

An Investigation into the Development of ICT Skills among Mathematics Students in Higher Learning Institutions, A Case of Mukuba University

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Abstract: *The purpose of this study was to examine factors affecting the development of ICT skills among mathematics students in higher learning institutions in Zambia, with a special focus on Mukuba University: a Teacher Training University for undergraduate mathematics and science teachers. The study is both qualitative and quantitative case study. A stratified random sampling procedure was used to sample one hundred and twenty-two (122) Mathematics students at Mukuba University in Kitwe. The following theories were used and discussed in detail in the literature review: Bowlby's (1969) theory of attachment, Bandura's (1977) social learning theory, Piaget's (1973) cognitive development theory and, Lev Vygotsky's (1934) Social interaction theory. Using multivariate linear regression model, sex of the student, age group, nature of the province in Zambia where they stay, confidence level ICTs, year of study, and the use of ICTs in a lecture were all found to affect the development of ICT skills among the different students. It is anticipated that the findings of this study will cause a paradigm shift in the way in which mathematics students are taught in future. In addition, it will help the trainee mathematics teachers to graduate with ICT skills, which are in great demand today. This study could also enable mathematics lecturers to reflect on their current practice, and increase the likelihood of them adopting and promoting the use of ICTs as a way of improving performance in the subject matter. Furthermore, suggestions and recommendations for similar higher learning institutions are made from the study.*

Keywords: ICT skills development, Environmental factors, Mathematics students, Higher learning institutions.

1. Introduction

World over, institutions of higher learning have emphasised the use of Information Communication Technology (ICT) in their teaching and learning process. ICTs have had a big impact on how we see the world and how we live today. According to Ajayi and Ekundayo (2009), ICT have become key tools and have a revolutionary impact on how we see the world and how we live. Bandlele in Ajayi and Ekundayo, (2009. p. 1) adds stating that "ICT is a revolution that involves the use of computers, Internet and other telecommunication technology in every aspect of human endeavour." Ajayi and Ekundayo (2009) further suggested that ICT is simply about sharing and having access to data with ease. It is regarded as the super highway through which information is transmitted and shared by people all over the world. Ozoji in Jimoh (2007. p. 10) defined ICT as "the handling and processing of information (texts, images, graphs, instruction and many more) for use, by means of electronic and communication devices such as computers, cameras, and telephones." Ofodu (2007) also refers to ICT as electronic or computerized devices, assisted by human and interactive materials that can be used for a wide range of teaching and learning as well as for personal use. From these definitions; ICT could therefore be defined as the processing and sharing of information using all kinds of electronic devices, an umbrella that includes all technologies for the manipulation and communication of information.

ICT skills involve the knowledge of, and ability to use communications technology such as telephone hardware, computers, etc. Basic ICT skills include being able to search the Internet, send emails and use a mobile phone. ICT helps people, companies and educational institutions to exchange, present and manage information. Furthermore, skills are behaviours used appropriately and responsibly in the management of personal affairs. They are a set of human skills acquired via teaching or direct experience that are used to handle problems and questions commonly encountered in daily human life. These skills vary greatly depending on societal norms and community expectations. This means that the environment has a role to play in the development of ICT skills.

Emphasising the importance of ICT skills, former Minister of Education in Zambia, Siliya (2010) said the following during her media breakfast:

Computer skills are more important than ever, required for nearly half of all jobs now compared to less than a third in 1997. People looking for new jobs should be aware that computer skills are necessary in today's modern workplace. In an increasingly technological work environment, employees need to develop ICT skills to be able to work successfully within a business as many key functions are based around computer use. For people in work there are two key clusters of skills that are rising in importance. One of those, broadly, is ICT skills.

Efforts to look at the level of usage of ICTs by students have been made; Bashi and Siddiqui (2012) revealed that usage of ICT by students in Higher Secondary Schools of Jammu and Kashmir in India was low and that more males than females use ICTs, because male students have higher opportunities than female students to access computers in other places other than school and home. They add that, socially and culturally constructed gender roles and relationships play a crucial role in shaping and limiting the capacity of women and girls to participate on equal terms in the information society. Alaqyi et.al (2009) also revealed that ICT facilities were lacking in educational institutions in Nigeria despite having good benefits in terms of making both teachers and students be up-to-date with information from the globe. This, they argue, is due to lack of computer literate teachers, inconsistent power supply and low level funding to acquire updated hardware and retrain the teachers in computer literacy skills.

Efforts to address the problem of development of ICT skills at Mukuba University have been undertaken in various ways. For instance, in 2005 Copperbelt College of Education (CBCE) currently Mukuba University, with support from the International Institute of Communication and Development (IICD) began implementing a project called 'ICT in the Curriculum'.

In collaboration with Text to Change of Kampala, Mukuba University has implemented the Short Message System – SMS services to improve the communication with students. Text to Change is a social enterprise based in Kampala that uses mobile technology for projects in education, agriculture, health etc. Text messages were sent using the open-source platform called Vusion on the shortcode 8448. Around 1550 students were added to the database of phone numbers and received text messages monthly on open dates and other information updates from the University. Around 25,000 were sent by April 2014. Currently, the students can only receive and cannot reply to the message. (Neema Iyer, May 8, 2014. MPH, Program Manager at Text to Change: personal communication)

Despite the efforts done in the past at Mukuba University, information on the level of skills and the factors affecting the development of skills in ICT is still scanty. Further, current literature is silent on how the society, community or environment affects the development of ICT skills among the users in Zambia. It is for this reason that the research has looked at the development of ICT skills among mathematics major students in higher learning institutions, a case of Mukuba University.

2. Statement of the Problem

The high ICT illiteracy levels among mathematics graduate teachers is affecting the teaching and learning of Mathematics, Science and Technology in the third world countries. Students cannot look for information online to expand on the knowledge gained from the lecture. They cannot compare the quality of work fellow students in other universities are doing to theirs. Neither can they have online academic dialogues. This results in lack of self-confidence in

University graduates. The public may question the credibility and status of the institution being a new University with the first graduation to be in 2014.

Mukuba University has tried to address the problem of poor ICT skills among students in various ways: it has been receiving support from IICD, ZAMREN, ZICTA, NUFFIC, and Text to-Change in terms of training lecturers, donation and supply of computers. As a result of a lack of an established ICT department at Mukuba University, the institution has further set up an ICT committee to look at all issues related to ICT use in the institution.

Despite all these efforts in looking at the ICT skills and its challenges, it is not yet known why students have low ICT skills development needed for their academic work. There has also been limited human skills to handle available network and computer services. Further, no study before has been taken to investigate the development of ICT skills in higher learning institutions in Zambia has been done. Therefore, there is a knowledge gap, which needs to be exploited in order to effectively address the challenges of poor ICT skills among university graduates. There is therefore a strong need to determine the factors contributing to high ICT skill illiteracy levels among graduates, with the aim of putting in place interventions to address the problem.

3. Objectives of the study

The study intends to meet the following specific objectives:

- (i) To determine hindrances in ICT skill development among mathematics students at Mukuba University.
- (ii) To describe the level of ICT usage among mathematics students at Mukuba University.
- (iii) To determine training needs in development of ICT skills among mathematics students at Mukuba University.
- (iv) To compare and contrast the levels of ICT skills development between males and females at Mukuba University.
- (v) To examine the environmental factors influencing the development of ICT skills at Mukuba University.

4. Research Questions

- (i) What are the hindrances in ICT skills development among mathematics students at Mukuba University?
- (ii) How is the level of ICT usage among mathematics students at Mukuba University?
- (iii) What are the training needs in development of ICT skills among mathematics students at Mukuba University?
- (iv) What are the levels of ICT skills development between males and females at Mukuba University?
- (v) How do the environmental factors influence the development of ICT skills at Mukuba University?

