

IS THE PROVISION OF QUALITY SCIENCE EDUCATION IN CRISIS? EVIDENCE FROM THE TANZANIAN JUNIOR SECONDARY SCHOOLS

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Abstract

Ensuring that students receive quality science education (SE) experiences is a goal that Tanzania has looked forward to achieving. However the effort to achieve such an accomplishment has shown little success. This study aimed to examine what goes on the ground in relation to the provision of quality SE in Tanzanian Junior secondary Schools (JSS). The study particularly explored the respondents' views about the reasons why this expectation has not been achieved so far. The study was mainly qualitative involving hundred and sixty respondents in the categories of policy makers, science alumni, science educators, parents, employers, and students. The study revealed a variety of perceived barriers, both internal and external, all of which appeared to impede the provision of quality SE in Tanzanian JSS. The study recommends that among other issues there is need to refocus the way SE is planned, practiced, evaluated and monitored. Without concerted efforts to do so, Tanzania may not be able to take advantage of the science and technological developments in the near future.

Key Words: Quality, Functional Science Education, Quality Science Education

INTRODUCTION

Tanzania is one of the countries in the Southern African Development Community (SADC) region which has made phenomenal strides in increasing access to junior secondary education with the introduction of ward secondary schools in every district. Despite such notable developments, the quality of SE being provided in these schools remains to be a challenge that leaves most of beneficiaries in a worrisome situation of whether the SE system is functional enough to enable the learners develop creative and innovative skills which necessary for their survival after school (Andres & Mattias, 2006; Osaki, Hosea, & Ottevanger, 2004). This situation has increased an interest for most, if not all, developing countries including Tanzania to provide quality and relevant SE experiences that would enable learners to solve various challenges they encounter in life (Organisation for Economic Co-operation and Development Global Science Forum {OECD-GSF}, 2006; Osaki, et al., 2004; Ogunniyi, 1986). The shift towards the provision of quality education has therefore become an essential desire for most countries' educational systems (Holt, 2000; Kubow & Fossum, 2003).

However, a review of the literature establishes that

efforts to improve SE in most African secondary schools since 1980's have been impacted by a number of global challenges (Ogunmade, 2005; Ogunniyi, 1986) which have greatly influenced SE practices in schools. In an attempt to address such challenges, schools have found themselves being pushed towards looking for best ways in which SE can be provided.

Despite clear and well-focused intent to provide quality SE experiences in schools, experiences reveal some limitations related to the way this initiative is accomplished in schools. For example, instead of making sure that science students are provided with quality SE experiences, practices in schools still seem to be limited to producing little impacts, a situation which suggest that there is something on the ground that limits the students from developing relevant skills, knowledge and attitudes about science.

The prevalence of these hidden limiting factors is likely to be negatively influencing the provision of quality and relevant SE, a criterion which is currently considered as necessary for developing social prowess, economic growth, strong scientific community, and producing skilled manpower in the field (Hodson, 2011). It is perhaps surprising that in this global era, where science holds the first priority in socio-economic

development, Tanzania still, has not shown a substantial progress in making sure that students receive quality SE experiences in JSS (Kalolo, 2015). This study is set out to explore the issues influencing the successful provision quality SE in Tanzanian JSS. The paper particularly focuses at answering three major questions, including: What is going on that the expectation to provide quality science education is insubstantially achieved? Are there any factors behind such a situation? And how can this situation best be addressed?

The paper is built on a desire to have a SE system that is able to provide necessary science skills among learners and ultimately help them to develop interest of embracing SE as their future career.

METHODS AND PROCEDURES

This study was mainly an exploratory study that was framed to find out whether quality SE was being provided in JSS as intended. In particular the study sought to uncover the experiences and barriers towards provision of quality SE. The study involved diverse categories of respondents to gain collective opinions about issues on the ground that influence the provision of functional SE in schools. Such categories of respondents included the following:

1. *The policy makers* – Two members from each of the following: The Ministry of Science and Technology, School Inspectorate Department (SI), Tanzanian Education Authority (TEA), National Examination Council of Tanzania (NECTA) and Tanzania Institute of Education (TIE); altogether adding up to a total of 10 respondents.
2. *The educators and school managers* – 4 science teachers and one head of school from each school among ten sampled schools, which altogether adds up to a total of 50 respondents.
3. *The society* – 20 selected parents from school boards, 2 parents from each school; 50 students, 5 students from each school; and 20 science alumni, 2 science alumni identified by each school.
4. The Association of Tanzania Employers (ATE)-5 private school owners and 5 owners of small science related industries.

