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TEACHING CHALLENGES AFFECTING STEM RESUSCITATION IN ZIMBABWE

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Abstract:
Although Zimbabwe has tried devoting resources to address vast educational challenges, literature reviewed has indicated that Zimbabwe education system despite reconstruction efforts still lacks priority towards consolidation and improvement of both quality and quantity in STEM pedagogy. This research through constant comparison of gathered data analysed learner-centred STEM education access challenges, from the internet and libraries. Data collection and analysis took place simultaneously. The research found out that, sustainability of science oriented education (STEM) greatly depends on both quality and quantity educational improvement. Closely associated with the discussion of quality are debates on the appropriateness of teaching pedagogies to promote STEM individualised intellectual empowerment, for both life-skills and socio-economic transformation. STEM focused education is not a new philosophical concept in the history of African and Western philosophies of education. Contemporary Zimbabwe education system curriculum does embrace both science and arts education orientations. In the dual education orientation the key qualitative teaching and learning challenge in Zimbabwe today is educational discrimination through STEM streaming-challenging 21st education theoretical trends of inclusive education for all. Given the challenge this research concluded that, STEM sustainability greatly relies on how STEM is democratised and taught in the classroom. The major recommendation is individualised teaching approaches of STEM subjects.

Keywords: teaching challenges, STEM, resuscitation

1. Introduction

Despite devoting resources and expanding access to education since independence, Zimbabwe education system is still affected by both qualitative and quantitative

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teaching educational challenges (Sefa Deli, 2010; Karras et al 2015; UNESCO, 2015; Jansen, 1989; Masuko, 2003). The greatest contemporary challenges in the Zimbabwe education system according to research include the need for improving all aspects of quality education including teaching excellence (Makoell, 2016; World Bank, 2010; Colclough et al 1990 UNESCO, 2010). Improving quality of teaching standards will result in recognised and measureable learning outcomes being achieved, especially in Sciences, Mathematics and essential empirical and functional life skills literacy where worst disparities have been observed (Steen, 2001; Pandor, 2006; Tella, 2006; Olatunji, 2001). Also relevant to meet required quality education standards is the question of what should be taught in terms of whether education should focus on how technology is invented or to teach learners to be consumers of already in existence technology.

Improving the quality of education is arguably the most critical element of successful sustainable education for all strategies in Africa, including Zimbabwe (Johnson, 2008; Verspoor, 2004, World Bank, 2008; Nkabinde 1997). But real quality improvement in inclusive pedagogy, assessment for effective learning, learner-centred approaches and democratic learning processes that result in enhanced learning outcomes, has been very difficult to bring about in both developing and industrialised countries. Improving Sciences and mathematics teaching in Zimbabwe is no exception in this regard, including the teaching of other practical subjects broadly called STEM (Science, Technology, Engineering, and Mathematics) education. Even if the need to improve quality teaching is favourable, immediate and can be resolved at school level as compared to improving quantity challenges that my require more time, resources and government involvement, addressing education challenges without a reciprocal consideration of both qualitative and quantitative challenges is detrimental to 21st century universal educational goals.

2. Theoretical Framework

There are diverse qualitative and quantitative teaching education challenges haunting the current Zimbabwe education system from primary to tertiary level (Harber, 1997; Ajayi et al 1996). The concern in this research is not to look at all possible challenges but to focus on teaching challenges affecting STEM resuscitation especially at school level. 'Resuscitation' because according to history of education and philosophical foundations of education (Ornstein et al 2010; Dunn, 2005; Barrow and Woods, 2006; Hansen, 2007) STEM concept is not a new issue in education, perhaps a new title for an old science oriented education concept. STEM education as practical sciences oriented education is embedded in both pre-colonial African Holistic education orientation and Western Pragmatism philosophies of education especially in Realism and Empiricism schools of thought (Carr, 2007; Baines, 2007; Gadalla, 2007). From time immemorial education orientation preference debates have always revolved on the question of which education orientation (science or arts orientation) has added value. Even today in Zimbabwe it is still debatable on which orientation should education incline to or consideration of both or multiple orientations.