5. Hypothesis

Null hypothesis (H_0)

Year of study, Sex of a student, Age of the student, Province where the student stay, Student's confidence, Nature of the

BEd programme, and Use of ICT by the lecturers has no effect on the development of ICT skills

Alternative Hypothesis/Research hypothesis (H_1)

Year of study, Sex of a student, Age of the student, Province where the student stay, Student's confidence, Nature of the BEd programme, and Use of ICT by the lecturers has an effect on the development of ICT skills

6. Conceptual Framework

Biological and environmental factors affect how we acquire certain behaviours and skills. The research has focused on how environmental factors affect the development of ICT skills. The following are the environmental factors of the researchers interest: Year of study, Sex of a student, Age of the student, Province where the student stay (whether developed or undeveloped), Student's confidence, Nature of the Bachelor of education (BEd) programme, and use of ICT by the lecturers. It is further necessary to understand that, though sex of a student and age of the student is a biological factor, in this paper, the two are looked at from the angle of how the society react to the them (age and sex).

7. Literature Review

7.1 Theoretical framework

Psychologists and sociologist in the field of education such as: John Bowlby's (1907-1990), Albert Banduras (1925), Jean Piaget (1896-1980) and Lev Semyonovich Vygotsky's (1896-1934), argue about whether development of skills is the result of Nature or Nurture. The Nurture school is further divided into two camps: prenatal and postnatal environments. Prenatal environment is the environment the individual goes through before birth while the postnatal environment is the one the child experiences from birth to the time one dies. (McLeod, 2007).

7.1.1 John Bowlby's Theory of attachment.

Bowlby (1969, 1988) in McLeod (2007) in his theory of attachment, postulated that nature plays an important role in the development of any individual. The theory of attachment proposes that individuals come into the world biologically pre-programmed to form attachments with others, as this will help them to survive. It highlights four major points namely: an individual has an innate need to the main attachment figure (montropy), an individual should receive the continuous care of this single most important attachment figure for approximately the first two years of life, **the long term** consequences of maternal deprivation are very dangerous and lastly short term separation from an attachment figure leads to distress.

Although Bowlby (1951) did not rule out the possibility of other attachment figures for an individual, he did believe that there should be a primary bond which was much more important than any other (usually the mother). Bowlby believes that this attachment is different in kind (qualitatively different) from any subsequent attachments.

He argues that the relationship with the mother is somehow different altogether from other relationships.

Bowlby (1951) advocates that an individual should receive the continuous care of this single most important attachment figure for approximately the first two years of life. Secondly, he claimed that mothering is almost useless if delayed until after two and a half to three years and, for most children, if the attachment figure is broken or disrupted during the critical two year period the child will suffer irreversible long-term consequences of this maternal deprivation. Thirdly, the long term consequences of maternal deprivation might include the following: delinquency, reduced intelligence, increased aggression, depression, affectionless psychopathy. Affectionless psychopathy is an inability to show affection or concern for others. Such individuals act on impulse with little regard for the consequences of their actions, for example, showing no guilt for antisocial behaviour. Fourthly, Robertson and Bowlby (1952. p. 8) believe that "short term separation from an attachment figure leads to distress outlined as PDD model involving Protest, Despair and Detachment" which are the extreme nature positions in the psychology of Bolby (1969) theory of attachment, which views the bond between mother and child as being an innate process that ensures survival.

Similarly, the students when applying for studies at any higher learning institution have an innate need and expectations to develop ICT skills at the institution. When they report and attend the first few lectures they get attached to their lecturers with whom they may find to either like the use of ICTs or have a phobia of ICTs. This experience is not limited to the lecturers but even to their colleagues in the hostels. This attachment to lecturers and colleagues whom they would like to learn from if not achieved may make them think ICT skills are not necessary. Some lecturers would not like to have higher ICT skills as seen in their everyday lives and homes appreciating their children to operate a television, phone, and camera than themselves. At work they will always ask their friends (lecturers or even students) to help then do the ICT works in classrooms or offices. The attitude trickles to the students who prefer to always seek help from others and never want to learn and have the ICT skills in their daily lives.

7.1.2 Albert Banduras' Social Learning Theory

Bandura's Social Learning Theory posits that people learn from one another via observation, imitation, and modelling. The theory has often been called a bridge between behaviourist and cognitive learning theories because it encompasses attention, memory, and motivation. (Bandura, 1977)

Bandura (1977, p. 4) emphasised that "Most human behaviour is learned observationally through modelling: from observing others, one forms an idea of how new behaviours are performed, and on later occasions this coded information serves as a guide for action." Social learning theory explains human behaviour in terms of continuous reciprocal interaction between cognitive, behavioural, and environmental influences. He outlined necessary conditions for effective modelling:

- (i) Attention - various factors increase or decrease the amount of attention paid to a learning situation. A learner's characteristics (for instance, sensory capacities, arousal level, and perceptual set, past reinforcement) do affect attention.
- (ii) Retention –this involves remembering what you paid attention to. It may include cognitive organization, symbolic rehearsal, and motor rehearsal.
- (iii) Reproduction –this involves reproducing the learnt material.
- (iv) Motivation - having a good reason to imitate. It Includes motives such as past achievements, promised incentives or rewards when successful in a learning task.

Bandura believed in “reciprocal determinism”, that is, the world and a person's behaviour cause each other, while behaviourism essentially states that one's environment causes one's behaviour. Bandura, who was studying adolescent aggression, found this too simplistic, further suggesting that behaviour causes environment as well. Later, Bandura considered personality as an interaction between three components: the environment, behaviour, and one's psychological processes (one's ability to entertain images in minds and language).

7.1.3 Jean Piaget Theory of Cognitive development

Jean Piaget, a Swiss psychologist, perceived human development as a series of progressive stages of cognitive development. He proposed four stages, which commence at infancy and progress into adulthood, characterize the cognitive abilities necessary at each stage to construct meaning of one's environment.

Central to Piagets (1973) theory in Singer and Revenson, (1997) is the concept of schemas. A schema is the basic building block of intelligent behaviour, a form of organizing information that a person uses to interpret the things he or she sees, hears, smell, and touches. A schema can be thought of as a unit of knowledge, relating to one aspect of the world including objects, actions, and abstract (theoretical) concepts. We use schemas to understand and to respond to situations. We store them and apply them when needed. A child is considered to be in a state of equilibrium or in a state of cognitive balance when she or he is capable of explaining what he or she is perceiving (schema) at the time. In forming a schema, assimilation and accommodation of information must take place. Assimilation and accommodation are processes of adjustment to changes in the environment and are defined as adaptation, the continuous process of using the environment to learn. And, according to Piaget, adaptation is the most important principle of human functioning.

According to David etal (2006), Jean Piaget studied the development of children's minds. He continued that, this includes learning to adapt information and skills. Piaget divides adaptation into two parts, ‘**assimilation**’ and ‘**accommodation**.’ Assimilation occurs when an individual takes on new information or skills, but does not shift his mind-set sufficiently. The individual tries to force the new skills to fit the mind-set he already has. Accommodation involves expanding a pre-existing mind-set in order to make

sufficient room for new skills. This is a more complicated process, but also more effective for gaining new knowledge and skills. While Piaget looks specifically at children, this skill assimilation and accommodation is an ongoing process.

In terms of cognitive development, an individual might be at formal operations in their use of language but not in their use of mathematics, or vice versa. A person may meet the Piagetian criteria to be at formal operations in many disciplines, but still not be at formal operations in ICT.

Moursund, (2005) further argues that we, educators are spending far too much time on lower-order aspects of ICT skills in education, and far too little time on the higher-order aspects.

The developmental psychologist and genetic epistemologist Jean Piaget in (Leslie, Jean Piaget Society, 2013) was interested in the question- how does knowledge grow? His answer is that the growth of knowledge is a progressive construction of logically embedded structures superseding one another by a process of inclusion of lower less powerful logical means into higher and more powerful ones up to adulthood. Therefore, children's logic and modes of thinking are initially entirely different from those of adults. Therefore the development of ICT skills must also differ between children and adults.

In the Zambian context, most of the children between 0 to 7 years have no experience of what the ICT cognitive developmental scale based on what ISTE NETS (2012) proposes. This is because most of the children are not even at pre-school in most parts of Zambia. It is however possible in parts of developed provinces like Copperbelt and Lusaka, parts of North-western, Central and Southern to have the ICT cognitive developmental skills based on the ISTE NETS scale (2012) in appendix C. And few children can experience what the extension of Piaget is talking about. Therefore formal edutainment skills development is restricted to a small number of children and very little or nothing at all in less developed provinces like Northern, Eastern, Luapula, Western, and Muchinga. However, the skills of accuracy are developed through other means including outdoor and indoor games and activities. These may require a transfer of knowledge in future to be appreciated by ICT skills development.