The study was mainly qualitative, focused at identifying issues influencing the provision of quality SE in Tanzania. The data was collected through questionnaire, interviews (for adult respondents), focus group discussion for students and the review of government documents. The choice of the respondents

was based on the vital information each category of respondents had with respect to the provision of quality SE experiences. The data was analysed thematically. The findings in this paper are not presented separately but rather merged with a discussion and the literature.

FINDINGS AND DISCUSSION

Most of selected respondents actively participated in the interview and open ended questionnaire around two major questions: What is going on that the expectation to provide quality science education is poorly achieved? How can the situation be best addressed? Most respondents identified that, the barriers towards quality SE are many, context specific, and that the barriers emanate from multiple sources. The findings from different data sources were merged to form subthemes (which in this paper are identified as challenges towards provision of quality SE) as presented in the subsections that follow.

Resource related challenge

The findings from this research revealed that schools faced three major resource related challenges including: lack of learning support facilities (such as science labs, computer labs and libraries); learning support resources (such as textual, visual and audio-visual materials); and the support learning services (such as counselling and guidance units) in schools a situation which is described by respondents as having an impact on achieving the goal of providing quality SE in schools. One teacher said that “*even when such facilities and services were present, they were usually not fully equipped with both material and responsible*”. Most respondents were in agreement that there was a huge gap between required and available learning support services and facilities in Tanzanian JSS, a situation which was described as impeding efforts to provide quality SE in schools. The respondents felt that adequate and modern learning support services were necessary for students to develop study skills, as well as important for those students who wanted to enhance their academic experience in science to meet their educational goals for science careers.

On the other hand the respondents of this study identified five major issues regarding quality learning resources. These were insufficiency, irrelevance, context irresponsiveness, inaccessibility, and obsolescence of resources. While context irresponsiveness, obsolescence and irrelevance of learning resources were identified as being a failure of the responsible departments to keep up to date

inventories, the problems of insufficiency and inaccessibility of resources were related to the failure of responsible departments to provide a variety of ways of learning science.

In light of the existing learning resource predicaments, Hamilton, Mahera, Mateng'e and Machumu, (2010) suggest that there is a need to incorporate a number of alternative pathways by which SE can be learnt into school curricula. These could include the use of other learning facilities in providing contextual learning experiences outside the classroom, and/or making use of the human and physical resources available in the local environment. This alternative pathway towards learning is also likely to solve the challenge of resource inadequacy.

Curricula relevancy

Evidence from the current Tanzanian science school curriculum materials (such as syllabi, schedules, exams, marking systems, and textbooks) showed that there was a high level of content abstraction, a situation which was felt by respondents as contributing to learners inability to connect curriculum materials to their daily experiences and lives. One teacher said that "most of the curricular materials in this were characterised by textbook-driven knowledge and inadequate SE programmes, experiences which contribute to learners' inability to actively participate in learning. Most of teachers also felt that the science syllabi were overloaded with too many topics per grade level, a situation identified as hampering student understanding and skill development in science.

It was consistently noticed among most respondents, except students and parents, that the science curricula materials had a number of problems including:

1. The failure to provide JSS students with knowledge, skills and competencies that would be useful to them when they leave school; consequently the SE being taught in schools was not useful in their daily life, and many students did not achieve sufficient understanding of it to be able to contribute to scientific debates;
2. Too much emphasis on theoretical aspects of science and not enough examples of applications of science to students' life. This situation contributes to a high level of content abstraction, content overload, and the failure of science being easily connected to the learners' daily lives;

3. Absence of opportunities to nurture students' abilities, including investigative, problem solving, and critical thinking skills. Consequently students were failing to develop self-driven creativity, curiosity, and success in learning;
4. Irrelevance of curricular materials such as science textbooks whose contents are usually adopted from foreign science textbooks with no emphasis on local science related contextual or environmental problems;
5. Cultural and context irresponsive of the science curricula whereby the structure and its focus do not reflecting the: demands of diverse abilities of the Tanzanian learners; learners' needs and daily experiences; and the needs requirements of the twenty first century which is governed by knowledge-based economy;
6. Poor implementation of the competence-based curriculum whereby although competence based syllabi was endorsed for use in schools as an outcome of the current curricula review, Tanzania still uses the content-based syllabi which still contain topics instead of tasks defined by competence descriptors and indicators;
7. Limited avenue for the majority of SE stakeholders to have their voices, needs and expectations addressed in the curriculum;
8. Mismatching between the three types of science curricula exemplified by disconnectedness between intended, implemented and attained curriculum.