Teaching challenges in this research will be categorised mainly under qualitative education challenges, however because of their interconnected nature to quantitative challenges, one cannot turn a blind eye on both. In this research quantitative challenges will be considered only to support the focus of this study. Related to the research question is a sub-question that maybe of concern here given the nature of qualitative teaching challenges like access to STEM education, the sub-question that looks at how a teacher should provide STEM access to a child with intellectual challenges especially a child challenged in sciences and mathematics?. This question becomes even more important in the Zimbabwe context where the 'new' curriculum argues for STEM to be 'compulsory'.

3. Methodology

The study sought to investigate teaching challenges affecting STEM resuscitation in Zimbabwe. The main sub-question addressed in this research was: how teaching pedagogies could be used to promote STEM individualised intellectual empowerment for all learners given the vast teaching challenges that hinder STEM sustainability in Zimbabwe?

In answering the key research question the research adopted a qualitative research paradigm to accommodate the researcher as the primary sole instrument for data collection and data analysis. Sources of data comprised of published literature-textbooks and journals from libraries and the internet on the challenges affecting STEM resuscitation in Zimbabwe. Sources of literature were selected using purposive sampling specifically the maximum variation sampling technique (Taylor, 2011; Gray, 2010; Paul, 2004; Merriam, 2007), where the researcher targeted literature sources thought to be relevant to the research question at hand.

True to the nature of a qualitative study, data was collected and analysed using the content analysis methodology (Esterberg, 2002) on the research question at hand. Data collection and analysis took place simultaneously as true to the cannons of the research design used here Corbin and Strauss (2008). The analytical model of constant comparison formulated by Glaser and Strauss in Lincoln and Guba (1985) through note taking, open coding and summarising literature judged relevant to the research according to data gathered was used to reach findings and conclusions about teaching challenges affecting STEM resuscitation in Zimbabwe.

4. Data Analysis and Discussion

4.1 Qualitative and quantitative Education Challenges

For a variety of reasons, Zimbabwe education system still lacks priority towards consolidation and improvement of both quality and quantity aspects of education. According to research (UNCEF, 2010; Bergmann, 1996; Harber, 1989; Nwomonoh, 1998; Mungazi, 1982) some of Zimbabwe's quantitative educational challenges include-lack of sufficient teaching facilities and equipment such as teaching materials, libraries,

electricity, computers, laboratories, access to efficient internet and science apparatus, classroom furniture, provision of decent schools to communities that have been resettled, congested classrooms both in urban and rural schools, double sessioning-contributing to dislike of schooling and academic failure of many Zimbabwe students. In addition to the above mentioned quantitative challenges (Walker, 1992; Simon, 1991; Nxumalo, 1990 in Nkabinde, 1997) observed that qualitative challenges include-failure by many African teachers to employ innovative pedagogies, schools discriminate intellectually challenged students through streaming, failure to apply individualised participatory learner-centred pedagogies especially in STEM teaching. They further blame teachers' failures in producing curious, analytic learners to the way teachers are prepared in teacher training institutions. Indeed poor teacher training affects STEM teaching creativity, motivation of students and the effective use of teaching talents.

Researchers summarise by arguing that African education challenges mainly fall into five categories: policy reform, access, materials and facilities, methodology and relevance (UNESCO, 2001; UNESCO, 2007; Shizha, 2013; Abdi, 2012; Woolman, 2001; Thompson 1981). In Zimbabwe the most debated contemporary education challenge has been the question of compulsory education; hitherto, resources and meeting the Jametian initiative of education for all and other international education protocols. These concerns and challenges affecting Africa not only Zimbabwe, should be seen as provision of insights about needed future educational reconstruction.

