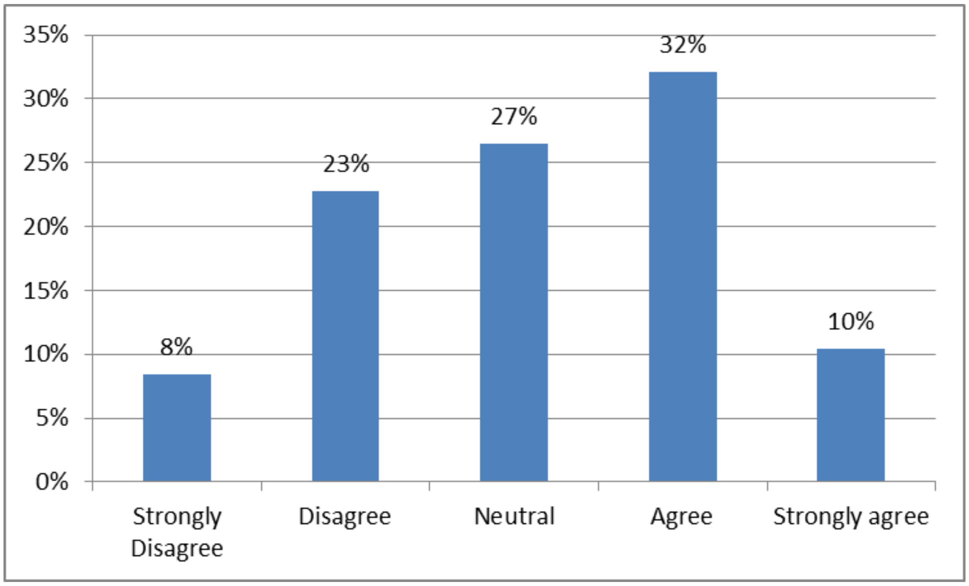

Figure 14: Students' perceived exposure to career guidance

Table 6: Students' perceived exposure to career guidance

B	S1	S2	S3	S4	S5	Mean	SD
B1	13	16	22	35	14	3.22	1.243
B2	12	27	28	27	7	2.90	1.137
B3	4	10	28	46	12	3.51	.982
B4	9	23	22	39	7	3.10	1.130
B5	5	16	27	16	46	3.38	1.069
B6	1	8	16	46	30	3.97	.922
B7	4	16	27	41	12	3.41	1.031
B8	12	37	31	17	3	2.61	.994
B9	16	41	26	15	3	2.47	1.008
B10	8	34	38	16	3	2.73	.945
TOTAL	**8**	**23**	**27**	**30**	**14**	3.13	

4.2.2 Students' Awareness of General ICT Trend

Figure 15, Figure 16 and Table 7 indicate that students rate their awareness of most (seven out of ten) ICT trends as average. However, students rate their awareness of the following three ICT trends as high: social media technologies centered around user generated content disseminated through the internet (average of 3.84 out of 5), mobile wireless technologies used for transferring information between devices not physically connected (average of 3.76 out of 5), VOIP (Voice over internet protocol) technologies used for transmitting voice over the internet (average of 3.55 out of 5). It is interesting to note that, here again, students rate their overall awareness of ICT trends as average (average value of 3.41 out of 5).

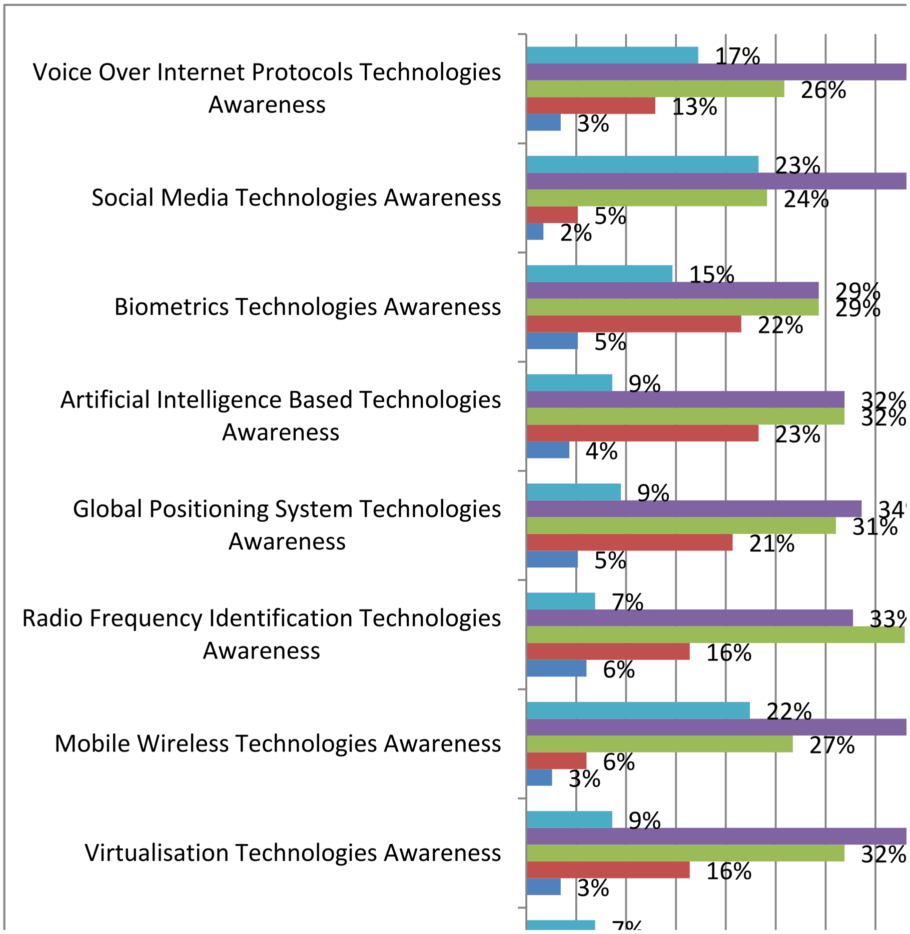

Figure 15: Students' awareness of general ICT trends

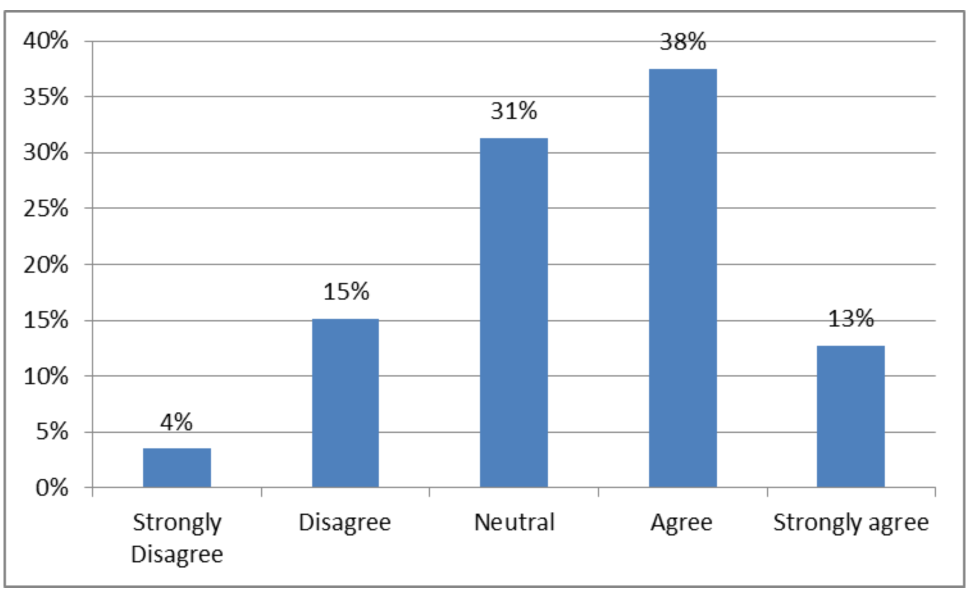

Figure 16: Students' awareness of general ICT trends

Table 7: Students' awareness of general ICT trends

C	S1	S2	S3	S4	S5	Mean	SD
C1	2	13	3	44	9	3.47	.899
C2	2	16	42	34	7	3.28	.873
C3	3	16	32	40	9	3.34	.969
C4	3	6	27	42	22	3.76	.957
C5	6	16	38	33	7	3.18	.992
C6	5	21	31	34	9	3.22	1.045
C7	4	23	32	32	9	3.17	1.024
C8	5	22	29	24	26	3.27	1.114
C9	2	5	24	46	23	3.84	.904
C10	3	13	26	41	17	3.55	1.033
TOTAL	**4**	**15**	**31**	**37**	**13.8**	3.41	

4.2.3 Students' Perceived Curriculum Currency

Figure 17, Figure 18 and Table 8 indicate that students rate the currency of their curriculum as average for half of the curriculum currency perception items. However, students rate the currency of their curriculum as high for the remaining half of curriculum currency perception items: use of technology for teaching and learning (average of 3.95 out of 5), catering for diversity within the student population (average of 3.72 out of 5), applicability to many real life situations (average of 3.66 out of 5), regular updating of textbooks and learning materials (average of 3.52 out of 5), regular professional training opportunities for lecturers (average of 3.50). It is very interesting to note that, this time, students are rating the currency of their curriculum as high (average value of 3.52 out of 5).