The science curriculum was also said to be confronted by the challenge of a knowledge explosion in scientific fields. This belief was evident from both the respondents' voices and the documents analysed. For example, in the JSS science syllabi, students were exposed to around ten compulsory and five optional subjects per grade level. This resulted in the exposure of learners to too many subjects per grade level, a situation suggested as having influence on students' understanding and knowledge development.

According to Dillon and Redfors (2014), and Hodson (2011) the presence of quality and relevant curriculum strongly creates the chances for good educational achievement and educational gains. Despite the clear intentions of the Tanzanian government to have a more relevant and useful curriculum as stated in the reports by Ministry of Education and Vocational Training {MoEVT} (2008) and United Republic of Tanzania {URT}, (2010); the findings have revealed that the science curricula is in crisis. This situation creates a need for a curriculum that would be: able

to connect classrooms experience to learners daily life; useful for the present and future life of a learner; enables learners to become responsible citizens; equipped to match the needs and daily experiences of the learner; and that presents a full range of career options that learners can pursue in the future.

Teachers related challenge

Improving teacher recruitment, development, and retention processes in education was another important factor that the respondents cited as essential area to ensuring a strong teacher workforce. However, respondents identified that this was constrained by a persistent shortage of well-trained, qualified, career-committed science teachers. The reasons for such a shortage were identified by the majority of respondents as including:

1. *Poor working environment of science teachers amplified by low teacher salaries.* This situation which led to most teachers taking up a secondary employment to make ends meet. The respondents identified that Tanzania was experiencing losses of a significant number of qualified science teachers due to more favourable employment conditions in countries such as Botswana and Namibia, where teachers are better paid and able to expect a better life. Respondents also noted rates of infection of HIV/AIDS, which has been wiping out the new generation in the education sector, including SE teachers;
2. *Low grades for recruiting the prospective teachers.* The reviewed documents also revealed a situation whereby individuals who had failed in secondary schools or did not meet the minimum entry qualifications to tertiary education were accepted as candidates to train as science teachers (Ministry of Education and Culture {MOEC}, 2000; 2009; URT, 2001a). Most respondents felt that low grade for recruitment of prospective teachers was compromising the quality of teachers produced and authenticity of their qualifications because most of them did not have requisite knowledge about the subject matter.
3. *Inadequate time for teacher training in both diploma and degree qualification in teaching.* This situation was described by the respondents as not only affecting the competence of the teachers produced but also leads to a failure to recruit and retain high calibre science teachers.
4. *Absence of teacher development programmes for both pre and in-service science teachers.*

Most respondents believed that there was inadequate teacher professional development programmes in which teachers could attend seminars, conferences and workshops during vacations so as to update their knowledge. This situation was described by respondents as leading to limited knowledge of new pedagogical developments in science among teachers;

5. *Poor teacher retention strategies for both pre and in-service science teachers.* A lack of motivation, incentives, and adequate salaries among science has led to the loss of a lot of teachers, who opted to move into other, more lucrative professions. Teachers and science alumni in particular, argued the need to develop effective teacher retention strategies a qualified and competent science workforce so as to solve the science professional shortage, especially in areas where they were of high demand.
6. *Turning the teaching profession into an all-comers' occupation.* Respondents identified this situation as negatively impacting the moral behaviour in teaching, the respect accorded to teaching and the quality of the teaching workforce.
7. *Poor relationship between the Government and teachers.* Teachers felt that the Tanzanian Teachers' Union did not have a good partnership with the Ministry of Education and Vocation Training. It was evident from science alumni and parents that the government, through the MoEVT, had been in conflict with teachers regarding their working conditions. This conflict has not only created fear among teachers about the viability of their livelihoods but also contributed to limiting the number of students who could study to become teachers. This in turn leads to a shortage of science graduates and subsequently to shortages of science teachers.