Secondly; ICT gadgets require a certain environment (dust free, moisture and room temperature specific) which is a big challenge to low developed and mid developed provinces. This is because, until recently, some schools had grass roofed classrooms; some still have houses which are grass roofed, where conditions to keep ICT equipment may be far from ideal. In some homes the only ICT gadget is a mobile phone with limited functionalities which cannot even play an educational video. In such environments, the language of software and hardware is absent leading to low development of software and hardware problems experiences. Realistically, parents to these children may not even realise that their children will experience ‘humanware’ problems when exposed to the language of software and hardware.

Thirdly, most of the people in Zambia rarely reach ICT formal operational stage even after their 4 year Bachelor's degree at tertiary level. This could be because they were faced with extreme situations of effective modelling as Bandura's (1977) social learning theory proposes. In their new ICT environments they will leave things to those who have had good experience with ICT gadget during their upbringing. Evidence of this is adults who cannot operate their own mobile phones to the fullest, use their remotely operated TV sets, and use an ATM machine. Such adults would always ask for help when need arises.

7.1.4 Lev Vygotsky theory of Psychosocial Development

Zaretskii (2009), outlines the Basic Themes of Vygotsky as: firstly, Social interaction plays a fundamental role in the process of cognitive development. In contrast to Jean Piaget's understanding of child development (in which development necessarily precedes learning), Vygotsky felt social learning precedes development. Vygotsky (1973, p. 57) thought that "Every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (inter-psychological) and then inside the child (intra-psychological)."

The implications are that the development of ICT skills depends on the social interaction of the learner with the peers and the lecturers who play a very important role in the cognition of the skills. Secondly, the More Knowledgeable Other (MKO) who is referred to as anyone who has a better understanding or a higher ability level than the learner, with respect to a particular task in terms of process, or concept. The MKO is normally thought of as being a teacher, coach, or older adult, but the MKO could also be peers, a younger person, or even computers. Therefore, ICT skills can be learnt either from the lecturer- teaching a student in a formal learning environment or indirectly by imitating how the lecturers uses ICT devices. Also these skills can be learnt from peers (fellow students) who have more developed ICT skills than others. Thirdly, the Zone of Proximal Development (ZPD), according to Vygotsky (1934) in Zaretskii, (2009), is the distance between a student's ability to perform a task under adult guidance and/or with peer collaboration and the student's ability in solving the problem independently. According to Vygotsky, learning occurred in this zone. In a similar way learning of ICT skills takes place between those with lower ICT skills and those with higher ICT skills.

Vygotsky's Social Development Theory is related to Banduras (1969, 1988) social learning theory in McLeod (2007) discussed earlier. This is an addition to Bowlby (1965) theory of attachment as Bandura has added the social and environmental aspect of the attachment. Therefore the language of ICTs can be learnt by students through observing the lecturer using the ICT equipment in the teaching and learning processes.

Life skills are commonly referred to as a set of human abilities acquired via teaching or direct experience used to handle problems and questions commonly encountered in daily human life. The development of life skills varies

greatly depending on **societal norms** and **community expectations**. ICT skills are part of the life skills the industry requires from any graduate (GRZ, 2006a). However, ICT skills development is influenced also, just like life skills in general by societal norms and community expectations.

The National Research Council (2012) in Washington DC, laments with the poor ICT skills, an imaginative statement about a day without Information Technology as

*A day without diagnostic medical imaging, a day during which automobiles lacked electronic ignition, antilock brakes, and electronic stability control. A day without digital media—without wireless telephones, high-definition televisions, MP3 audio, cable- or Internet-delivered video, computer animation, and video games. A day during which aircraft could not fly, travellers had to navigate without benefit of the Global Positioning System (GPS), weather forecasters had no models, banks and merchants could not transfer funds electronically, and factory automation ceased to function. It would be a day in which the U.S. military lacked **precision** munitions, did not have the capabilities for **network-centric warfare**, and did not **enjoy technological supremacy**. It would be, for most people in the United States and the rest of the developed world, a 'day the Earth stood still.' (p. 1)*

This statement is re-emphasising the importance of ICTs in our daily lives, describing everyday activities which are ICT dependent. It is also empathising the importance of having ICT skills in our daily lives, the result of lack of skills being failure in precision. This aptly describes a day without the Internet and all that it enables.

7.2 Research Done

7.2.1 Situation outside Africa

Upon a global scale, Bee & Chia (2008) in Malaysia revealed that there is low usage of an ICT equipment in classrooms due to lack of time to explore ICTs and prepare ICT resources as a leading barrier in implementing ICT use in schools. They continued that there is lack of technical support to schools in the uptake of ICT in teaching leading to teachers avoiding ICTs, for concern of a technical fault occurring and cannot be rectified or lessons being unsuccessful. They add that teachers who are more competent in using computers are those who have favourable attitudes towards computer and that ICTs can motivate students in their learning by bringing variety into the lessons, and at the same time, sustaining teachers' own interest in teaching.

The gap between the supply and the demand for practical skills in industry has created a huge demand for skills training. The private sector through Malaysian society for computers has offered two programmes, namely: "the undergraduate skills programme and the Multimedia Super Corridor (MSC) internship programme." The government has also been conducting training programmes to enhance ICT knowledge and skill levels of workforce through Human Resource Development Fund. (Malaysia Vision 2020)

The Malaysian 2014 Budget has offered initiatives that are related to ICT of high Internet speed for the suburban and rural areas especially where the exposure to the Internet is new and dedicated to see increase in usage. However, people reacted to 10mbps for the urban areas that it was rather low as the internet consumption of the urban population was closer to a developed country, whereby the minimum offering of 50mbps was common and 10mbps was no longer sufficient to meet the demands of the urbanites. (www.computerworld.com.my, 2014)

In Jammu and Kashmir in India, Bashir and Siddiqui (2012) in the Journal of Humanities and Social Science (JOSR) revealed that expensive and latest ICTs for example on-line learning, LCD, epidiascope, working models, laptops and electronic boards and others are not used by the students. They suggest incompetency to use such technological devices and lack of interest and low participation by students as a probable reason. The female students opined that they do not use Internet, newspaper and tape recorders in the school due to cultural and societal barriers. However, women's access to ICT and their effective use are constrained by factors that go beyond issues of technological infrastructure and socioeconomic environment. From the data it is quite evident that males use ICT more than females. The very low usage of ICT by the female students might be due to the fact that the female students have fewer opportunities than the male students. Another reason was that males are much aware of ICTs compared to females since males had more opportunities to access ICT. The study revealed that most female students used computers only once or twice in a week, and that six percent of female students did not use computers at all. The result indicates that the male students have higher opportunities to access computers in other places except school and home compared to female students. Socially and culturally constructed gender roles and relationships play a crucial role in shaping and limiting the capacity of women and girls to participate on equal terms in the information society.

Bingimlas (2009) in Australia confirmed that ICT use in the classroom is very important for providing opportunities for students to operate the information age. His findings showed that teachers had a strong desire to integrate ICTs in classroom despite having barriers like lack of self-confidence, accessibility to resources (software and hardware) effective CPD, sufficient time to practice and attachment to technical support systems. He further indicated that looking at one component alone is not sufficient to provide good skills but the presence of all will provide good integration of ICT in the learning and teaching process. The Queensland government (2012) in Australia responded by providing a smart classroom curriculum which outlines the student ICT expectations, identifies the ICT knowledge, looks at the understandings and skills that students in Queensland state schools are required to have the opportunity to develop from preparations to year 12.

The Australian Council for Educational Research (ACER) has been helping in the implementation of the Digital Education Revolution (DER) policy is focused on the provision of computers for students in years 9 – 12; with

high speed broadband connections to Australian education institutions. In addition, the DER policy supports the continued development of online curriculum content, conferencing facilities, pre-service and in-service professional development for teachers and the development of web portals to enable community participation in education. The DER expects significant changes in education to occur as a wider group become engaged in the education process (White, 2008). However, the Australian Computer Society (ACS) (2014) reported that ICT skills shortages continued to grow by up to 14,000 extra ICT jobs in 2012 and 35,000 by 2014. At the same time, curriculum initiatives in ICT at the secondary level had not gone far enough to encourage high-achieving students in years 11 and 12 to study tertiary ICT courses or promote the discipline as a rewarding and vibrant career.