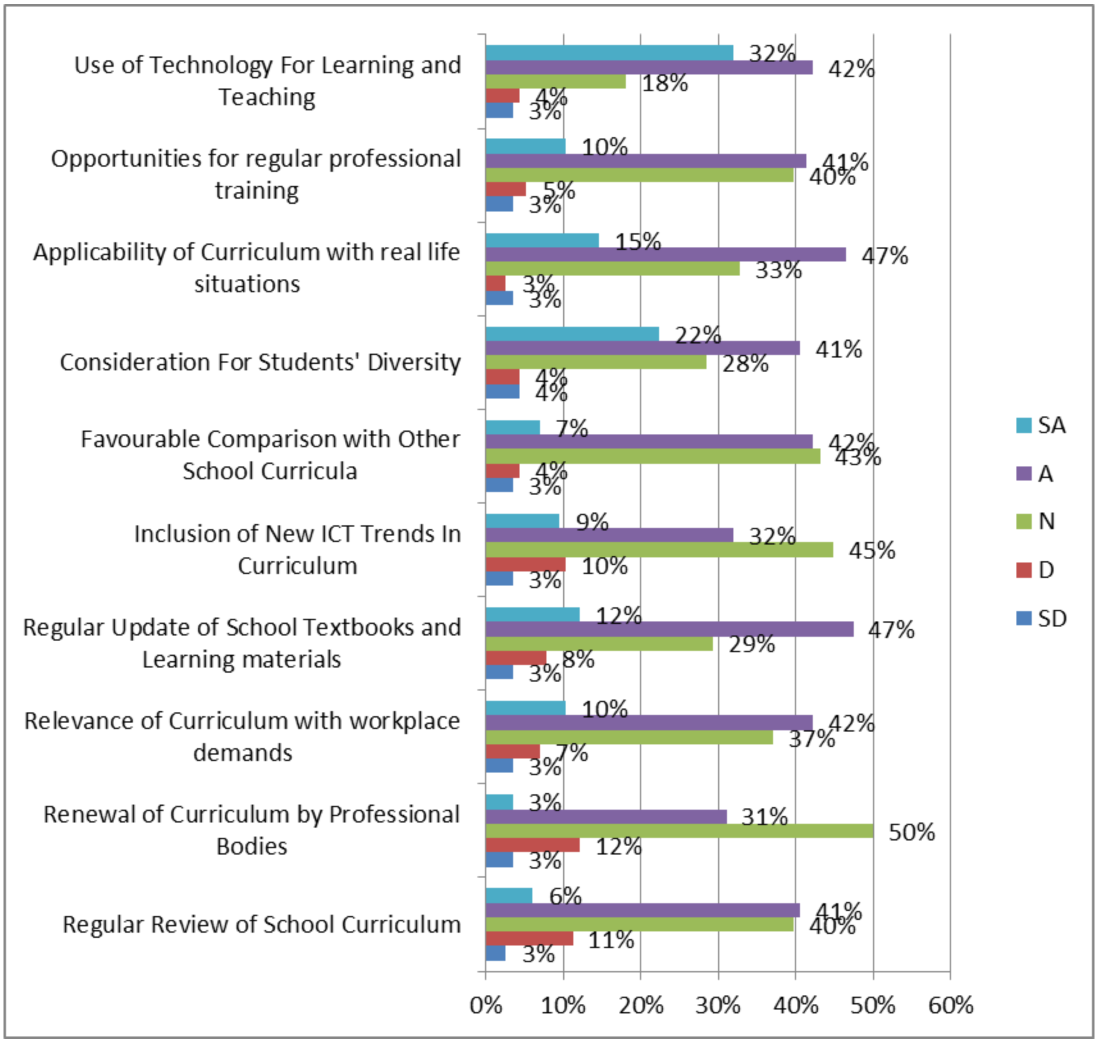

Figure 17: Students' perceived curriculum currency

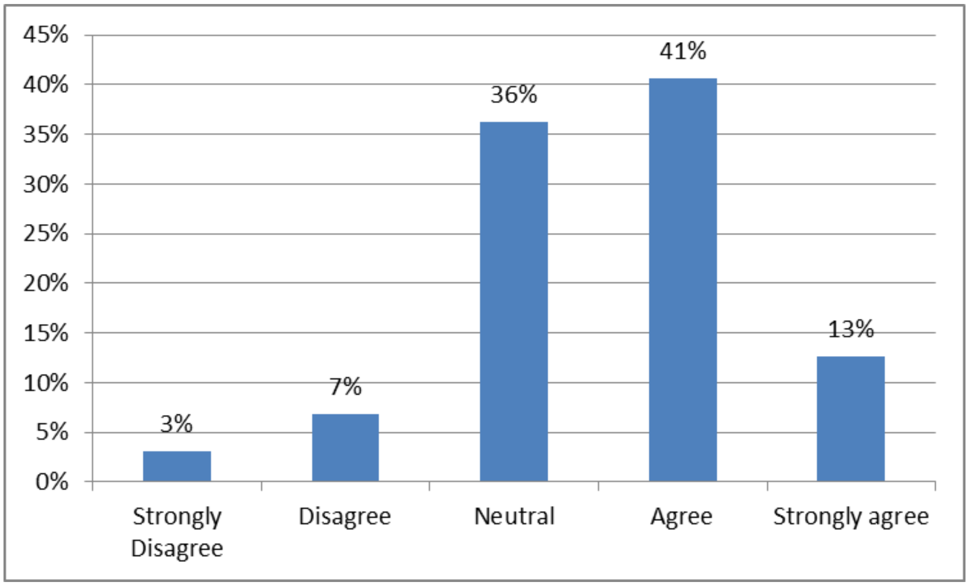

Figure 18: Students' perceived curriculum currency

Table 8: Students' perceived curriculum currency

D	**S1**	**S2**	**S3**	**S4**	**S5**	**Mean**	**SD**
D1	3	11	40	41	13	3.36	.859
D2	3	12	50	31	3	3.19	.823
D3	3	7	37	42	10	3.49	.899
D4	3	8	29	47	12	3.57	.925
D5	3	10	45	32	9	3.34	.913
D6	3	4	43	42	7	3.45	.827
D7	4	4	28	41	22	3.72	1.001
D8	3	3	33	47	15	3.66	.884
D9	3	5	40	41	10	3.50	.880
D10	3	4	18	42	32	3.95	.994
TOTAL	**3**	**7**	**36**	**41**	**13**	3.52	

4.2.4 Student's awareness of Digital Switch Over

It is interesting to note that, according to Figure 19, Figure 20 and Table 9, students rate their awareness of digital switchover as low for each of the DSO awareness items and for DSO awareness as a variable.