Looking at all these teacher related challenges, it appears that there is an urgent need for solutions. Burke, Schuck, Aubusson, Buchanan, Louviere, and Prescott, (2013) argued that teacher related challenges including abandonment, underpayment, and poor care need to be addressed as they are likely to contribute towards closing down the teachers' motivation to stay in the teaching profession.

Adequacy of pedagogical approaches among teachers

Pedagogical competence among teachers was described by most respondents as being determined by a number of factors including; subject matter

knowledge, classroom management techniques, class size, and the culture. A consistent response from students and science alumni was that a limited range of pedagogical strategies were used and that mostly the science pedagogical approaches were teacher-directed. As a result of this, students appeared to assume the role of passive learners with limited power to select and use the effective learning strategies to manage their own learning. The findings also revealed a number of other pedagogical challenges including:

1. Limited teaching approaches to encourage problem solving;
2. Inadequate instructional time and lack of remedial classes to help students with learning difficulties;
3. Failure of teachers to acknowledge students' socio-cultural backgrounds, a condition which had further contributed to student disconnection from science learning.
4. Dominance of passive and static methods of teaching whose impact limit the learner, cutting them off from connecting to what they learn with their own experiences, creating an environment where there is little interaction between the teacher, the subject matter, and the students, and forcing teachers to cover an overcrowded science curriculum within a specified timeframe to ensure that students are prepared for the norm-referenced assessments.

Despite the developments in global science pedagogy, the practices outlined by the Tanzanian science syllabi indicated the dominance of traditional teacher centred lecture methods, chalk-and-talk, and the giving of instructions for learners to follow. According to Hashweh (2013) traditional methods of teaching usually promote recalling factual information rather than developing skills, transforms teachers to being the main sources of knowledge while students assuming a passive role, reproducing knowledge gained through memorisation.

Such a traditional pedagogical outlook also indicated the dominance of what Freire (2000) called the banking approach to education. The pedagogical inadequacy among teachers presents a need to refocus science teaching and teachers' development practices. It also appears that the quality teacher concepts need to be redefined beyond mere possession of the minimum acceptable teaching qualification. While Okeke (2004) considers a focus on skill and professional development as being important in today's teachers, it is also important to

consider what it takes to produce good, committed, qualified and experienced science teachers. This view is similar to opinions by Hashweh (2013) and Burke, Schuck, Aubusson, Buchanan, Louviere, and Prescott (2013), who argue that good competent teachers would require a huge capital investment in helping teachers reveal and build upon their current cognitive schemas, as well as providing opportunities to construct their own understanding of concepts through events that challenge preconceived ideas and their pedagogical competencies.

Fluency on the language of instruction (LOI)

The command of English (as a Language of Instruction) for both teachers and students was identified by most respondents as an important component of quality SE. Respondents with the notable exception of parents, felt that using the English language as a medium of instruction was another impediment to the provision of quality learning of science in Tanzania. For example, one science alumni noted that "*both students and teachers were struggling to make sense of the subject matter because of their poor proficiencies in using English as a language of instruction*". Contrary to the comments by most parents who viewed English as an important indicator for quality SE, students complained that using English as a medium of instruction for science contributed to their failure to comprehend what was written or taught and, consequently leaving them with no option besides resorting to memorisation. Similar to later view parents said that "the use of English language as a medium of instruction was not only limiting students' ability to easily understand the science subject matter but also contributed to the alienation of students from their own Tanzanian languages.

The general analysis of the findings about the language of instruction showed that poor understanding of English among teachers and students had resulted in a number of negative impacts in schools. These included:

1. Limiting most science classrooms sessions to providing exercises and teachers explaining the fixed body of knowledge to students;
2. Insensitivity to a sociolinguistic reality in Tanzania, whereby more than 120 tribal languages are spoken by students as their first languages. Consequently, students are alienated from their own language;
3. Banning the use of the Swahili language at all levels of secondary education, a practice which leads to denial of an opportunity for learners to

competently interact with and benefit from the science content using the language they are conversant with, and failure to support learners in (who are non-English language learners) understanding of what is being taught in the science classrooms.