Australian 2014 Federal Budget budgeted \$3.8 million in 2014 over four years to enhance and expand the Higher Education Information Management System (HEIMS) for universities and other higher education providers. It also budgeted \$2 million in capital funding over two years for biometric systems software and equipment to expand the Offshore Biometrics Program. Government expects the investment to return a dividend of \$18.6 million over four years by introducing user-pays arrangements for visa services and biometric collection services with third-party service delivery partners. Despite these efforts the public cries that there are no big ticket ICT projects in an Australian 2014 Federal Budget because the Government has confirmed it will cease funding for National ICT Australia (NICTA) in two years' time. Just under \$85 million has been committed to maintaining operations in the interim and NICTA would transfer to a private funding model in 2016 (Hilvert, 2014).

7.2.2 Situation in Africa

A number of studies have been done in Africa concerning the development of ICT skills. Important to this study is Huyer (2003) in Ghana, Mauritania, Senegal, and Uganda who revealed that a high student-to-computer ratio and first-come-first-serve computer policies put girls at a disadvantage. In Uganda, where computers were set up in a separate lab, girls used computers less than boys because it was considered unsuitable for them to run. The boys arrived first at the computers and were unwilling to limit their time at the computers to allow the girls to use them. Other socio-cultural factors affecting girls' access included their domestic chores and early curfews at boarding schools, as well as lack of confidence in using computers. She emphasised that when girls had access to computers, they tended to use them more for academic research and communication with friends and family, increasing their reasoning and communication skills. They also used Internet access to obtain information on issues such as reproduction and sexuality, information not available from their families or communities. Boys tended to use the computers for sports and music and received little academic benefit. When girls did have equal access to computers, their self-confidence improved.

In addition to Huyer (2003), the Government of Uganda had cut funding to the ICT sector downplaying the need to fast

track the growth of Uganda Information and Communications Technology sector. This came amid assurances that the government in the 2013/14 financial year would fast-track ICT growth to match global standards. The sector was allocated a total of Shs15.3 billion down from the Shs15.5 billion it received in the 2012/13 financial year. The allocation represents 1 per cent of the Shs13.1 trillion resources envelop. ICT is listed under the National Development Plan as one of the tool that shall enable the modernisation of Uganda in East Africa. This reduction will have chilling effects on government's commitment to match global growth through the use of ICT. Among the listed priorities included a Shs475 million allocation for IT and Information management services, Shs459 million for Communication and Broadcasting infrastructures, and Shs10.4 billion on Information Technology Governance Services managed by the National Information Technology Authority-Uganda. A total of Shs3.5 billion will be spent on ICT policy planning and support services. (The Development Analyst Magazine, 2014). This in turn would affect the development of ICTs which were reported by Huyer (2003) to disadvantage the females.

Nevertheless, Farrell, (2007), revealed that adoption of ICT in education in Uganda faces the same challenges as most developing economies - poorly developed ICT infrastructure, high bandwidth costs, an unreliable supply of electricity, and a general lack of resources to meet a broad spectrum of needs. However, with the rapid emergence of wireless network capacity and the ubiquitous growth of mobile phones, the context of the infrastructure was changing. A national ICT policy was in place and an education sector ICT policy was in place. The Ministry of Education and sports was taking steps to co-ordinate ICT development and had allocated resources to support implementation of its ICT strategy.

That South African study by Bovée, Voogt and Meelissen (2007) in contrast to most studies on gender differences and computer attitudes, showed no gender differences in computer attitudes. However, this study showed differences in computer attitudes between students from the upper/middle class schools and students from the township schools. The latter showed a less positive attitude towards computers, but more interest in computer-related careers compared with the students in the upper/middle class schools. The study found that computer access and experience, which was significantly lower in the township schools, was also related to computer attitude.

In addition to Bovée, Voogt and Meelissen (2007), Carrim (2014) Bovée the cost of communication in the country remains stubbornly high. Whilst Independent Communications Authority of South Africa (ICASA) and the Department of Communications (DoC) have made some strides in reducing the cost of doing e-business in the country, more needs to be done. ICASA and DoC have set regulatory frameworks in line with technological and market realities. This frame work looks at: the appropriate role of the regulator in the digital era, how legacy regulations should be carried over into the new environment, and how sustainable funding model for the independent regulator should be. He further advised that The quality of our

children's education is today in many countries as much a function of the quality of their schools, as it is the quality of their access to the Internet. "Today in South Africa, if you have money your access to learning resources is infinite and global. If you do not have money, the riches of online educational content are locked behind a door for which you can't afford the key" (Carrim, 2014, p. 3). This means that the South African ICT environment has a social status barrier and education has also followed the same way.

Mutula and Brakel (2007) reported that in Botswana there was an acute global shortage of highly skilled and hands-on personnel necessary for steering the emerging digital economy in both developed and developing countries including Botswana. In addition, there is a serious skills gap for certified specialists to help develop the sophisticated applications necessary to power the digital economy and more so the applications that depend on it. The development of the ICT sector in Botswana has been looked at as a way to diversify the country's economy and position itself to play a leading role in the global emerging digital economy. Shafika (2007) advances that for Botswana to play such a leading role there is need for visionary leadership in the sector of ICTs in education. Such leadership should ensure that education and national ICT policies are linked to a broader economic vision for the country. This will ensure that secondary schools and government tertiary institutions have computer labs. The government had committed financial resources to improve connectivity and to promote the educational use of ICTs. Shafika (2007) continued that, the University of Botswana was responding to these challenges in a number of ways. Notable among them was the integration of information and communication technology into the entire education process. The University sees the use of information communications technology as an important tool in bringing about education reforms.

Furthermore, The Botswana Minister of Finance and National Planning in his budget speech (2014) emphasised the fostering of economic growth and for investment to flourish, necessary service facilities are required like: technology and innovation to contribute positively towards economic development and diversification. He further added that the Government of Botswana had established the Botswana Fibre Networks Ltd (BoFiNet) as a separate organization responsible for provision of national and international telecommunication. While this is a major milestone in privatisation of Botswana Telecommunication Corporation (BTC), it will also address the challenges with respect to internet connectivity, particularly the bandwidth so that access to information and communication technology for doing business in Botswana is increased. (Matambo, 2014). The speech is very silent about Mutula and Brakel (2007) ICT challenges and how higher learning institutions will directly benefit in 2014.

7.3 Situation in Zambia

Research has been done in Zambia either by locals or foreign organisations; Panos London Information Society programme (2009) reported that one of the major constraints on ICT development in Zambia, as elsewhere in Southern

Africa, has been the lack of adequate international communications infrastructure.

At least one of Zambia's mobile networks now has coverage throughout the national territory. The Mobile Cellular Subscription Trend in Zambia has been going up from 2000 until 2014 first quarter where it has dropped from 71.2% compared to 61.9% in 2013. The fixed telephone network, however, remains extremely limited in range and use – largely confined to the main urban centres, the Copperbelt and the rail links between them. In first quarter of 2014 there were just over 116,198 fixed line subscriptions. While the mobile and Internet sectors are competitive – there are three national mobile operators and some 23 Internet service providers (ISPs) – the fixed network is at 18,741 (0.12%) total subscribers, 2,559,500 (16.4%) mobile internet users of the inhabitants and has remained a monopoly of the state-owned company ZAMTEL. ZAMTEL also has monopoly rights over the country's international gateway which allows phone connectivity to other countries. (ZICTA, 2014). Generally the Zambian ICT environment from this picture limits the learners even before they come to Mukuba University in terms of acquisition and development of ICT skills.

7.3.1 National Vision 2030

In 2006, the National Vision 2030 was launched which is the Zambian government's long-term plan "to be a prosperous middle income nation by the year 2030." (GRZ 2006a, p. 1). The vision emanates from a series of discussions with a range of stakeholders from civil society, the private sector, and within government, and it articulates national and sectorial goals for the socio-economic development of Zambian economy and society. In ICT sector the goal is that "An information and knowledge-based society by 2030." (p. v) With the following targets: Increase connectivity to fibre optic (telecommunication infrastructure rollout) and other high capacity transmission technologies (networks) from 7 to 72 districts by 2010, Increase the access to phones per 100 people (tele-density) from 0.9 to 8 by 2015 and to 50 by 2030 and Increase access to ICT services such as Internet users from 35,000 in 2005 to 100,000 by 2015 and to 1,000,000 by 2030.

