Chalimbana University, Mission Press, Ndola, Zambia. ISBN: 998207552-7.

PROBLEM-SOLVING ICT INCLUSIVE EDUCATION

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Cite: Phiri, W. A. (2023). Problem-solving ICT inclusive education. In A. D. Sikalumbi, W. P. Abwino, & B. Chirwa (Eds.), *Inclusive education: Unlocking the potential of every learner* (pp. 141–153). Mission Press, Ndola, Zambia.

Introduction

This chapter presents "A problem-solving ICT education and its implications on the teaching and learning of mathematics and statistics in selected secondary schools of Lusaka and Central province, Zambia." The background of the chapter emanates from the fact that there has been a growing body of research in recent years that has stressed on the importance of ICTs in the teaching and learning process especially in the field of Mathematics, Statistics and science. For instance, studies have shown that integrating the use of ICTs in teaching and learning does benefit both the teacher and learner. It is argued that ICTs play critical role in the teaching and learning process as they lessen teacher centred curriculum, and that students will be self-directed learners thereby enabling students to better comprehend and easily understand mathematical or statistical problems. Despite such empirical benefits that come along with ICTs, the approach that has been adopted by government and other key stake holders are mainly reactive rather than proactive. The pupils are mainly taught how to use ICTs that have already been developed by other developed countries. The curriculum and syllabus are tailored to

teach pupils how to merely use rather than offering pupils skills that will enable them idealise, design, implement, monitor and evaluate the use ICTs in the learning and teaching process. In other words, the anatomy of ICTs as far as its benefits are concerned in relation to the Zambian secondary schools context, lies in a problem-solving type of education. In this regard, education tailored towards problem-solving sets a strong foundation for ICTs spurts. The type of education being offered in this 21st century must be different from the one that occurred in the 1900s. Moreover, Nations that will develop superior technologies will also be nations that will lead in the 21st century. Zambia cannot afford to lag behind in this regard. Technology is one of the three ingredients of economic growth. Therefore, this section argues that pupils in Zambian secondary schools should not only be taught how to use but more important how to create, invent and innovate ICTs.

Background

The emergence of Information and Communication Technology (ICTs) has been one of the technological developments that have evolved in the recent decade. In short, the age of ICTs has arrived (Kapesa and Katulwende, 2015). Indeed, that time to embrace ICTs in our daily individual and organisations' operations has come and anyone resisting this change will be consumed by the change itself. This is because today, more than ever before, there is hardly any field of life that does not utilize ICTs in one way or another.

The importance of ICTs cannot be overemphasised as correctly observed by Annan (2003) that 'if harnessed properly, ICTs have the potential to improve all aspects of peoples' social, economic and cultural lives and it can create a stimulating environment for development. One of the key facets where ICTs adoption and implementation should highly be applied is the education sector. Moreover, ICTs are one of the answers to that call for change in education due its good effects on the general knowledge of individuals and in learning situations. Voogt and Knezek (2008) argue that ICTs facilitate the move from the 'traditional pedagogy' to the modern discovery methodologies which are centred on the learner. Other benefits of using ICTs in the learning and teaching process

include producing a self-directed learner, increasing motivation for teaching and learning and stimulating creativity and collaboration to mention but a few.

In order to promote the design and implementation of ICTs, the Zambian government through various Ministries has been making deliberate efforts such as the development and adoption of the National ICT policy and the drafting of an ICT policy for education (UNESCO, 2013). Further, the Ministry of General Education (MoGE) has been initiating ICT activities in education which are mainly centred on developing curriculum materials, e-learning, classroom teaching and learning, delivery of education through radio and television, development of teacher capacities and development (digitalisation) of distance learning materials, all of these focusing on ICT integration in education in order to improve quality and access to education. Recently, the government through the Ministry of General Education revised its education curriculum in order to synchronise ICTs in the Zambian education system. The ministry has gone further by introducing ICTs in the primary and secondary schools and computer studies as a subject. The republican President while addressing the Fifth Session of the Eleventh National Assembly emphasised for Zambia as a nation to embrace innovation, technology and ICTs in the education curriculum as these were key to national development (Times, 2015).

While all these measures being undertaken by government and other stake holders are welcome, the approach however being undertaken of integrating ICTs in the Zambian education system has remain problematic for some time now. The approach has being that of rote learning as compared to active learning. For instance, one may ask; what type of ICT education is being emphasised in the newly revised curriculum? The answer is categorical that of teaching pupils how to merely use the already developed ICTs by other countries as opposed to stimulating invention, creativity and innovation among the pupils. This scenario of teaching our pupils how to maintain rather than creating ICTs is not health not only for the nation's economic development but also for the future youth generation ability to learn and apply mathematics, statistics and other science-based subjects in real life situations.