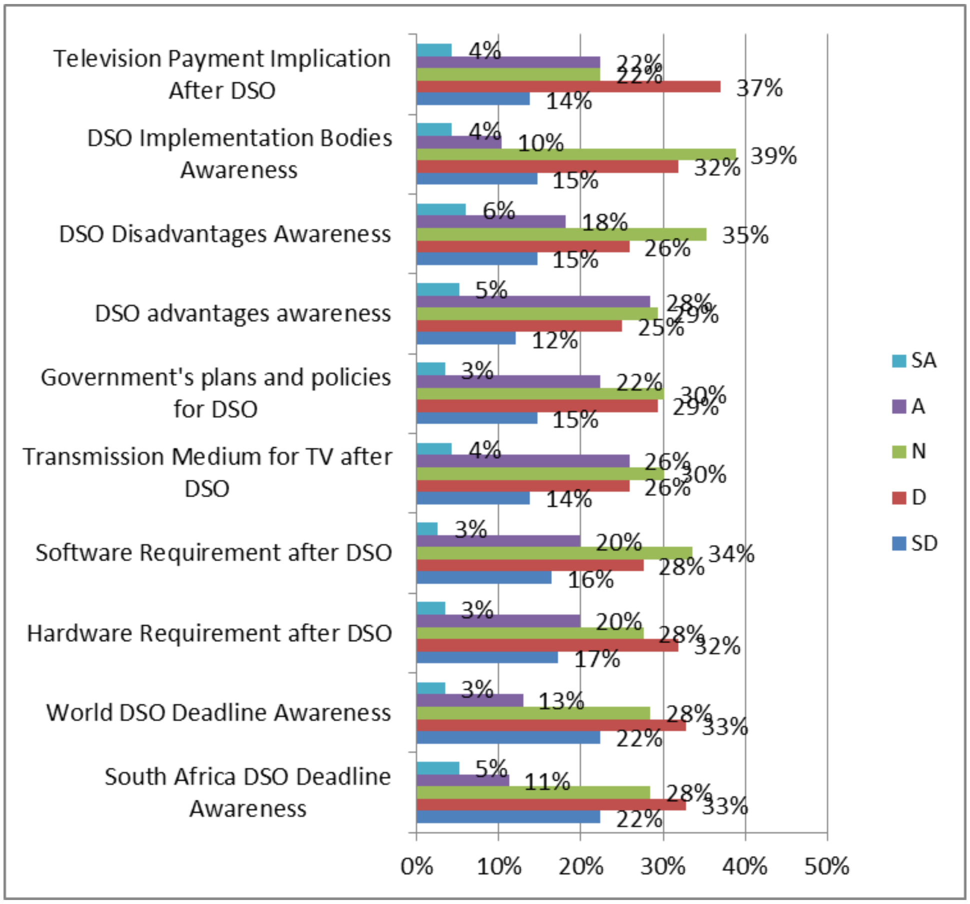

Figure 19: Students' awareness of digital switchover

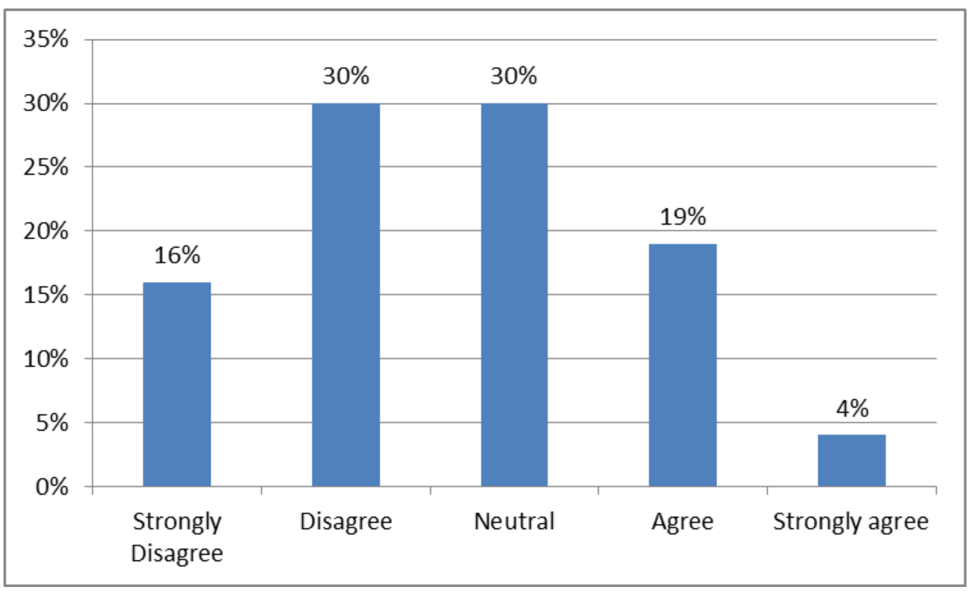

Figure 20: Students' awareness of digital switchover

Table 9: Students' awareness of Digital Switchover

E	S1	S2	S3	S4	S5	Mean	SD
E1	22	33	28	11	4	2.44	1.113
E2	22	33	28	13	3	2.42	1.081
E3	17	32	28	20	3	2.60	1.094
E4	16	28	34	20	3	2.65	1.057
E5	14	26	30	26	4	2.81	1.103
E6	15	29	30	22	3	2.71	1.080
E7	12	25	29	28	5	2.90	1.106
E8	15	26	35	18	6	2.75	1.102
E9	15	32	39	10	4	2.58	1.006
E10	14	37	22	22	4	2.66	1.103
TOTAL	**16**	**30**	**30**	**19**	**4**	2.65	

4.3 Inferential Statistics

As mentioned at the beginning of this chapter, ANOVA and Pearson correlation tests were performed on the data collected by this study, and the results of the tests are presented below, starting with the results of the ANOVA tests.

4.3.1 ANOVA Test Results

ANOVA test results are presented from Table 10 to Table 19 and they indicate that:

- Fb: Gender, Ethnicity and High School Computing Course of a computing student has a direct relationship with his or her perceptions on the currency of his or her curriculum.
- Fd: The location of the high school of a computing student has a direct relationship with his or her perceived awareness of digital switchover.

Table 10: ANOVA test results (Age Group)

		Sum of Squares	df	Mean Square	F	Sig.
B_CareerGuidance	Between Groups	87.296	4	21.824	0.625	0.646
	Within Groups	3875.144	111	34.911		
	Total	3962.44	115			
C_GenICTTrends	Between Groups	67.406	4	16.851	0.423	0.792
	Within Groups	4420.042	111	39.82		
	Total	4487.448	115			
D_PerceivedCurriculumCurrency	Between Groups	6.776	4	1.694	0.044	0.996
	Within Groups	4293.94	111	38.684		
	Total	4300.716	115			
E_DSOAwareness	Between Groups	170.016	4	42.504	0.521	0.721
	Within Groups	9058.949	111	81.612		
	Total	9228.966	115			

Table 11: ANOVA test results (Gender)

		Sum of Squares	df	Mean Square	F	Sig.
B_CareerGuidance	Between Groups	8.352	1	8.352	0.241	0.625
	Within Groups	3954.088	114	34.685		
	Total	3962.44	115			
C_GenICTTrends	Between Groups	29.24	1	29.24	0.748	0.389
	Within Groups	4458.208	114	39.107		
	Total	4487.448	115			
D_PerceivedCurriculumCurrency	Between Groups	286.989	1	286.989	8.151	0.005
	Within Groups	4013.726	114	35.208		
	Total	4300.716	115			
E_DSOAwareness	Between Groups	2.116	1	2.116	0.026	0.872
	Within Groups	9226.849	114	80.937		
	Total	9228.966	115			

Table 12: ANOVA Test Results (Ethnicity)

		Sum of Squares	df	Mean Square	F	Sig.
B_CareerGuidance	Between Groups	96.449	3	32.15	0.931	0.428
	Within Groups	3865.99	112	34.518		
	Total	3962.44	115			
C_GenICTTrends	Between Groups	195.215	3	65.072	1.698	0.172
	Within Groups	4292.233	112	38.324		
	Total	4487.448	115			
D_PerceivedCurriculumCurrency	Between Groups	308.042	3	102.681	2.88	0.039
	Within Groups	3992.673	112	35.649		
	Total	4300.716	115			
E_DSOAwareness	Between Groups	306.709	3	102.236	1.283	0.284
	Within Groups	8922.257	112	79.663		
	Total	9228.966	115			

Table 13: ANOVA test results (University)

		Sum of Squares	df	Mean Square	F	Sig.
B_CareerGuidance	Between Groups	206.545	3	68.848	2.053	0.111
	Within Groups	3755.894	112	33.535		
	Total	3962.44	115			
C_GenICTTrends	Between Groups	298.01	3	99.337	2.656	0.052
	Within Groups	4189.439	112	37.406		
	Total	4487.448	115			
D_PerceivedCurriculumCurrency	Between Groups	177.632	3	59.211	1.608	0.191
	Within Groups	4123.083	112	36.813		
	Total	4300.716	115			
E_DSOAwareness	Between Groups	585.078	3	195.026	2.527	0.061
	Within Groups	8643.888	112	77.178		
	Total	9228.966	115			

Table 14: ANOVA test results (Programme of Study)

		Sum of Squares	df	Mean Square	F	Sig.
B_CareerGuidance	Between Groups	22.492	2	11.246	0.323	0.725
	Within Groups	3939.948	113	34.867		
	Total	3962.44	115			
C_GenICTTrends	Between Groups	53.561	2	26.78	0.683	0.507
	Within Groups	4433.887	113	39.238		
	Total	4487.448	115			
D_PerceivedCurriculumCurrency	Between Groups	88.167	2	44.083	1.183	0.31
	Within Groups	4212.549	113	37.279		
	Total	4300.716	115			
E_DSOAwareness	Between Groups	67.885	2	33.943	0.419	0.659
	Within Groups	9161.08	113	81.072		
	Total	9228.966	115			