The GRZ (2006a) in Vision 2030 highlights the direct consequences that technological laggardness entails:

Lack of access to modern ICTs has adversely affected timely and effective delivery of information as the current information and communication infrastructure is inadequate to meet the information needs of the whole population. This has led to poor and limited radio and television coverage, thereby denying information to most people living in the rural parts of Zambia. (p. 29)

While the Vision 2030 has identified accessibility as a factor, it has identified it from the delivery of information point of view not from the development of skills point of view. The Vision 2030 also lacks the gender balance on the vision to be achieved by 2030. Increased access in ICT has not been highlighted in the higher educational institution too. The 2013 national education curriculum has also added that the primary and secondary curriculum will include the

introduction of ICT, entrepreneurship education, business studies, and design and technology studies among others but has not looked at the development of ICT skills in terms of environmental factors.

In this document Vision 2030 it has been noted that there has been lack of access to modern ICTs has adversely affected timely and effective delivery of information as the current information and communication infrastructure is inadequate to meet the information needs of the whole population, although Veldhuizen (2010:9) argues that "ICTs can have a significant impact on a country's ability to achieve the Millennium Development Goals (MDGs), replacing teacher with a video," he, (Veldhuizen, 2010) cited the greatest constraints on the potential impact of ICTs in many developing countries like Zambia as limited human skills to use available networks and computer services.

7.3.2 National ICT Policy

In March 2007, the Zambian Government launched its National ICT Policy which emphasises the creation of an innovative, market responsive, highly competitive, coordinated, and well-regulated ICT industry.

The policy identifies three goals which need to be addressed in order to improve ICT skills among the population. The three goals are: To enable a diversified and export-oriented economy, To improve livelihoods and protect the vulnerable through service delivery, To provide an efficient and effective public sector. The policy recognises the need to face the following challenges in education: Low levels of ICT literacy and High cost of technology acquisition..

The GRZ (2007) in the National gender policy recognises the need to face the following challenges in education: Low levels of ICT literacy., High cost of technology acquisition, Brain drain" resulting in considerable loss of skilled personnel, Limited local ICT industry, Lack of standardisation and certification programmes in ICT and Inadequate institutional capacity.

The policy further recognises that computer studies as a subject was introduced in public schools in 1998 though there has still not been significant improvement in ICT skills development among secondary school leavers. This is in stark contrast to Zambia's private schools, which consistently produce ICT literate individuals. It also highlights challenges such as the financial and technological resource constraints, inadequate awareness of the benefits of integrating ICTs in the administration of the delivery chain of the education sector, and the high opportunity costs and lack of coordination between policy makers, implementers and the professionals in the industry. The policy overlooks the fact that there are few skilled individuals to teach in public schools to begin with and that a long-lasting solution should take this into account.

Shafika (2007) stresses that while the policy does not provide clear guidelines on how the challenges will be confronted, it does suggest the need to scale up the introduction of computer studies in schools and the need to focus research and development on products to service the

local market. Shafika (2007) further argues that Zambia's ICT for development strategy is strongly dependent on external donor funding and the ICT for education policy and implementation framework makes little emphasis on gender.

7.3.3 The Sixth National Development Plan

GRZ(2011) in the Sixth National Development Plan (SNDP) has identified that poor transport infrastructure together with high cost and inadequate Information and Communications Technology (ICT) services, as factors affecting the productivity and competitiveness of the economy: ICT to cover backbone infrastructure, digitalization, next generation networks, centres of excellence and that the major programme will be the continued implementation of the Rural Finance Programme and rapid roll-out of ICT services in rural areas to support the expansion and increased use of financial services. According to the GRZ (2011) in the SNDP, this will be complemented by infrastructure development initiatives such as increasing access to electricity and ICT services.

GRZ (2011) through the SNDP further emphasised that, Information and Communications Technology (ICT) and Meteorology play a vital role in the socio-economic development of a country. The growth of ICT is a widely recognized as an enabling precursor to wealth creation and the attainment of a well informed and knowledgeable society. It further proposed to introduce ICT as a teaching and learning tool, introduce and expand alternative modes of education including ICT, provide alternative modes of University education delivery including ICT, provide alternative modes of basic skills and TEVET delivery including ICT, have scientists trained in electronics and ICTs through formal education and provide professional development for ICT. However, the pace and prioritisation of the value recognised in the document are different. This can be seen by the type of educational infrastructure being built. The building can only be approved to be built with a waterline and electricity line, if ICTs have been identified to be essential components of our lives and the economy of the country then it is important to add network line in any building to be built as a condition for approval, especially health institutions and higher learning institutions. This will reduce the cost of networking the building after it is complete.

7.3.4 ICT Policy in Education

The GRZ (2006b) in Shafika (2007) argues that with the support of the International Institute for Communication and Development (IICD), the Commonwealth of Learning (COL), and the United States Agency for International Development (USAID), the Zambian Ministry of Education had developed a draft ICT Policy for Education by October 2006 and an implementation strategy by January 2007. This represents an extension of Zambia's National Education and National ICT policies. The vision is for ICTs to contribute towards reaching innovative and lifelong education and training in Zambia by 2030.

The guiding principles of policy include that it must fit into national policies on education and ICTs. The policy also provides an overview of goals, objectives, and government

commitment in key programme areas of ICT infrastructure to education institutions, content development, curriculum integration, teacher training, distance education, administration and support services, as well as finance. Linked to the policy is an implementation framework that sets out in detail the implementation objectives, activities, time frames, and budgets for each of these programme areas. It also outlines the ministry's commitment to promote collaboration between the private sector and education institutions and to establish appropriate structures to facilitate the integration of ICTs in the education system. The estimated budget to support access to computer facilities and Internet access to the Ministry headquarters, provincial offices and districts; the 14 colleges of education (among these is Mukuba University formerly called Copperbelt College of Education); the nine provincial, 78 district, and 400 zonal resource centres; and the 350 high schools and 460 basic schools is USD \$63.6 million.

7.3.5 Other ICT efforts in Zambia

In addition, the Government of the Republic of Zambia through ZICTA (the ICT Regulatory body) has embarked on an initiative to promote low-cost, quality, reliable and affordable ICT goods and services that are universally accessible to and meet the needs of the Zambian community. (www.zamren.zm 24/04.14)

In 2012, ZAMREN secured a project funding from the Netherlands Government under the NICHE (Netherlands Initiative for Capacity building in Higher Education) programme. The three-year project is aimed at supporting the establishment of ZAMREN. The total project funding was Euro 2, 250,000. However, the funds under this project being applied for capital investments and capacity building. In this project University of Zambia (UNZA), Copperbelt University (CBU), Mulungushi University (MU), Copperbelt Secondary Teachers College (COSETCO) (currently Mukuba University) and Kwame Nkrumah University are currently the recipient institutions in the project.

Zambia Research and Education Network (ZAMREN) is a specialised Internet service provider dedicated to supporting the needs of the research and education communities in Zambia. The purpose of ZAMREN is to provide the inter-institutional connectivity in terms of a National Research and Education Network (NREN), and to connect it to the Regional Research and Education Network (RREN) in Eastern and Southern Africa, UbuntuNet (www.ubuntunet.net), thereby extending ZAMREN to other National Research and Education Networks in Africa and in the rest of the World. (www.zamren.zm 24/04.14)

The University of Zambia, Copperbelt University and Mulungushi University offer computer science as a study subject, and these institutions have invested in ICT infrastructure. The University of Zambia installed PCs with Internet connectivity in its regional offices. The Copperbelt University has a curriculum development centre that develops the syllabus on computer studies for grades eight to twelve following international syllabuses on ICTs. They have further helped in the development of the new education curriculum that has integrated ICTs in the subject areas.

8. Methodology

8.1 Research Design

The study follows both qualitative and quantitative approaches, which according to White (2005) qualifies to be a mixed research and it is a case study.