This chapter therefore, argues that our learners should be given a problem-solving ICT education curriculum. Mwewa (2011) equally notes that a problem-solving education is a must if Zambia is going to begin to compete in the economic and technological marketplace. Zambia needs to expose its progeny to science, technology, and mathematics at very tender ages. The Zambian children need to be told that science and technology are necessary tools to its development. [11] They need to be exposed to this type of education very early in their academic life and be given ready resources for experimentation in science, technology and mathematics as correctly pointed out that 'strong schools today mean strong economy tomorrow' (CP 24, 2010).

Problem-Solving ICT Education

The Zambian republican president in his address when he opened the Fifth Session of the Eleventh National Assembly on 18th September 2015, acknowledged that human development through education and skills training is instrumental for the transformation of any country. In this regard, government is currently reviewing the policies on education, science and technology as well as the technical education, vocational and entrepreneurship training in order to make them more relevant to the current and future needs of our country. He observed that mathematics and science lie at the core of innovation, the country's' future competitive advantage and progress. The president called for massive investment in training which should go hand in hand with a deliberate policy to equip all schools with Information Communication Technology (ICT) facilities. He retaliated that the Zambian children must be computer literate (Times, 2015: 15). This chapter argues that while the presidents' speech was a welcome, but by merely making our pupils to be computer literate is not adequate and sustainable. What kind of education should the government, private sector and other stake holders provide to our learners? The answer lies in the provision of problem-solving education and in this regard, the ICT education.

Problem solving according to Mayer and Wittrock (2006) is "...cognitive processing directed at achieving a goal when no solution method is obvious to the problem solver."

It is clear from the definition that problem solving is cognitive, process, directed and personal. Put it simply, problem solving education is a type of education that inspires learners into thinking, reasoning, decision making, critical thinking and creative thinking. Therefore, the ICT education that is being offered in our schools should evolve around these domains. Mwewa (2011: 607) supports this kind of approach in the education system, "the Zambian...curriculum should be designed around problem-solving tasks." In this regard, problem-solving education is the type of education that will enable learners to develop competences for independent initiatives and capacity for solving daily problems that enhance their own personal worth and quality of life.

Characteristics of problem-solving education and its role in ICT education

As government through the Ministry of General Education vigorously implement ICTs in the education sector, it is important to adopt the problem solving type of ICT education. This is attested by Mayer and Wittrock (2006) who acknowledged that a major goal of education is to help pupils learn in ways that enable them use what they have learned to solve problems in new situations. They further argue that problem solving is therefore fundamental to education because educators are interested in improving learners' ability to solve problems. But what are some of the key features of problem solving education and why should it be preferred in the adoption and implementation of ICTs in the Zambian secondary schools? While! The National Council of Teachers of Mathematics (NCTM, 1980: 2-3) outlines some of the major benefits pupils would benefit from a problem-solving education such as:

- Developing skills and ability to apply these skills to unfamiliar situations

Problem Identification

- Gathering, organising, interpreting and communicating information.

Testing

- Formulating key questions, analysing and conceptualizing problems, defining problems and goals, discovering patterns and similarities, seeking out appropriate data, experimenting, transferring skills and strategies to new situations.

⬇

Analysis

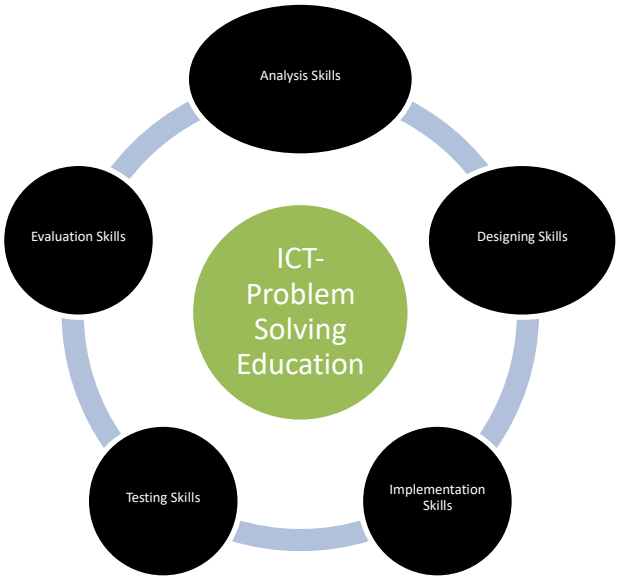
- Developing curiosity, confidence, and open mindedness.