While qualitative challenges may include the question of how to provide STEM education to disadvantaged social groups especially rural underprivileged schools not offering STEM subjects maybe an immediate cause of concern, attraction of STEM motivated, qualified and dedicated teaching professionals, above all attraction of teachers able to promote and cultivate life competences for economic growth, employment and self-reliance, is of greater concern (World Bank, 2002; Musoro, 2002; Masuko, 2003; Nziramasanga, 1999; Zimbabwe Education National Report, 2004; Curren, 2007). Despite challenges there is still a need to forge solutions and emphasize science orientated education. In other words, science and mathematics competence is an essential component in preparing all human beings for employment or self-reliance. Interesting questions given the above prediction are raised as to how the Zimbabwe teaching and learning respond to the need for teaching STEM to gifted and non-gifted learners, also of concern is how to respond to global trends of inclusive pedagogy?. In order to answer these questions it is also helpful to think about developing legal instruments to support compulsory STEM education for all.

A key challenge hindering STEM education for all is STEM streaming. STEM streaming practices and failure by schools to appreciate inclusive STEM education reverses the Zimbabwe vision of achieving quality education. Streaming students into performance levels based upon sciences and mathematics intelligence is a common practice in most, if not all Zimbabwe schools (Zuriff in Curren, 2007). Streaming is a learning, access to quality education and STEM teaching obstacle that 'slow-learners' face in most Zimbabwe schools. Usually those students who excel in sciences and mathematics are tracked to first classes and encouraged by the school to concentrate

more on sciences. The arising question given such a bias, is on how to address the discriminatory mentality? Since the importance of having a solid STEM background is recognised as a necessity for all (Steen, 2001; Chireshe et al 2009; Tella, 2008; Pandor, 2006). Given the inclusivity challenge African education development should have a dual burden, the concern to availing STEM access to all at the same time improve quality to those already in access.

4.2 Teaching Challenges Affecting STEM Resuscitation

From analysis of gathered information and general observations on qualitative and quantitative school level education challenges present in Africa, one can deduce that discrimination in the form of streaming and teacher competency are two major teaching challenges affecting effective resuscitation of STEM education in Zimbabwe. Because of these two challenges' outstanding nature they will be discussed in greater detail in the subheadings below.

4.3 Streaming

Many African schools and class teachers group students by ability in specific subjects, separating slower learners from faster ones or the more advanced from less advanced. Advocates of homogeneous grouping argue that it is both fair and effective, but critics have charged that it harms students, particularly low achievers (Slaughter, 2009; Tough, 2008; Payne, 2008; Cromwell, 1999). Most schools in Zimbabwe practice streaming, students are assessed using their previous end of year results and grouped into classes based on achieved examination performance. Streaming in Zimbabwe usually happens when students move from one education level to another, for example moving from early childhood development to junior primary, from primary to form one, from form two to form three, and from form four to form six.

In Zimbabwe there is limited research to voice against such decisions to stream children and teach them according to assumed intellectual differences. Streaming is also currently being used by some secondary schools to offer sciences to gifted classes while least or non-gifted classes are encouraged to focus on arts. Debates on the benefits and disadvantages of streaming have never been put to rest and researchers have continued to study the streaming practice since 1880s (Mansor et al 2016; Dukmak, 2009; Kuma, 2004; Smith, 2011), because they believe it has great impact on student outcomes.

Streaming has long been associated with disadvantaging students in lower ability groups since its inception (Ollerton, 2007). Streaming has also been found to produce different affect towards student's academic achievement and to a certain extent mentioned as being unjust and discriminatory (Kilgour, 2007; Liu, 2009; Marks, 2011; Pare, 2004; Rudowicz, 2003). It has also received a fair share of criticism by learner-centred and inclusive education advocates (Nind, 2005; Barton, 2004; Hegarty and Alur, 2002; Vlachou, 1999), especially for its inconsistency to the millennium development goals of inclusive education for all. All forms of streaming have their advantages and disadvantages, however not the focus to this research. Streaming in order to disallow another group of children not to study STEM subjects has more disadvantages than

advantages especially for economic and life-long education development. Even though supported by some schools in Zimbabwe, (DiMartino, 2005; Hoffer, 1992), argue that benefits of streaming are 'questionable'. It is not possible to place students equitably or accurately into groups based on ability. Hoffer (1992) adds that, 'any academic gains from ability grouping are too small to be significant'.