In this study, since the students in the first, second, third and fourth years, are different in number by year of study and sex, Stratified Random Sampling procedure was used to come up to the sample representing both sex and year of study. Strata's were defined by year of study and sex of the student in that particular year.

White (2005) suggests that at least 32% of the total population between 200 and 500 is enough to be used as a sample: It is for this reason that in this research 112 of the total students of Mathematics at Mukuba University were used as a sample which is above 32% of the total population. The composition of the sample is as shown in Table 3.2

Table 3.2: Composition of the sample by year of study and sex (n=112)

Years of Study	Sex		Total
	Male	Female	
First	19	11	30
Second	20	10	30
Third	19	9	28
Fourth	15	9	24
Total	73	39	112

3.2 Data Collection

A questionnaire designed by the researcher, was used in data collection. The questionnaire composed of short objective questions and descriptive subjective questions. The questionnaire was used to collect data concerning the development of ICT skills, by looking at the number of ICT equipment the respondent could use. These ICT equipment were only restricted to the one found in Mukuba University environment. The Score as in Table 3.3 was not availed to the respondent to reduce cheating.

Table 3.3: Key to show the description of the ICT Skills level of a student

Number of ICT equipment a student can use	User skill level
1	No Skill
2-5	Beginner
6-9	Intermediate
9-13	Advanced

3.3 Data Analysis

This study employed qualitative data analysis by categorizing respondents' views and opinions according to similarities to draw generalizations and also quantitative data analysis that involve drawing conclusions from numerical magnitudes. However, it has more of quantitative conclusion than qualitative ones. To achieve this, analysis of data was done by the use of the following software: SPSS Version 16

and Microsoft excel 2013. In addition, some information that could not be analysed by means of software, were analysed manually.

3.4 Location of the study

The study was conducted at Mukuba University (formerly Copperbelt College of Education). The institution is located on the Copperbelt Province of the Republic of Zambia. It is situated to the Northwest of Kitwe District along Kitwe-Chingola Road, about 16 Kilometres from Central Business District (CBD). The institution trains Secondary School teachers of Mathematics, Physics, Biology and Chemistry at Bachelors level and also trains Home Economics teachers at Diploma level.

3.5 Limitations of the Study

The primary research took place at Mukuba University between October 2013 and June 2014, and whilst there was an acceptable return of the questionnaire, there may have been self-selection bias in terms of selection of the location of the study and study population. Hence, the findings may be particular for the participants in this study and may not generalise to education systems and mathematics students in other places. However, the sample did include, both male and female, in terms of proportion of gender and year of study, age, and this dictates whether findings are generalizable to different contexts.

9. Data Presentation, Analysis and Discussion

9.1 Sex of the Students and ICT skills Development.

The study involved 73 males and 39 females selected by stratified random procedure according to year of study and sex of the students as shown in Table 3.2 on page 36. Furthermore Figure 4.1 gives a detailed description of level of ICT skill before the student's came to Mukuba University, while Figure 4.2 gives the description of the level of ICT skills who are at least a year at Mukuba University.

Table 4.1: Description of level of ICT skills. (n=112)

level of skills	Before being Mukuba Univeristy		At least a year at Mukuba University	
	male (%)	female (%)	male (%)	female (%)
no skill	40.8	35.9	1.8	5.1
beginner	42.3	41	30.1	35.9
intermediate	11.3	20.5	42.5	46.2
advanced	5.6	2.6	26	12.8
total	100	100	100	100

Figure 4.1, shows that more males described themselves as having no ICT Skills compared to females. The findings also revealed that there were more male beginners than females. It was also established that there were more males students who came to Mukuba University with advanced ICT skills than females.

After at least one year at Mukuba University, there was a reduction on the percentage of male and female students

with no ICT skills. Male students reduced from 40.8% to 1.4% and female students reduced from 35.9% to 5.1% in this ICT skill level. While females were leading at beginner and intermediate level, males were found to be leading at advanced level. Comparing Figure 4.1 and Figure 4.2, it shows that both male and female have improved in terms of acquisition of ICT skill. Therefore the environment at Mukuba University is contributing to the acquisition of ICT skills.

Mukuba University has no programme to train students in ICT basic skills though Figure 4.1 and Figure 4.2 have shown an improvement in ICT skills development. This could be attributed to students learning from each other and other people around them including lecturers. This supports Vygotsky's (1934) argument that social interaction plays an important role of cognitive development. This is also in line with Bandura (1977) theory that we learn through observation, imitation and modelling. However, Piaget (1973) proposes that skills development is age dependent. The upward trend in terms of ICT skills development happened within the same year and there was no change in age of the learner. On the other hand, Piagetian (1973) assimilation and accommodation of information was necessary for the ICT skills development.

9.2 Description of how students feel about lessons involving ICTs

Figure 4.3 reveals that 32.73%, 23.64%, 21.82%, 21.82% of the first, second, third and fourth years male students respectively doing mathematics do not enjoy lessons presented using ICTs. While 31.48%, 18.52%, 29.63%, 20.37% of the first, second, third and fourth years female students respectively said they do enjoy.

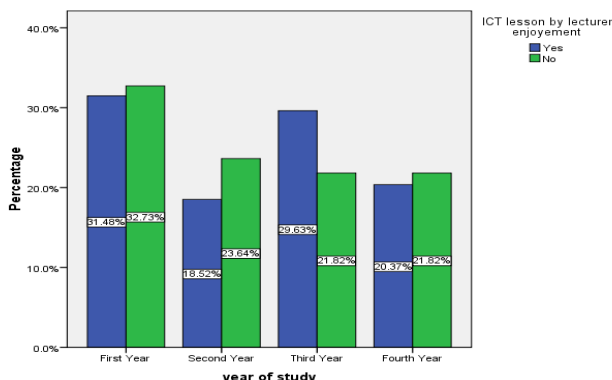


Figure 4.3: whether students enjoy lectures using

ICTs by year of study (n=112)

Among the reasons given by students who did not enjoy lessons presented on Power point are sight related problems. Students said that they experienced eye pain during lectures and after the lecture and that this affected the following lecture. Others said use of ICT reduced the step by step flow of information making it difficult to grasp the concepts and the lecture is made boring that way. Some students also said that the lecturer was too fast making it difficult for them to take notes or important points.

Eighteen percent of the students who said they enjoyed lessons presented using ICTs claimed to learn more ICT than the mathematics in the lesson and they were forced to go and practice. This made the students to go and try to learn for example: how good the power point slides were prepared and how they were being presented. Therefore instead of learning mathematics only, students end up learning also how to prepare good PowerPoint presentations. 10% of the students also said it is easy to view abstract concepts and terminologies that cannot be drawn on the board. They further suggested that it could be very interesting if mathematics lectures on Power point could be presented while explanations were being given on the chalk board or white board.

9.3 Frequency of ICT use with regard to gender

It was found that 26% and 31.6% males and females respectively used Internet on daily basis. 21.9% and 10.5% males and females respectively used internet twice a week. 23.3% and 34.2% males and females respectively used Internet twice a month. 15.1% and 15.8% males and females respectively used Internet once a month. 13.7% and 7.9% males and females respectively never used Internet. Therefore, the level of internet usage was different among males and females. Figure 4.4 shows that the level of Internet use was high among females compared to males on a daily basis.

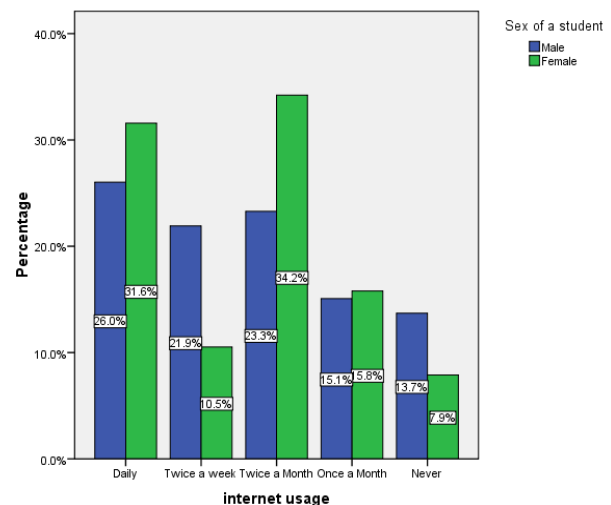


Figure 4.4: level of Internet usage by students (n=112)

Furthermore there were more male students who never used Internet twice a week. However, the use of internet may be not related to accessing educational material as some students may just be on social media such as face book. The reason why they are using internet is not part of this study.