⬇

Evaluation

If our pupils are exposed to such kind of ICT education as argued by Mwale (2015) they would in turn given opportunities to develop critical and practical skills which are summarised below:

Figure: Problem-Solving ICT Inclusive Education



The point of departure of the ICT education as illustrated in the diagram above should be to allow pupils acquire practical experiences in identifying methods of solution and design, implementation, testing, and evaluation of actual solutions based on a variety of application.

Carpenter (1989) equally argues that problem solving education encourages pupils to refine and build onto their own processes over a period as their experiences allow them to discard some ideas and become aware of further possibilities. This is a kind of ICT education curriculum that should be given to our 21st century learners. Mwewa (2011:606) sums it up all "the anatomy of technology as far as its benefits are concerned in relation to the Zambian context, lies in a problem-solving type of education. Education tailored towards problem solving sets a strong foundation for technological spurts." It is clear therefore that superior, problem solving education can produce superior brains which are able to drive Zambia forward.[11] As the republican president correctly put it "education is important to developing a skilled work force required for socio-economic development...I have approved an initiative for transforming the education sector through e-learning by using an innovative education tablet called the ZEDUPAD...I expect that by 2017, 50% of our children in school will have access to the ZEDUPAD and put us on a path of smart education" (Times, 2015: 16). The president further directed the ministry of education in conjunction with the Industrial Development Corporation (IDC) to initiate a programme of locally manufactured affordable tablets.

The directive by the president is timely but what practical measures are needed to attain this ideal education system? Apart from making financial resources available, the ICT education in schools should be tailored in such a way that it encourages critical thinking, reasoning and active participating among learners rather than the current scenario where rote learning is being promoted. Mwewa (2011: 609) notes "emerging Zambian leaders should insist on investing in the future of Zambia by placing emphasis on technology, science and mathematics. This is fundamental to the goal of a free, democratic and prosperous society." Therefore, the Ministry of General Education should not reactively adopt ICTs in the education sector but rather be proactive so that our pupils should not only be taught to know how a computer works but also given necessary skills of creating these much talked about and needed ICTs. We don't want our education system to only produce maintainers but rather pioneers in the ICT sector.

Challenges of imparting a problem-solving ICT education in the learners

A recent survey conducted by Mwale (2015) revealed that although the ministry of education's decision to introduce ICT as a compulsory subject in secondary schools may be a step in the right direction, its implementation however has proved beyond the capabilities of those involved. The survey cited several challenges that boarded on many schools both urban and rural areas having little or no access to computers, inadequate technical infrastructure, limited human skills, relatively high cost of communications equipment and poor policy and regulatory environment. The Ministry of General Education (MoGE) equally highlighted the challenge of lack of electricity that hampers the implementation of the new policy (Habeenzu, 2010). The Zambia National Union of Teachers (ZNUT) stated in the survey that the policy was not effective because there were currently no facilities in both rural and urban schools (Mwale, 2015). The survey furthermore indicated that ICTs cannot be done in theory only because it is a practical subject. This was coupled with the policy implementation being poorly funded. Additionally, studies such as those done by UNESCO (2013) revealed lack of qualified teachers to teach ICTs in schools. Views from the teachers who were interviewed in the survey observed that the Zambian government through Ministry of General Education rushed into implementing the policy because there were no computers, solar and no skilled teachers especially in rural areas to help pupils (Shafika, 2007). For instance, it is estimated that access to electricity in rural areas is unprecedented low at less than 5% while urban areas is pegged at 26% a situation which hampers the adoption and implementation of ICTs in Zambian schools (Mwale, 2015).

It is clear from the challenges reviewed that the current situation remains a pipe dream for Zambia to impart a problem-solving ICT education into its learners. This is because the Ministry of General Education is struggling even just to provide basic knowledge about ICTs. What more about attaining an innovative, creative, critical thinking and reasoning among pupils in the ICT education? These constraints are worsened by low literacy levels among citizens that further hinder the attainment of a sound ICT

education. Mwewa (2011) argues that Zambia cannot ignore the role of literacy in fostering modern technology and development. He observes that literacy does not only teach a nation how to read and write it enables a nation to participate fully in the liberation of people's minds. For Zambia, which is a developing nation, literacy is crucial. It can therefore be deduced that the future of Zambia depends on literacy. Hence, if the nation does not improve its population's literacy, it will be far away from becoming a technologically sovereign country. Clearly, the Zambian government should address this challenge because literacy prolongs life, promotes innovation, and lay a ground for a sound problem solving nation.