Table 15: ANOVA test results (Mode of Study)

		Sum of Squares	df	Mean Square	F	Sig.
B_CareerGuidance	Between Groups	13.643	1	13.643	0.394	0.532
	Within Groups	3948.797	114	34.639		
	Total	3962.44	115			
C_GenICTTrends	Between Groups	7.23	1	7.23	0.184	0.669
	Within Groups	4480.218	114	39.3		
	Total	4487.448	115			
D_PerceivedCurriculumCurrency	Between Groups	16.209	1	16.209	0.431	0.513
	Within Groups	4284.506	114	37.583		
	Total	4300.716	115			
E_DSOAwareness	Between Groups	34.959	1	34.959	0.433	0.512
	Within Groups	9194.006	114	80.649		
	Total	9228.966	115			

Table 16: ANOVA test results (Year of Study)

		Sum of Squares	df	Mean Square	F	Sig.
B_CareerGuidance	Between Groups	88.64	1	88.64	2.609	0.109
	Within Groups	3873.799	114	33.981		
	Total	3962.44	115			
C_GenICTTrends	Between Groups	1.1	1	1.1	0.028	0.868
	Within Groups	4486.348	114	39.354		
	Total	4487.448	115			
D_PerceivedCurriculumCurrency	Between Groups	11.111	1	11.111	0.295	0.588
	Within Groups	4289.605	114	37.628		
	Total	4300.716	115			
E_DSOAwareness	Between Groups	317.237	1	317.237	4.058	0.046
	Within Groups	8911.729	114	78.173		
	Total	9228.966	115			

Table 17: ANOVA test results (High School Maths Option)

		Sum of Squares	df	Mean Square	F	Sig.
B_CareerGuidance	Between Groups	14.817	1	14.817	0.428	0.514
	Within Groups	3947.623	114	34.628		
	Total	3962.44	115			
C_GenICTTrends	Between Groups	2.325	1	2.325	0.059	0.808
	Within Groups	4485.123	114	39.343		
	Total	4487.448	115			
D_PerceivedCurriculumCurrency	Between Groups	21.724	1	21.724	0.579	0.448
	Within Groups	4278.991	114	37.535		
	Total	4300.716	115			
E_DSOAwareness	Between Groups	0.544	1	0.544	0.007	0.935
	Within Groups	9228.421	114	80.951		
	Total	9228.966	115			

Table 18: ANOVA test results (High School Location)

		Sum of Squares	df	Mean Square	F	Sig.
B_CareerGuidance	Between Groups	11.267	1	11.267	0.325	0.57
	Within Groups	3951.173	114	34.659		
	Total	3962.44	115			
C_GenICTTrends	Between Groups	24.112	1	24.112	0.616	0.434
	Within Groups	4463.336	114	39.152		
	Total	4487.448	115			
D_PerceivedCurriculumCurrency	Between Groups	44.187	1	44.187	1.183	0.279
	Within Groups	4256.528	114	37.338		
	Total	4300.716	115			
E_DSOAwareness	Between Groups	358.518	1	358.518	4.608	0.034
	Within Groups	8870.447	114	77.811		
	Total	9228.966	115			

Table 19: ANOVA test results (High School Computing Course)

		Sum of Squares	df	Mean Square	F	Sig.
B_CareerGuidance	Between Groups	43.594	2	21.797	0.629	0.535
	Within Groups	3918.845	113	34.68		
	Total	3962.44	115			
C_GenICTTrends	Between Groups	222.957	2	111.479	2.954	0.056
	Within Groups	4264.491	113	37.739		
	Total	4487.448	115			
D_PerceivedCurriculumCurrency	Between Groups	312.172	2	156.086	4.422	0.014
	Within Groups	3988.544	113	35.297		
	Total	4300.716	115			
E_DSOAwareness	Between Groups	326.839	2	163.419	2.074	0.13
	Within Groups	8902.127	113	78.78		
	Total	9228.966	115			

4.3.2 Differences Between Groups

A further interpretation of the ANOVA test conducted by this study is presented below. Female computing students perceive their curriculum to be more current compared to their male counterparts (Table 20). Computing students of African origin perceive their curriculum to be more current compared to their Indian counterparts (Table 21). The Coloured and White ethnic groups were not compared with the African and Indian ethnic groups because they contained too few participants. The computing students who took end user computing in high school perceived their curriculum to be more current compared to their counterparts who did programming in high school (Table 22). Lastly, computing students who had their high school education in an urban area were more aware of the digital switch over compared to their counterparts who had their high school education in a rural area (Table 23).

Table 20: Descriptive statistics for computing students' gender and computing students' perceptions on the currency of their curriculum

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Male	83	34.2410	6.33147	.69497	32.8584	35.6235	13.00	45.00
Female	33	37.7273	4.76493	.82947	36.0377	39.4168	27.00	46.00
Total	116	35.2328	6.11535	.56780	34.1081	36.3575	13.00	46.00

Table 21: Descriptive Statistics for computing students' ethnicity and computing students' perceptions on the currency of their curriculum

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
African	93	35.9247	5.54083	.57456	34.7836	37.0659	18.00	46.00
Indian	20	31.7000	7.50509	1.67819	28.1875	35.2125	13.00	43.00
3	1	38.0000					38.00	38.00
4	2	37.0000	9.89949	7.00000	-51.9434	125.9434	30.00	44.00
Total	116	35.2328	6.11535	.56780	34.1081	36.3575	13.00	46.00

Table 22: Descriptive Statistics for computing students' high school computing course and computing students' perceptions on the currency of their curriculum

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
End User Computing	61	36.6066	4.93720	.63214	35.3421	37.8710	24.00	46.00
Programming	43	34.3023	7.18972	1.09642	32.0897	36.5150	13.00	45.00
Others	12	31.5833	5.68024	1.63974	27.9743	35.1924	21.00	38.00
Total	116	35.2328	6.11535	.56780	34.1081	36.3575	13.00	46.00

Table 23: Multiple comparison between computing students' perceived curriculum currency and computing students' high school computing course

High school location		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
End user computing	Programming	2.30423	1.18300	.130	-.5054	5.1139
	Others	5.02322*	1.87618	.023	.5673	9.4791
Programming	End user computing	-2.30423	1.18300	.130	-5.1139	.5054
	Others	2.71899	1.93965	.343	-1.8877	7.3257
Others	End user computing	-5.02322*	1.87618	.023	-9.4791	-.5673
	Programming	-2.71899	1.93965	.343	-7.3257	1.8877

4.3.3 Pearson Correlations Results

Table 24 presents the results of the Pearson correlation tests conducted by this study, which confirm the following hypotheses on the relationship between the prior conditions of the computing students and his or her awareness of ICTs:

Fe: A student's perceived exposure to career guidance opportunities has a direct relationship with his or her perceived awareness of DSO.

Ff: A students' perceived exposure to career guidance opportunities has a direct relationship with his or her perceptions on the currency of his or her curriculum.

Fg: A student's perceptions on the currency of his or her curriculum have a direct relationship with his or her perceived awareness of DSO.

Fh: A students' perceived awareness of the latest ICT trends has a direct relationship with his or her perceived awareness of DSO.

Fi: A student's perceived exposure to career guidance has a direct relationship with his or her perceived awareness of the latest ICT trends.

Fj: A student's perceptions on the currency of his or her curriculum have a direct relationship with his perceived awareness of the latest ICT trends.

Figure 21 shows the validated conceptual model.