Streaming is also criticised by the implications of African philosophy principles which informed pre-colonial African indigenous education epistemology. Streaming does not ensure equity in access to quality learning but furthers education inequalities in access to formal modern education. Streaming contrasts sharply with pre-colonial African education perspectives that valued inclusivity, purposefulness and functionality, all round learning of multiple skills (Mudimbe, 1996; Ramose, 1988; Serequeberhan, 1990). The spirit of collectivism was encouraged while individualism discouraged, learners were not differentiated and discriminated on the bases of their intellectual capabilities nor their social or economic status but on the basis of their soul and character. Today African formal education including Zimbabwe reproduces a western type class structure with great inequalities where a wide range of wealth and poverty influences individual opportunity.

4.4 Pedagogy

Related to streaming teaching challenges that affect efficient resuscitation of STEM in Zimbabwe is failure by most teachers to apply best educational practices (Du Preez, 2004; Tachie and Chireshe, 2013). They posit that learners in most African schools do not do well in sciences and mathematics when their teachers who were supposed to guide did not know the subject themselves. They further observed that, it may be interesting to note that, learners often fail sciences even if they were taught by highly qualified teachers. The answer to the above attribution comes from Nyaumwe et al. (2004) who reported that some of the teaching methods teachers use does not help students' conceptual understanding of STEM subjects. Most criticised teaching methods are teacher-centred approaches (Nwomonoh, 1998: Ajayi et al, 1996), but mostly used in Zimbabwe schools. Johnston in Johnston et al. (2010) add that, effective STEM teaching is hindered by an education system that places more emphasis on the curriculum and teacher-centred focus, yet there is need to move from how teachers teach to how children can be taught or learn. Meyer et al. (2008) gives a solution to the above challenge by suggesting that, learner-centred pedagogies sometimes called independent or personalised learning, improve academic performance, increased motivation and confidence, greater student awareness of their limitations and their ability to manage them. These suggestions are no exception to Zimbabwe STEM success.

5. Findings

Through analysis and categorising of gathered data this research discovered that sustainability of science oriented education STEM greatly depends on improving both quality and quantity educational limits. According to research findings key quantitative

challenges that hinder effective teaching in Zimbabwe are mainly lack of teaching facilities and equipment, shortage of well-equipped libraries, access to efficient internet and science apparatus, congested classrooms, double sessioning and shortage of adequate schools within a reasonable walking distance. Key qualitative challenges deduced were lack of inclusive pedagogy, assessment for learning, learner centred approaches and democratic learning processes that result in enhanced learning outcomes.

Even though quality and quantity aspects of education were not the major focus of this research there are however intertwined to the focus of this research in such a way that it became impossible to ignore them. The focus of this research was to find out teaching challenges affecting STEM resuscitation in Zimbabwe, according to research findings these were related to both qualitative and quantitative educational issues.

Two major teaching challenges sufficed through data analysis, discussion and comparison. The first teaching challenge observed was streaming which discriminates non-gifted children to access STEM education, yet every child despite intellectual capabilities do need science and mathematics foundations for self-reliance and employment after completing basic formal education. The second challenge deduced from reviewed literature was failure by most STEM teachers in Zimbabwe to apply innovative pedagogies and appropriate learner-centred STEM teaching approaches especially to students with science and mathematics learning disabilities.

6. Conclusion

From the research findings of this study, it can be concluded that both qualitative and quantitative challenges affect effective teaching of STEM in Zimbabwe. However of more concern, given the research question at hand, to this study was mainly to focus on qualitative matters specifically teaching challenges. The teaching challenges discovered to affect STEM sustainability are streaming also referred to in this research as STEM discrimination and failure by teachers to utilise appropriate and creative learner sensitive pedagogies to promote effective learning of STEM by pupils of diverse intellectual capacities especially by intellectually challenged students or students who do not like sciences. Given the challenge of streaming and teacher competency STEM sustainability greatly relies on how schools democratise STEM education access and how teachers teach STEM.

7. Recommendations

From the two major findings of this study, the following recommendations are suggested: There is need to teach STEM to all learners despite their intellectual disabilities. There is also need for individualised teaching approaches to be applied by STEM teachers to cater for learner differences. There is need for a legal instrument to mandate schools in democratizing STEM access to all on paper and in practice.

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