Strategies for attaining a problem-solving ICT education

There are several practical steps that government through the Ministry of General Education and other stake holders can institute to address issues of ICT implementation in schools. The first critical area to attend to is the curriculum and policy matters. In his speech to the Fifth Session of the Eleventh National Assembly, His Excellency the President of the Republic of Zambia adopted a theme "embracing a transformational culture for a smart Zambia now". It was retaliated in the speech that the nation needed to be adaptive, innovative and determined to change the way we do things (Daily Mail, 2015). In agreement to the above, Mwewa (2011: 607) confirms that "while machines make a person's life easier, technology improves a person's quality of that life and has enormous benefits. The Zambian...curriculum should be designed around problem solving tasks." The curriculum in this regard should be tailored in such a way that our graduates should be equipped both intellectually and resourcefully so that they can take Zambia further into setting a solid foundation for a technologically oriented nation. In other words, the learning and teaching content and intent in the curriculum should help our learners to think in abstraction, and not just in concrete terms, for their own well-being but also for society. With this mentality, our pupils after attaining ICT education will be able to construct situations, simulate actuality and develop strategies for solutions to the nation's numerous problems.

Secondly, it is important to inspire a sense of self-belief, confidence and determination in our pupils as we adopt and implement ICTs in our schools. As we teach pupils about ICT education, both the policy makers and pupils should realise that technology is a resource. Unlike non-renewable and exhaustible resources, our young generation should know that technology can be acquired by any nation at any time. It is sad to note that developing nations like Zambia pride in the use of technologies developed by the developed nations. As a result, developing or Least Developed Countries (LDCs) design their national education and calibre on their proficient use of the rich nations' technology. This is wrong.

For example, the Ministry of education approved and adopted the use of an innovative education tablet called ZEDUPAD (Times, 2015). This tablet is pre-loaded with lessons, learning materials and extension agriculture and health information. The University of Zambia, after forty-six years of existence still teach and relay on statistical packages such as the SPSS, STRATA, etc for data analysis which were developed by students from other universities from developed nations. While there is nothing wrong in using these technologies developed from Western countries, the argument is that we can do better and develop our own technologies. Since the inception of ICTs, government leaders such as ministers of education, permanent secretaries, directors, provincial Education Officers, head teachers and in some instances classroom teachers have been sent outside the country to be trained how to merely use ICTs developed by other nations. As a result, these foreign technologies are being imposed on Zambian pupils and teachers and the outcome is usually unsatisfactory. What is being emphasised today is to learn and use ICTs in schools where there is no electricity, no skilled human resource, no computers, no internet connectivity and no technological infrastructure. There is need to plan, design, implement and invest huge resources in our local ICTs innovation.

Mwewa (2011) argues that Zambians have used mobile, social, industrial and other technologies created by the developed nations with effulgent perfection. He further observes that although these technologies go a long way in improving the lives of many

Zambians, they do more for the patented nations. Therefore, the challenge that emerging Zambian leaders have is to dispel the myth that Black Africans are devoid of technological innovation; the notion that Black people are semi-evolved organisms who depend upon the ingenuity of their White counterparts to survive. This has partly been invigorated by the tendency by the African governments to rely entirely on the Western and Eastern technologies and innovations. It is imperative therefore, to encourage local innovations in the ICT sector and this can only be achieved if our education curriculum offers a problem solving type of education. Our graduates should have confidence that Zambians and other African communities can develop technologies that other societies can emulate and pay for. Hence there is need for Zambians begin to think in terms of developing authentic technologies. Therefore, the ICT education in our schools should be implemented with caution as argued by Mwewa (2011) that technology tenders a competitive advantage to the one who owns and uses it. It does even more; it makes the developing countries dependent upon the West. It does so even at the expense of national security and sovereignty.