Table 24: Pearson correlation results

		B_Career Guidance	C_GenICTTr ends	D_PerceivedCurriculumC urrency	E_DSOaware ness
B_CareerGuidance	Pearson Correlation	1	.288**	.508**	.350**
	Sig. (2-tailed)		.002	.000	.000
	N	116	116	116	116
C_GenICTTrends	Pearson Correlation	.288**	1	.303**	.375**
	Sig. (2-tailed)	.002		.001	.000
	N	116	116	116	116
D_PerceivedCurriculumC urrency	Pearson Correlation	.508**	.303**	1	.362**
	Sig. (2-tailed)	.000	.001		.000
	N	116	116	116	116
E_DSOawareness	Pearson Correlation	.350**	.375**	.362**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	116	116	116	116

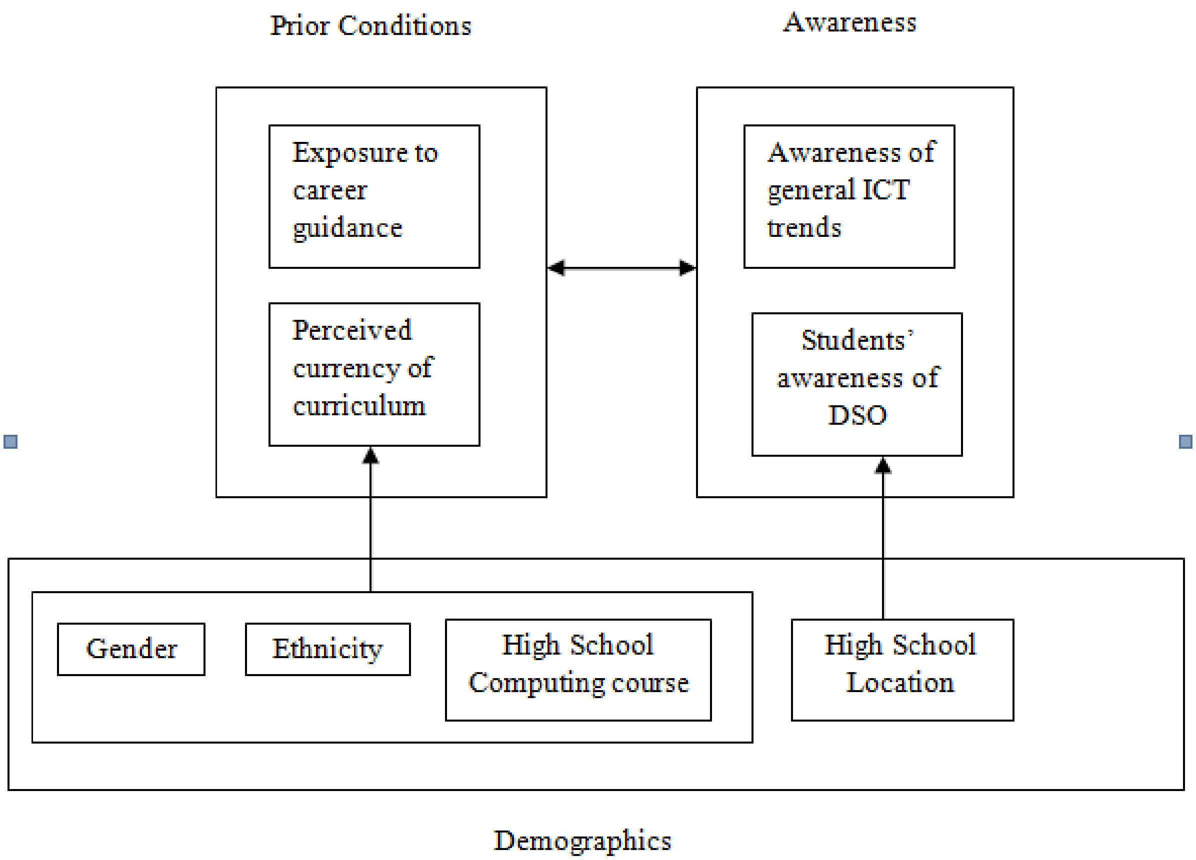

Figure 21: Validated conceptual model

4.3.3 Linear Regression Test

Table 25 presents the results of the test for co-linear regression between the dependent variable and the independent variables that were found to be correlated through Pearson tests. Unfortunately, according to Table 25, students' perceived DSO awareness is the only variable which is linked to the dependent variable students' awareness of general ICT trends through a linear regression. Therefore, another co-linearity regression test was conducted only between the students' awareness of general ICT trends and DSO awareness, as presented by Table 26 and Equation 2.

Table 25: Linear regression test results 1

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	19.864	3.464		5.734	.000
	B_CareerGuidance	.124	.108	.117	1.152	.252
	D_PerceivedCurriculumCurrency	.144	.104	.141	1.387	.168
	E_DSOawareness	.197	.065	.283	3.019	.003

a. Dependent Variable: C_GenICTTrends awareness

Table 26: Linear regression test results 2

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	T	Sig.
1	(Constant)	27.136	1.694		16.020	.000
	E_DSOawareness	.261	.061	.375	4.318	.000

a. Dependent Variable: C_GenICTTrends

$$C = 27.136 + 0.261E \quad (2)$$

Where C is computing students' awareness of the latest ICT trends and E=Computing students'DSO awareness**.**

4.5 Summary and Conclusion

This chapter starts by presenting the positive reliability and validity results for all the four research variables of the survey conducted in this study. It then presents the descriptive statistics of that survey where it can be seen that the majority of students are male, aged between 20-22;

they are full time students from the African ethnic group, and they took “Core maths” in high school. The descriptive results of this study also indicate that students perceive their curriculum as relatively current even though their awareness of the digital switch over is low, but their perceived exposure to career guidance opportunities as well as their perceived awareness of general ICT trends is average. The last part of the chapter presents the results of the inferential statistics, where it can be seen that gender, ethnicity, and high school computing course are the demographic factors that have a direct relationship with students’ perceptions on the currency of their curriculum, even though the high school location is the only demographic factor affecting students’ awareness of DSO. Other inferential results basically empirically validate the existence of a direct relationship between the four variables of this study, namely, students’ exposure to career guidance opportunities, their perceptions on the currency of their curriculum, their awareness of DSO, and their awareness of general ICT trends. The next chapter will discuss the above findings in comparison with existing empirical studies on awareness and adoption of technologies in the education sector.

CHAPTER FIVE

COMPARISON WITH RELATED LITERATURE, RECOMMENDATIONS AND CONCLUSION

The purpose of this chapter is to fulfil the last objective of this study, which is to make recommendations on how to improve technology awareness in the education sector especially among students through curriculum initiatives. However, before making these recommendations, this chapter also presents an overview of existing studies on technology awareness and adoption in the education sector in order to compare the results of these studies with the results of the current study and to highlight the contributions of the current study.

5.1 Summary of the Current Empirical Study

Most of the respondents of the survey conducted in this study are male, and they are aged between 20-22 years, they are full time students from the African ethnic group and they took "core maths" in high school. The descriptive results of this study indicate that students perceive their curriculum as relatively current even though their awareness of the digital switch over is low, but their perceived exposure to career guidance opportunities and their perceived awareness of general ICTs are average. The results of the inferential statistics indicate that among the demographic factors, gender, ethnicity, and high school computing course have a direct relationship with students' perception on the currency of their curriculum. On the hand, the high school location was the only demographic variable that affected that has a direct relationship with the students' awareness of DSO. The correlation tests indicate that there is a direct relationship between all the four variables, namely students' perceived exposure to career guidance opportunities, students' perceived curriculum currency, students' awareness of the digital switch over and awareness of general ICT trends.

5.2 Descriptive Results of Existing Literature on Awareness of Technologies in the Education Sector

This section presents the descriptive results of studies reviewed by this chapter on the awareness level of technologies in the education sector. This is presented in the Table 27, along with a brief description of the gender, age, and academic field of the respondents, the technology that was the focus of their research and the technology awareness level of their respondents, and the country where the studies took place.

Table 27: Descriptive result of existing literature on awareness of technologies in the education sector

Author	**Majority Gender**	**Majority age**	**Academic field**	**Country or Ethnicity**	**Technology**	**Awareness level**
Asemi and Riyahiniya (2007)	55.6% female	x	Medical Sciences	Iran	Digital Resources	70% aware (high)
Alzaza and Yaakub (2011)	63.6 % female	85.8% below 26	Various disciplines	Malaysia	Mobile technology	Over 50 % / average awareness
Dookhitram *et al.* (2012)	55% male	x	School of innovative technology and engineering	Mauritius	Green computing	80 percent aware (high)
Eyaufe, Golley and Brume-Ezewu (2013)	Not reported	x	Medicine	Nigeria	E journals	Low awareness
Fabunmi Miss and Asubiojo Mrs (2013)	53.3% male	38.7% 20-24 years	All faculties in a university	Nigeria	Online public access catalogue	68.7% aware (high)
Liu and Harvin (2012)	77 % female	x	Education	America	Web 2.0	Aware (high)
Velmurugan (2013)	67.46% female	x	Frontiers in technology	India	Electronic journals	77.78% aware
Yacob *et al.* (2012)	59.8% male	x	Education	Malaysia	E-learning technologies	Awareness (high)

Abdullah and Gibb (2006)	54% female	x	Various disciplines	Glasgow , UK	E book	Low awareness 57% not aware
Ahmad, Bello and Nordin (2014)	54% male	x	Various disciplines	Malaysia	Green computing	General low awareness
(Kinley 2010)	64% male	x	Education	University of \bhutan	E-learning software	Low awareness
Borchert, Hunter and Macdonald (2009)	67% female	20-29	All faculties	Austrialia	E books	Awareness (high)
Claudy *et al.* (2010)	X	x	General population	Ireland	Micro generation technologies	Low 18%
Bello *et al.* (2004)	81% male	x	Medicine	Nigeria	Computers	Low awareness
Kwapong (2009)	51.6% male	20-30 years	General	Ghana	GENERAl IT	RELATIVELY HIGH / average awareness
Baro, Endouware and Ubogu (2011)	53% male	x	Medicine	Nigeria	ONLINE INFORMATION RESOURCES	LOW awareness

5.2.1 Gender

Table 27 shows that, out of the 16 studies reviewed by this chapter, male respondents form the majority gender for eight of these studies, female respondents from the majority gender for six of these studies, and two of the studies didn't report on the gender of their respondents. This gives an indication that both the male and the female genders are well represented in the studies reviewed by this chapter.