9.4 Modes of access of Internet.

Accessibility to internet by the students was found to be mainly through phones, computers and other means such as iPads and tablets. The percentage of accessibility is as shown in figure 4.5.

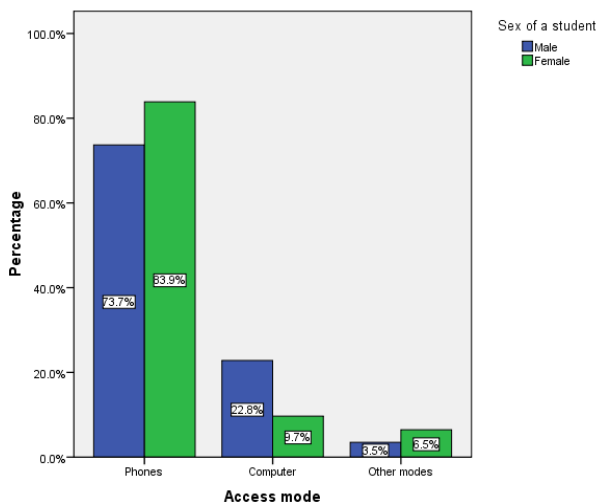


Figure 4.5: Modes of Internet access of students by gender (n=112)

It was found that 83.9% of the females access Internet by the use of phones while 73.7% males access by the use of phones, 22.8% of males used Computer while 9.7% percent of their female counterparts used Computers. Further, 3.5% and 6.5% of the male and females respectively accessed Internet by other modes which included: iPad, tablets, and so on.

It was also found that females had more advanced phones which they said are used to communicate to their parents regularly and the information shared included pictures and videos, while males said they do communicate with their parents by just calling them and they did not mind the nature of the phone. The males further said parents also get those advanced phones which they sold within and outside the University. The females also added that most of them have iPads and tablets and they would leave the computer labs to others as they enjoyed privacy.

9.5 Areas of training needs.

Information on areas of training needs was collected in two ways: areas where the students had insufficient skills and where they feel they needed training by gender and year of study. Figure 4.6 and figure 4.7 shows the details.

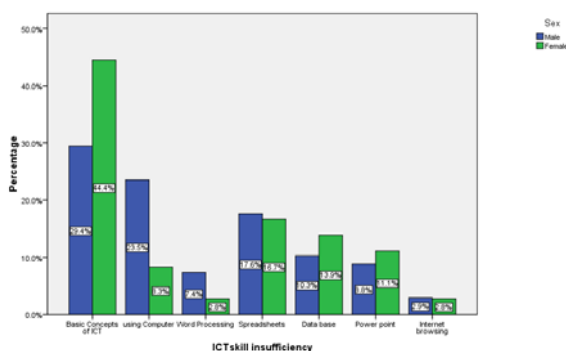


Figure 4.6: Description of the Skill insufficiency of students by gender (n=112)

Figure 4.6 shows that the highest percentage of mathematics students felt they needed basic ICT skills accounting for 29.4% males and 44.4% females. This agrees with the findings of William (2003) in London but this is however in contrast to Bashir and Siddiqui (2012) in Jammu and Kashmir in India where males have more ICT skills than females because of societal influence on the development of ICT skills.

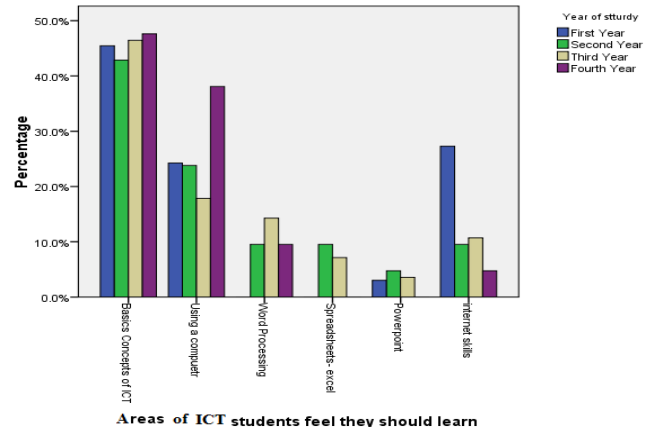


Figure 4.7: Areas of ICT students feel they should learn by year of study (n=112)

On average 45% of students all years of study said they needed basic ICT skills, with 48% of the fourth year being the highest percentage and the lowest being 44% of second years. This suggests that there is urgent need to introduce an orientation course in basic ICT skills for mathematics students at first year. This is supported by their feeling of having basic use of the computer which contributed to an average of 28% of the mathematics students from first year through to fourth year. On average only about 5% of mathematics students would like to know how to use Power point as most of them said they did not make any presentations, while 10% of them felt they needed to know, especially the use of spread sheets like Microsoft Excel.

9.6 Confidence levels of the students.

It was found that the levels of confidence among students were different by confidence category, sex of the student and year of study. Figure 4.8, shows that 33.3% of females compared to 23.9% of males could not tell their level of confidence in handling ICT equipment. 22.4% males compared to 13.9% females were not confident. 41.8% females compared to 44.4% males were confident 11.9% males as compared to 8.3% females were very confident. This means that, 63.1% of the males against 52.7% of the females said they had some confidence in using ICTs. Figure 4.9 further gives a description of the level of confidence by year of study.

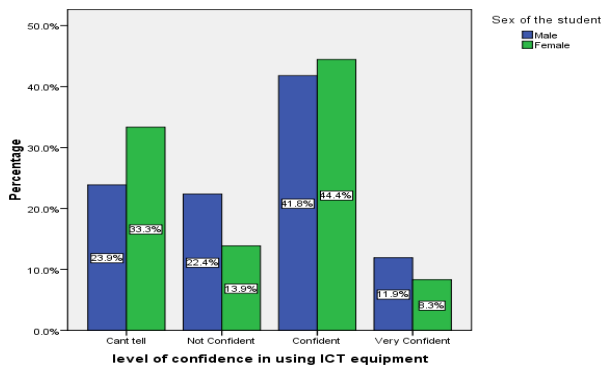


Figure 4.8: Description of the level of ICT confidence of students by gender (n=112)

This is in line with Sophia (2003) and Huyer (2003) who reported that the attitude of males is higher than that of females due to high computer-to-student ratio. At Mukuba University, there are 65 computers in the computer labs against about 650 internal students of which 257 student were studying Mathematics in 2013 giving a very high student-to-computer ratio. Furthermore the number of male students was higher than that of female students, which disadvantaged the females, as they said they did not like competing with the male students as they sat the whole day at the computers in the lab.

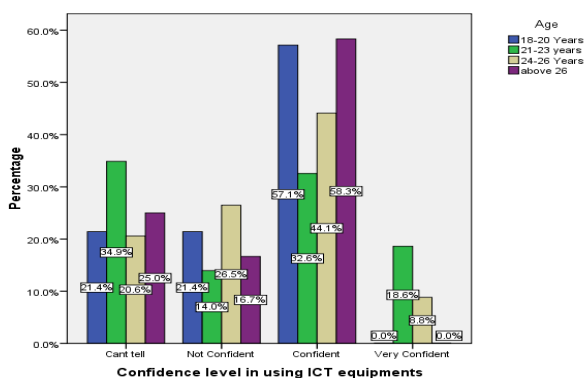


Figure 4.9: Students confidence level in using ICT equipment's by age group (n=112)

Students of mathematics in the age group 21-23 years appeared to be at all levels of confidence, though 34.9% of them did not know their level of confidence. The ages groups 18-20years and above 26 years were almost equally confident with 57.1% and 58.3% respectively for each age range.