Valuable lessons can be learned from countries like Malaysia, China and India who sacrificed and chatted their own course by creating and implementing their own indigenous technologies that have rewarded them handsomely. These countries did not succumb to Western pressure of imposing their technologies on such nations but they instead believed and promoted their own technologies. Zambia therefore faces a huge challenge of not just merely implement ICTs from developed nations but to saw, cultivate and harvest the technologies designed by its indigenous people. The directive by the Zambian Republican president to the Ministry of General Education to revamp and strengthen the Junior Engineers, Technicians and Scientists (JETS) in secondary schools is a welcome move. He further pronounced that an effective tracking system of those budding scientists as they progress in their education should be instituted so that a deliberate effort of awarding scholarship to deserving students with a strong competency in mathematics and sciences (Daily Mail, 2015).

Apart from making sure there is adequate provision of electricity, computer laboratories, internet connectivity and capacity building among teachers especially in rural areas, the implementation of ICT policy should be budgeted for and heavy investment being apportioned to an ICT sector unlike depending on donor funding. While other traditional subjects like English Language, Mathematics, Sciences, Business studies and History to mention but a few have structures from the school level up to the national level, the introduction of ICTs in schools lacks established monitoring, quality assurance and adherence structures. In order to avoid giving pupils substandard ICT education the Ministry of General Education (MoGE), Zambia Information Technology Communication Authority (ZICTA) and Zambia Education Broadcasting (ZEBS) should formulate an effective e-safety policy not only to ensure quality is attained but also to regulate safe use of ICTs in schools. If this is not done, the current trend where the emphasis in the ICT education is rote learning rather than active learning will continue.

The current ICT education system in Zambia leaves much to be desired. For instance pupils especially in rural areas lack well-trained ICT teachers, go to dilapidated school buildings, learn in an environment lacking adequate ICT teaching facilities, and are subjected to obsolete ICT teaching materials. For example, Zambia conducted its first ever grade nine ICT practical examinations this year 2015 on November 2. Although this is a good development, the examination did not go smoothly. The Ministry of General Education for instance encountered challenges to run the 2015 ICT grade nine practical examinations due to lack of adequate computers and supply of electricity especially in rural areas. The Daily Nation (2015: 17) reports "...at a named school...the exam ended after 20:00 hours..." Some of the grade nine had to do their practical examinations at very awkward hours of the night and some had to walk long distances to schools where they could access computers and other facilities. The Permanent Secretary in the Ministry of General Education had to apologise for the inconvenience caused to the pupils. This kind of ICT education leads to poor ICT education and hence to a nation devoid of solving its own problems.

As argued by Mwewa (2011) a lack in quality education leads to lack in the production of superior minds able to tackle modern problems effectively and efficiently. As already noted earlier that another indirect result of the sub-standard ICT education is that it only produces maintainers and not pioneers; doctors, ICT experts and other professionals who are solely dependent on other people's innovations. This is dangerous in that the nation may fail to produce superior minds that can bring answers from experimentation, understand and manipulate nature and provide ready solutions to economic, political and technological challenges. This article submits therefore that a problem solving ICT education is the answer.

Conclusion

This chapter has unearthed various issues affecting the adoption and implementation of ICTs in the Zambian education system. While other similar studies dwelled much on highlighting some of the traditional challenges impeding progress in this important sector such as lack of electricity, inadequate ICT infrastructure, lack of trained ICT teachers to mention but a few, this article has however gone further by evaluating some of the sustainable ways of implementing ICTs in our Zambian schools. The argument of the chapter is that the current ICT education being implemented in schools is rather reactive than proactive. The approach being adopted is that of merely making use of ICTs and technologies that other Western and Eastern countries developed. Our learners are taught how to use a calculator to solve a given mathematical problem, use other software such as the SPSS and STRATA to analyse data and so on and so forth. In contrast, very little is being given to our young generation that would inspire them into critical thinking, reasoning, flexibility and transfer of knowledge to various real-life situations. By merely implementing the ICT education, innovation and creativity imposed and developed by other nations is not good enough. Our young generation deserve better. Our education system should not merely produce graduates who are maintainers but rather to be innovators and pioneers in the ICT sector. This chapter recommend that government and

other stake holders should plan, invest huge financial resources, create an enabling environment where our pupils, students, graduates and the general populace are able to design, implement and apply indigenous ICTs that other societies can import and pay for just like we have been doing for centuries now. This calls for political will, selflessness among our leaders, and change of attitudes among our young generation, self-belief, determination and perseverance. Our leaders and everyone else should champion for a problem solving ICT education that will not only enable our ICT graduates to think and reason critically but also to be able to construct situations, simulate actuality and develop strategies for solutions to the many problems our country Zambia or Africa as a whole is experiencing.

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