5.2.2 Age

Table 27 shows that, out of the 16 studies reviewed in this chapter, 12 of them didn't report on the age of their respondents, and the age range for the respondents of the other four studies is between 20 and 30 years old. This gives an indication that age as a demographic variable is not being given adequate attention in technology awareness studies in the education sector.

5.2.3 Discipline

According to Table 27, seven of the studies reviewed by this chapter chose their respondents from a mix of academic disciplines, in contrast to the nine studies that chose their respondents from a single academic discipline. The academic disciplines of these nine studies are: four studies for medicine, three studies for education, and two for engineering. This shows that no single disciple is over represented in technology awareness studies in the education sector.

5.2.4 Country

Table 27 shows that, out of 16 studies reviewed, four studies took place in Nigeria, three took place in Malaysia, one each in India, Bhutan, Australia, America, United Kingdom, Iran, Mauritius, and Ireland. This gives an indication that the majority of these studies is conducted in either in Asia or in Africa. North America, Oceania, and Europe have a minimal representation in this list of countries, and South America is totally absent from it.

5.2.5 Technology

According to Table 27, three of the papers reviewed by this study are focusing on e-learning software, two of them are focusing on green computing, two on e-books, two on computers, two on digital resources, one on mobile technology, and one on micro-generation technologies. This suggests that no single type of technology is over represented in technology awareness studies in the education sector.

5.2.6 Level of Awareness

Table 27 shows that, out of the 16 studies reviewed, seven studies are reporting high technology awareness levels for their respondents, seven studies are reporting low technology awareness levels for their respondents, and two of the studies are reporting average technology awareness levels for their respondents. This gives an indication that the reviewed technology awareness studies in the education sector are indecisive on the level of technology awareness among technology adopters.

5.3 Inferential Results of Studies on Technology Adoption in the Education Sector

This section presents the results of reviewed studies on literature on technology adoption in the education sector in Table 28. It also presents a brief discussion of the authors, population, dependent variable, independent variable, and related IDT construct of the studies.

Table 28: Inferential results on existing literature on adoption of technologies in the education sector

	Author	**Population**	**Country**	**Technology**	**Dependent variable**	**Independent variable**	**IDT Construct**
1	Isleem (2003)	Teachers	United states	Computer	Use of computer	Access	Trialability
						Teachers' beliefs about personal effectiveness and efficiency when using computers	Relative advantage, complexity and Compatibility
						Attitude towards the use of computers	Relative advantage, and Compatibility
						Support	Norms of the Social system
2	Medlin (2001)	Faculty members	United States	General Technologies	Adoption of new technologies	Peer support, friends	Norms of the Social system
						Physical resource support	Norms of the Social system/Triability
						Interest in improving learning	Innovativeness/felt problems and needs/Characteristics of decision making unit

3	Jacobson 1998	Faculty members	United States	Computer	Adoption of computer technology	Expertise	Previous practice
						Self-efficacy	Personality variables
						Teaching and learning changes	Relative advantage
						Impediments to teaching	Socioeconomic characteristics
						Incentives to integrate technology	Relative Advantage
						Methods of learning about technology	Communication channel
4	Less 2003	Faculty	United States	Computer Technology	Adoption of computer technologies	Age, Gender, Race, teaching experience, highest degree attained	Socioeconomic characteristics
5	Blankenship 1998	Teachers	United States	Computer	Use of computers	Access to computer	Trialability
						Training	Norms of the Social system/communication system
						Support	Social system/communication system
6	Surendra 2001	Professors and administrators	Canada	Web technology	Acceptance of web technology	Access	Trialability
						Training	Norms of the Social system
7	Carter 1998	Faculty members	United states	Computer based technologies	Attitude for Use of computer based technologies	Support	Norms of the Social system/communication system
						Resources	Norms of the Social system/Triability

						Training	Norms of the Social system
8	Zakaria 2001	Faculty members	United States	Information Technology	IT use	Willingness	Personality variable
						Level of education	Socioeconomic characteristics
						Gender	Socioeconomic characteristics
9	Anderson 1998	Faculty	Canada	IT	IT use	ICTs competence	Previous practice
						Relative advantage	Relative advantage
						Relationship btw staff and students	Norms of the Social system
						Potential to transform learning	Relative advantage
10	Nazari 2014	Faculty members	Iran	Online database in library system	Adoption of online database	Relative advantages	Relative advantage
						Compatibility	Compatibility
						Complexity	Complexity
						Triability	Trialability
						Observability	Observability
11	Penjor and Zander 2015	Academic staff	Bhutan	Virtual learning environment	Use of virtual learning environment	Relative advantages	Relative advantage
						Compatibility	Compatibility
						Complexity	Complexity
						Triability	Trialability
						Observability	Observability
12	Yatigammana, Johar, and Gunawardhana 2014	Post graduate students	Sri-Laka and Malaysia	E-learning for distance education	Acceptance of E-learning	Relative advantage	Relative advantage
						Compatibility	Compatibility
						Complexity	Complexity
						Triability	Trialability
						Observability	Observability

13	Tunmibi, Aregbesola &Asani 2015	University students	Nigeria and Republic of Benin	Smart phones	Adoption of smart phones	Relative advantage	Relative advantage
						Compatibility	Compatibility
						Complexity	Complexity
						Triability	Trialability
						Observability	Observability
14	Karamanos and Gibb 2012	Postgraduate Students	United Kingdom	Online interactivity	Adoption of online interactivity	Perceived attributes of innovation	Innovation characteristics
						Change facilitator interventions	Norms of the Social system
						Peer student actions	Norms of the Social system
15	Sanni *et al* 2014	Journal pubilishers	Malaysia	e-journals	e-journal publishing	Peer network influence	Norms of the Social system
						Change agent influence	Norms of the Social system
						Organization characteristics	Characteristics of decision making unit
16	Ntemana and Olatokun 2012	Lecturers	Lesotho	ICTs	Use of ICTs	Relative advantage	Relative advantage
						Compatibility	Compatibility
						Complexity	Complexity
						Triability	Trialability
						Observability	Observability
17	Alajmi 2014	Faculty members	State of Kuwait	Digital library system	Use of digital library system	Perceived relative advantage	Relative advantage
						Perceived Triability	Trialability
						Visibility	Visibility
						Awareness-knowledge	Knowledge
18	Sahin 2012	Pre-service teachers	Turkey	ICTs	Use of ICTs	Innovativeness	Innovativeness
						Relative Advantage	Relative Advantage

19	Hsbollah and Idris 2009	Lecturers	Malaysia	E-learning for distance learning	Adoption of e-learning	Relative-advantage	Relative advantage
						Trialability	Trialability
						Academic specialization	Socioeconomic characteristics
20	Al-senaidi and Gewande 2013	Faculty members	Oman	ICTs	ICT adoption	Level of ICT skill	Previous practice
						Innovation attributes	Perceived characteristics of innovation
21	Yosof *et al* 2011	Faculty members	Malaysia	ICTs	E-learning adoption	Compatibility Observability	Compatibility Observability
22	Shea, Pickett and Li 2005	Faculty members	United States	E-learning for distance learning	Adoption and satisfaction of online teaching	Interaction	Norms of the Social system
						Technical support	Norms of the Social system
						Faculty learning/training	Norms of the Social system
						Ability to devote time to innovation	Characteristics of decision making unit
23	Corrigan 2012	High School Students	Canada	E-learning software	Adoption of e-tutoring	Relative advantage	Relative advantage
						Compatibility	Compatibility
						Complexity	Complexity
						Trialability	Trialability
						Observability	Observability
24	Duan *et al* 2010	Undergraduate Students	China	Distance learning E-learning	Acceptance of E-learning	Relative advantage	Relative advantage
						Compatibility	Compatibility
						Complexity	Complexity
						Triability	Trialability
						Observability	Observability