Table 4.2: cross tabulation of user skill level by nature of the program (n=112)

Nature of the Program	User Skill Level				
	A	B	C	D	Total
single major	15%	40%	40%	5%	100%
Major & minor	5%	30%	50%	15%	100%

A= No skill, B= Beginner, C= Intermediate, D = Advanced

Table 4.3 reveals that 15% of the students doing single major mathematics, 5% majoring in mathematics and minoring in Physics or chemistry have no ICT skill. Students said they

do not have time to practice as they occupied most of the time with assignments that are hand written. Those minoring in physics or chemistry said they are given some presentations that help them practice the use of ICTs. This agrees with Bowlby's (1977) theory of attachment, Bandura (1977) social interaction and Lev Vygotsky's (1934) social learning theory. The less the interaction and attachments with ICTs the less the skills are acquired by the students. This agrees with Piaget (1973) that cognitive development occurs in stages, therefore skills development also follow stages.

Model		U C		Sig.	VIF
		B	t		
1	(Constant)	2.794	6.927	0	
	year of study	-0.015	-2.197	0.03	1.352
	Age of the student	-0.012	-3.655	0	1.465
	Sex of the student	0.274	2.621	0.001	1.104
	Province where the student stay	0.034	4.198	0	1.021
	ICT lesson by Lecturer enjoyment	-0.04	-3.252	0.002	1.088
	Confidence in ICT equipment	0.123	2.558	0.012	1.114
	Nature of BEd Programme	0.265	3.81	0	1.174

a. Dependent Variable: users skill Level

UC= unstandardized coefficients

Using Table 4.3, a double tailed t-test $t_{111,(0.025)} = 1.98$

revealed that there is significance evidence at 5% level of significance of the following:

- Year of study, age of the student and the low use of ICTs by the lecturers affects negatively in the development of ICT skills.
- Sex of a student, Province where the student stay, Student's confidence in the use of ICT equipment and Nature of BEd Programme affects positively in the development of ICT skills. There is no multicollinearity in the variables since Varaince inflation factors (VIF) are less than 5

Table 4.4: ANOVA Table to test the model (n=112, sig level=0.05^a)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	34.317	7	4.902	16.682	.000a
	Residual	30.56	104	0.294		
	Total	64.877	111			

- a) Predictors: (Constant), Nature of BEd Programme, Age of student, Confidence in ICT equipment, Province where the Student stay, whether students enjoy lessons involving ICT, Sex of student, year of study
- b) Dependent Variable: user skill level

10. Conclusion

From table 4.4 the Null hypothesis is rejected since $F_{calculated} = 16.682 > F_{0.05,(7/104)} = 2.09$ and conclude that Province where the student stay, year of study, sex of a student, age of the student, nature of BEd Programme, student's confidence, and use of ICT by the lecturers has an

effect on the development of ICT skills at 5% level of significance. $R^2 = 52.9\%$,

10.1 Findings and Conclusions

The following findings and recommendations are made. Province where the student come from, year of study, sex of a student, age of the student, lack of practice, Nature of the BEd Programme, and use of ICT by the lecturers has an effect on the development of ICT skills. It is further worthwhile to mention that:

- (i) Year of study, age of the student, low use of ICTs by the lecturers, and Nature of BEd Programme affected negatively in the development of ICT skills.
- (ii) Sex of a student, Province where the student stay and Student's confidence in the use of ICT equipment, affected positively in the development of ICT skills.

Mukuba University has no mathematical software to use for mathematical work. This could be one of the factors accounting for the negative attitude of students who said they did not like to use computers for higher mathematical courses. The main disadvantage in not having mathematical software is the difficulty associated with using generic word processing software such as Microsoft Word for typing higher mathematical work. The only benefit the students derived from using computers was the reading of electronic books and surfing the Internet to get information and not using a computer for mathematical purposes. This justifies why the year of study negatively affects the development of ICT skills.

It appears that on average 38.3% (40.8% males and 35.9% females) of the students admitted to Mukuba University majoring in mathematics had no ICT skills and they acquire their ICT skills while at the Mukuba University. This implies that the environmental factors such as Year of study, Sex of a student, Age of the student, Province where the student stay, Student's confidence, Nature of the BEd programme, and use of ICT by the lecturers help in the improvement of ICT skills.

- (i) The rate of acquisition of ICT skills differs depending on sex of the student and issues of computer student ratio are very crucial in the development of ICT skills.
- (ii) The data showed that female students spend more time on the Internet than male ones and those they prefer to use their own ICT equipment than the male ones. This is shown in Figure 4.3 and Figure 4.4.
- (iii) Many trainee teachers are confident in using a wide range of ICT resources, and limited accessibility affects the way the acquisition of their ICT skills progresses.
- (iv) The pedagogical practices of lecturers using ICT can be enhanced by not forgetting the traditional methods of teaching in order to give detailed explanations to the students.
- (v) Majority of the people in Zambia live in poverty and computers are not even something they dream about. This has always been one of the main challenges of ICT promotion. The home environments do not have ICT equipment where students during the holidays can

practice. Therefore, the government's prime challenge will be combating Zambia's illiteracy rate and creating ICT educated citizens first.

- (vi) Another intervention which directly affects the quality of trainee teachers is the deliberate and aggressive integration of mathematics teaching and learning with technology. This will give students the opportunity to acquire ICT skills in their daily experiences and education system. This would create both men and women who are conversant with using technology and computers from a very early age and could go on to share knowledge and skills with the peers as Vygotsky suggested.

10.2 Recommendations

10.2.1 Recommendations for further research

Based on the results of this study, there is now a substantial body of research into the development of ICT Skills among students at Mukuba University, there is much research still to be done to map out the specific relationships between development of ICT skills and various environmental factors. This study concentrated on only seven factors (Province where the student stay, year of study, Sex of a student, Age of the student, lack of practice, Student's confidence, and use of ICT by the lecturers). Therefore many details of these factors might have not been explored; providing areas which need exploiting through further research in order to further explain the precise nature and interplay of the various factors affecting ICT skills development. In view of this, the following recommendations aimed at improving the development of ICT skills among mathematics students could be investigated:

- (i) In order to evaluate the relevance of the importance of the environmental factors to the development of ICT skills, researchers should have relevant subject knowledge.
- (ii) Details of the school where the student did his or her secondary school education rather than the province where the student stay.
- (iii) Further research can be conducted to compare the views of students and the lecturers as this research was restricted to students only. The research findings are based on the student as the subject of study, and therefore lack the input of the lecturers.
- (iv) It is also important that the same focus be replicated in other institutions and also across the institutions. This is to compare and contrast findings and would be critical in determining geographical gaps as well as other factors which were beyond the scope of this study.
- (v) Researchers need extensive knowledge of the ICT skills being investigated and used by trainee teachers in order to develop measures aimed at enhancing the development of relevant skills. The levels of ICT skills (No skill, beginner, intermediate, and advanced) considered in this study may not be the same to another researcher, institution or country. In addition the researcher needs to have extensive knowledge about various software, interpretations, as well as the relevance of the subject matter both qualitatively and

quantitatively. This is in order to narrow the gaps in the meaning, reasoning of the data collected, presented, and the literature review.

11. Other Recommendations

For more effective acquisition of ICT skills the following recommendations are proposed:

- (i) Introduction of an orientation programme in ICTs to all new students to be done in the first few weeks of their being at the university, or to actively integrate such a programme in other courses.
- (ii) The Ministry of Education, Science, Vocational, Training and Early Childhood Education in collaboration with ZICTA to develop a scale to determine the level of skills in ICTs students should have acquired at a particular educational level in order to make it easier for researchers to carry out studies employing on a standard scale and making comparisons with other researchers valid.
- (iii) It is a universally accepted fact that, we now live in a technology and media-driven environment, marked by access to an abundance of information, rapid changes in technology tools and the ability to collaborate and make individual contributions on an unprecedented scale. Effective citizens and workers must be able to exhibit a range of functional and critical thinking skills, such as: Information Literacy, Media Literacy, and ICT Literacy.
- (iv) Deliberately integrating specialized schools (Secondary schools with enhanced coverage of certain subjects that constitute the specialization of the school) in science and technology into the mainstream educational system starting from grade 8. This would create both men and women who know what technology and computers are from a fairly early age and could go on to study and excel in the fields of Computer Science and other technology-dependent fields. Individuals with this advanced knowledge are lacking in Zambia because they usually leave the country looking for better opportunities elsewhere.
- (v) Mathematical software should be bought for trainee teachers of mathematics to use for mathematical work. These Conclusions and recommendations of this study may not be the same for the future as responses can change over time as participants can change, as does the ICT landscape.

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