25	Nazari, Khosravi and Babalhavaeji 2013	Faculty	Iran	Online database	Acceptance of online database	Relative advantage	Relative advantage
						Compatibility	Compatibility
						Complexity	Complexity
						Trialability	Trialability
						Observability	Observability
26	Joo, Lim and Lim 2014	Undergraduate students	South Korea	Mobile learning	Use of Mobile learning	Relative advantage	Relative advantage
						Compatibility	Compatibility
						Complexity	Complexity
						Trialability	Trialability
						Observability	Observability
27	Slyke, Lou and Day 2002	Undergraduates students	USA	Groupware	Use of Groupware application	Relative advantage	Relative advantage
						Complexity	Complexity
						Compatibility	Compatibility
						Trialability	Trialability
28	Yatigamana, Johar, and Gunavardhana	Postgraduate Students	Sri-Larka and Malaysia	Elearning for distance learning	ELearning Acceptance	Relative advantage	Relative advantage
						Complexity	Complexity
						Compatibility	Compatibility
						Trialability	Trialability
						Observability	Observability
						Psychological well-being	Personality variable
29	Song 2010	University Students	United States	Online High definition video adoption	Adoption of online High Definition video	Media consumption	Communication channel
						Demographics	Socioeconomic characteristics
						Personality Traits	Personality variables
						Innovation attributes	Innovation characteristics
						Awareness of innovation	Knowledge
						Perceptions on benefits of innovation	Relative advantage

30	Ademola 2014	Journal publishers	Malaysia	E-journal	Adoption of E-journal publishing	Adopter characteristics variables	Characteristics of decision making unit
						Attributes of innovation	Innovation characteristics
						Peer network influence	Norms of the Social system
						Change agent influence	Norms of the Social System

5.3.1 Country

Table 28 shows that, out of the thirty studies reviewed, ten studies took place in the United States sector, six took place in Malaysia, three in Canada, two in Iran, two in Sri-larka, and one each in Bhutan, Nigeria, Benin, United Kingdom, Lesotho, State of Kuwait, Turkey, Oman, China, and South Korea. This gives an indication that the majority of these studies is conducted either in Asia or in North America. Africa and Europe have a minimal representation in this list of countries; and South America and Oceania are totally absent from it.

5.3.2 Population

Sixteen of the studies presented in Table 28 focus on university faculties, four on undergraduate students; three on postgraduate students, three on teachers; two on e-journal publishers, and one on high school students. This gives an indication that the majority of these studies focused on university faculties and teachers (19 studies) compared to students and learners (9 studies), and other types of education stakeholders such as e-journal publishers (2 studies).

5.3.3 Technology

According to Table 28, 11 of the papers reviewed by this study focus on computer technologies that are not clearly identified by the authors of their papers, seven of them on web 2.0 e-learning technologies, two on online database, two on distance education e-learning, two on digital library adoption, two on e-journal publishing, one on groupware technology, and one on online high definition television. This suggests that there is no single type of computing technology at the center of the studies reviewed by Table 5.2.

5.3.4 Dependent Variable

This is a summary of the analysis of Table 28 with regard to the identification of the popularity of the following dependent variables: the use of computer technologies (18 publications); adoption of e-learning in distance education (five publications); acceptance of e-learning software (three); e-journal publishing adoption (two), adoption of online database in digital libraries (two). The above analysis shows that the majority of the reviewed studies focus on the use of computer technologies as their dependent variable.

5.3.5 IDT Constructs

This section is an attempt to indicate the number of times each IDT item appears in Table 28 as an independent factor. Relative advantage appears 20 times; triability appears 17 times; norms of the social system appears 17 times; compatibility appears 12 times; complexity appears 11 times; observability appears nine times; socioeconomic characteristics appears six times; communication channels appear five times; personality variables appear four times; previous practice appears three times; knowledge and innovativeness appears two times each. A further analysis of these statistics reveals that the innovation attributes construct appears 69 times, prior conditions appear 22 times, communication channels appear five times, and knowledge or awareness only appears two times.

5.4 Contributions

This section attempts to present the contribution of this research project in comparison with the above analysis of existing literature. These contributions are summarized by the following points.

- Most of the studies reviewed by this chapter were conducted in North America and in Asia, and the fact that other continents such as Africa are under-represented in these studies is a research gap. Therefore, conducting the current study in South Africa can be taken as a step towards closing this research gap.

- Innovation attributes and prior conditions are the two IDT variables that are examined by the overwhelming majority of the studies reviewed by this chapter, and the fact that other IDT variables such as knowledge/awareness are under-represented in these studies is a research gap. Therefore, having knowledge/awareness as the main variable of the current study can be seen as a step towards closing this research gap in view of the fact that the only two studies from the reviewed literature that examined the awareness/knowledge construct of the IDT confirmed the impact of that construct on adoption but they didn't analyze the factors influencing it. Moreover, in view of the fact that awareness/knowledge is the main research variable of the current study, it is important to also compare the descriptive results of this study with regard to that variable against the descriptive results from the literature reviewed by this chapter.

5.5 Recommendations

The following recommendations can be suggested based on the results of the analysis of the existing literature on one hand and on the results of the current study on the other hand. This is because both results are complementary instead of being contradictory.

- The above literature review indicates that some continents are not being given adequate attention in technology awareness research in the education sector; and the same applies to the age demographic factor and to the knowledge/awareness and communication channels IDT constructs. Therefore, it is proposed that more technology awareness research be conducted on these continents, on the age demographic factor, on the knowledge/awareness IDT construct, and on the communication channels IDT construct.

- The fact that the reviewed technology awareness studies are indecisive on the level of technology awareness among technology adopters might be due to these studies being conducted on different technologies, different research population, and different geographical location. Therefore, more studies should be conducted using similar technologies, or similar populations, or similar locations in order to verify or uncover the actual level of awareness of such technologies.

- The demographic profile of the respondents of the current study mainly consists of full time 20 to 22 years old computing students of Africa origin who took “core maths” in high school. Therefore, more studies should be conducted on other education stakeholders with different demographic profiles.

- According to the results of the current study, students’ awareness of DSO is low, but their perceived awareness of general ICTs and their perceived exposure to career guidance is average. Therefore, it is recommended that further research be conducted on how to ensure that students become more aware of new ICT trends such as DSO so that they can play a creative and active role in the design and adoption of new technologies.

- The results of the inferential statistics of the current study indicate that among the demographic factors, gender, ethnicity, and high school computing course have a direct relationship with students' perceptions on the currency of their curriculum; and high school location has a direct relationship with students' awareness of DSO. Therefore, one is interested in improving the awareness level of rural learners with regard to new technologies. More studies should also be conducted on the reasons why gender and ethnicity, and high computing course affect students' perceptions on the currency of their curriculum.

- The result of the inferential statistics of the current study indicates that gender, ethnicity, and high school computing all affect students' perceptions on the currency of their curriculum, which itself affects their perceptions of perceived technological awareness. Regarding the impact of high school computing of students' perceptions on the currency of their curriculum, this study found that students who took programming courses in high school perceive their curriculum as being less current compared to students who took end user computing. This might mean that students who took programming in high school believe that they are being taught what they already know compared to those who took end user computing who believe they are learning new things. This study, therefore, recommends that the computing curriculum be updated in order to remove the redundancies between the high school programming curriculum and university programming curriculum. Moreover, the fact that the female gender perceives their curriculum as more current compared to the male gender might mean that female students are discovering more ICT novelties from their curriculum compared to male students and their previous exposure to ICTs is low. This study, therefore, recommends that the design of ICTs be more gender sensitive as well as its curriculation. The above recommendations on high school computing and on gender can be adapted and extended to ethnicity.

5.6 Conclusion

The purpose of this section is two-fold, to summarise this chapter, and to conclude this study. The chapter summary can be found in the first paragraph of this section while the study's conclusion can be found in the second paragraph.

This chapter presented a summary of the descriptive and of the inferential results of the current study and of the studies that were reviewed in this chapter on technology awareness and on technology adoption in the education sector. Both the reviewed studies and the current study are conducted on respondents whose average age range is between 20 to 30 years old. Regarding the technology awareness levels of the respondents, the fact that the respondents from the current study, exhibit a low level of awareness cannot be generalized since the studies reviewed by this chapter are indecisive on the awareness level of their respondents. A major contribution of this study is its focus on awareness as its main/dependent research variable compared to only two studies among the forty six studies reviewed in this chapter; moreover, these two studies analysed technology awareness as a predictor of technology adoption while the current study analysed factors affecting technology awareness. Another contribution of the current study is the fact that this study was conducted in an African country, and this can be seen as an attempt to close a research gap on the under-representation of Africa and other continents in the studies reviewed by this chapter. Recommendations presented at the end of this chapter suggest that: more studies should be conducted on continents that were found to be minimally represented or totally absent in the literature reviewed by this chapter, age as a demographic variable should be given more attention in technology awareness studies, and more studies on IDT should focus on the knowledge/awareness and on the communication channels constructs.

The best way to conclude this study is to recall its research questions or its research sub-aims and to indicate how these research questions have answered or how these research sub-aims have been achieved.. The first research question is "which theories can help to understand the factors affecting ICT students' awareness of the latest ICTs?" This question was answered in the second chapter of the dissertation with the selection of theoretical models on technology awareness and on curriculum development to help to understand the factors affecting computing students' awareness of the latest ICTs. The second research question is "how can the factors affecting ICT students' awareness of the latest ICTs be shaped into a conceptual model?" This question is answered by the conceptual model presented in the second chapter of this dissertation. This model is based on the Innovation diffusion theory (IDT) and it mainly uses one of its constructs, prior conditions, as one of the factors affecting potential users awareness or knowledge of innovations. In the conceptual model proposed by this study, prior conditions are represented by three research variables, students' demographics, their prior exposure to career guidance, and their perceptions on how their curriculum has regularly been updated. The third research question is "how can the conceptual model of research question 2 be empirically validated?" This conceptual model was validated by a survey of computing students from the four universities in the KwaZulu-Natal province of South Africa; except that, out of the ten demographic items initially proposed by the model, only four of them, namely, gender, ethnicity, high school computing course and high school location were finally validated by the survey. The fourth research question is "which recommendations can be suggested from the analysis of the factors affecting ICT students' awareness of the latest ICTs for the improvement of technology awareness in the education sector?" One of the recommendation from these findings is to review both high school and university computing so as to remove the redundancies between their content. Another recommendation is to work towards improving the gender sensitivity of the computing curriculum and of computing in general. These recommendations are adding new evidence or new knowledge about the need for more research both on computing curriculum and on the interaction between computing and the female gender.

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APPENDIX

Research Questionnaire

Title: Analysing the factors affecting computing students' awareness of the latest ICTs

This questionnaire is designed to gather data on factors affecting the awareness of IT and related students about Digital Switch Over.

The information is required for MTech research and your name will not be used therefore please answer as fully and truthfully as possible.

Instructions: Please mark your answers with an X

A. Demographics

1. Age Group

Less than 20 ☐ 20-22 ☐ 23-25 ☐
26-28 ☐ More than 28 ☐

2. Gender

Male ☐ Female ☐

3. Ethnicity

African ☐ Indian ☐ Coloured ☐
White ☐ Other ☐

4. University

DUT ☐ MUT ☐ UKZN ☐
UNIZULU ☐

5. Programme of study

Computer Systems ☐ Computer science ☐ IT ☐
Information systems ☐

6. Mode of Study	Full Time ☐		
7. Year of Study	1st ☐	2nd ☐	3rd ☐
8. High school maths option	Maths literacy ☐	Core ☐	
9. High school location	Urban ☐	Rural ☐	
10. High school computing course	End User Computing ☐	Programming ☐	

B. Exposure to Career Guidance Opportunities	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I usually receive career guidance from parents and relatives					
2. I usually receive career guidance from the University counselling center					
3. I usually receive career guidance from lecturers and teachers					
4. I usually receive career guidance from out of campus seminars and industry professionals					
5. I usually receive career guidance from campus seminars ,workshops and presentations					
6. I usually receive career guidance from general media such as internet, TV, radio,newspapers and magazines					
7. I usually receive career guidance from friends, role models and mentors					
8. I usually receive career guidance from organizations specialized in career advice such as PACE, SA career focus, etc					
9. I usually receive career guidance by participating in voluntary work, internships, WIL, apprenticeships, etc					
10. I usually receive career guidance from student chapters of professional associations and societies					

C. Level of awareness of general ICT trends					
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I possess a satisfactory level of awareness of Cloud computing based technologies used for accessing computing resources as services over the internet (e.g. online storage, online collaboration, and online transactions)					
2.I possess a satisfactory level of awareness of Grid computing based technologies used for solving complex computing problems over the internet (e.g. high processing computations, data intensive computations, high bandwidth communications)					
3. I possess a satisfactory level of awareness of Virtualization technologies used for creating virtual versions of computing resources to improve computing performance (e.g. storage virtualization, desktop virtualization, server virtualization)					
4. I possess a satisfactory level of Mobile Wireless technologies used for transfering information between devices not physically connected (e.g. 3G-4G technologies, GPRS - General Packet Radio Service, and EDGE - Enhanced Data rate for GSM Evolution technology)					
5. I possess a satisfactory level of awareness of Radio frequency identification technologies used for the transmission of the identity of an object or a person wirelessly using radio waves (e.g. security tags, tracking tags and identification tags)					
6. I possess a satisfactory level of awareness of Global Positioning System technologies used for providing location and time information (e.g. traffic/congestion control systems, navigation systems, and mapping systems)					
7. I possess a satisfactory level of awareness of Artificial Intelligence based technologies allowing computers to act like humans (e.g. robotics, natural language processing, and computer vision)					
8 I possess a satisfactory level of awareness of Biometrics technologies used for verifying the identity of a person using their physiological attributes (e.g. iris, facial and finger scan, voice recognition, and vein matching)					
9. I possess a satisfactory level of awareness of social media technologies centered around user generated content disseminated through internet and mobile phones (e.g. online community, blogs, and internet forums)					
10. I possess a satisfactory level of awareness of VOIP (Voice over internet protocol) technologies used for transmitting voice over the internet (e.g. video conferencing, internet phone, and podcast)					

D. Perceived currency of curriculum					
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. My school curriculum is regularly reviewed					
2.The accreditation of my school curriculum is regularly renewed by relevant professional bodies					
3. My school curriculum is generally relevant with regard to workplace demands					
4. My school textbooks and learning materials are regularly updated					
5. My school curriculum contains a considerable number of topics on new ICT trends					
6. My school curriculum is usually favorably comparable with other schools' curricula					
7. My school curriculum generally caters for students' diversity including disabled students, foreign language students, etc					
8. My school curriculum is generally applicable to many real life situations					
9.My lecturers regularly have opportunities for professional training					
10.My school generally encourages the use of technology for teaching and learning					

E. Digital Switch Over (DSO) Awareness					
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I am well aware of the DSO deadline for South Africa					
2. I am well aware of the DSO deadline for the world					
3. I am well aware of television's hardware requirements after the DSO					
4. I am well aware of television's software requirements after the DSO					
5. I am well aware of the various transmission medium for receiving DTV(Digital Television) signal after DSO					
6. I am well aware of government plans/policies on DSO (e.g. subsidies for vulnerable people, DTV transmission standards, DTV signal providers, etc)					
7. I am well aware of the advantages of DSO (interactivity, internet accessibility, better TV quality, etc)					
8. I am well aware of the disadvantages of DSO (Cost, obsolete equipment, negative environmental impact)					
9. I am well aware of the DSO implementation bodies (e.g. government agencies)					
10.I am well aware of television’s payment implications of TV after DSO					

Table 29 Variables, their coded values and their 'NOIR' measure types

Variable Name	Measure	Questionnaire Section	Coded Value
Item 1	Ordinal	A	1 = "less than 20" 2 = "20 to 22" 3 = "23to25" 4= "26 to 28" 5 = "more than 28"
Item 2	Nominal	A	1 = "Male" 2 = "Female"
Item 3	Nominal	A	1 = African" 2 = "Indian" 3 = "Coloured" 4 = "White" 5 = "Other"
Item 4	Nominal	A	1 = "DUT" 2 = "MUT" 3 = "UKZN" 4 = "UNIZULU"
Item 5	Nominal	A	1 = "Computer Systems" 2 = "Computer Systems" 3 = "IT"
Item 6	Nominal	A	1 = "Full Time" 2 = "Part Time"
Item 7	Ordinal	A	1 = "1st " 2 = "2nd"
Item 8	Nominal	A	1 = "Maths Literacy" 2 = "Core"
Item 9	Nominal	A	1 = "Urban" 2 = "Rural"
Item 10	Ordinal	A	1 = "End User Computing" 2 = "Programming"

Exposure to Career Guidance Opportunities	Ordinal	B	1= “strongly disagree” 2 = “disagree” 3 = “neutral” 4 = “agree” 5 = “strongly agree”
Level of awareness of general ICT trends	Ordinal	C	1 = “strongly disagree” 2 = “disagree” 3 = “neutral” 4 = “agree” 5 = “strongly agree”
Perceived currency of curriculum	Ordinal	D	1 = “strongly disagree” 2 = “disagree” 3= “neutral” 4 = “agree” 5 = “strongly agree”
Awareness of Digital Switch Over	Ordinal	E	1 = “strongly disagree” 2 = “disagree” 3 = “neutral” 4 = “agree” 5 = “strongly agree”