According to Osaki (2005) the use of English as a language of instruction in SE has for a long time frustrated students in their learning and knowledge acquisition. The findings in this study are also aligned with those of Maddock (1981), Qorro (2006), and Vuzo (2005) who found that the use of English as a language of instruction in the countries whereby English is a second and/or third language, not only frustrates the efforts of educators and researchers to improve the delivery of quality education but also has led to most learners failing to comprehend what is written or taught. According Roy-Campbell and Qorro (1997), the use of a foreign language as the language of instruction (English in this case) sometimes leads to a point where instead of producing critical thinkers, well-prepared learners, and a capable future workforce, it leads to a generation of graduates who have spent countless hours memorising words and phrases which they neither understood nor could apply. As an important factor for provision of quality education, the issue of teachers' and students' fluency and competence in the language of instruction has no alternative- it needs to be readdressed.

Relevancy of science content

Most respondents felt that there was a lack of relevance of the science content in Tanzanian JSS textbooks, a situation which was described by science alumni, students, and parents as limiting the quality of learning science and developing interest in the subject. Of concern was the tendency to use books and other learning materials in Tanzanian JSS that were culturally intended for schools in Europe and North America.

The analysis of curriculum materials also revealed that science concepts and nature of content that had to be learned by students were overwhelmingly prescriptive, abstract, and irrelevant to learners' daily lives. Most of the science content was not described by teachers as being tied together strongly by bigger unifying ideas or concepts. This problem was identified as being common across all science subjects' syllabi. The other notable limiting situations about science content in the Tanzanian curriculum materials include:

1. Over-emphasis of the theoretical aspects of science with its content being packaged and presented to students in ways that are not underpinned by learning theory and do not take into account the students' ages, interests and abilities.
2. The applications of science content were consistently presented as examples and not as the essence of the science learning itself
3. Limiting the science learning towards acquisition of science ideas than developing the link of science with the students' everyday situations.
4. The use of culturally inappropriate and un-contextualised science textbooks and other learning resources offered by the western publishers which have little consideration of the local science, contextual challenges and needs.

The problems related to the science content not only seem to make science as an alien subject, but also appear to limit learners from connecting science to their daily lives. This situation presents a need for reorganization of science content to make it relevant to learners' daily lives. Hashweh (2013) and Kalolo and Kafanabo (2012) insist that it is important to have a relevant science content as a necessary prerequisite for providing a strong base for informed decision making, enhancing interest in science careers, developing science interest and a desire to stay longer in science careers.

Students learning characteristics

Most respondents mentioned that students' learning characteristics were one of the important factors in the provision of quality SE. The students' learning characteristics were identified as including: students' willingness to learn, SE background knowledge, proficiency in the instructional language, motivation, family stress, interest in the subjects, perseverance with the challenges specific to science learning, desire to gain new knowledge or achieve new competencies, and the attitudes towards science studies.

The teachers' questionnaire also showed broad agreement that the Tanzanian students' characteristics had a lot to contribute in the failure to provide quality SE. Some of the mentioned negative student characteristics included:

1. Increasing loss of interest towards science studies among learners who are showing an apathetic attitude towards science, with preferences to forgo science after secondary school education for other lucrative subjects, for example, accounting, political science, or law.

2. Persistent dependency on teachers rather than developing an independent learning (owning their own learning).
3. Lack of self-enthusiasm to learn.

The prevalence of these negative students' characteristics appear to interfere the students' hope to continue with science as their future careers. As such there is a need to address such areas. The studies by Fletcher (2003), Kalolo and Kafanabo (2012), and the OECD-GSF (2006) insist that the students' learning characteristics play a significant role in providing quality SE in schools. According to Dawson (2000) the students' characteristics in SE can be maximized if SE experiences are connected to the students' lives, a situation which also is likely to enable them to see the relevance of what they are learning and perceive science as something they encounter in their everyday activities at school or at home. It appears that students' loss of interest and engagement in science requires immediate attention if the science workforce gap in the near future is to be addressed. In sum, for learners to develop interest, willingness, and active engagement in the learning process in science, there is a need for all internal and external students' characteristics to be positively operating.

Effectiveness of assessment procedures

Most respondents identified that the provision of quality of education was highly dependent on the ability of assessment procedures to measure and guide the school practice towards excellent educational achievements. While considerable initiatives had been undertaken to improve assessment procedures in Tanzanian SE, the respondents felt that there was little effort invested in developing authentic, reliable, valid, fair, dependable, and engaging assessment procedures. Respondents were in agreement that assessment procedures were still harbouring a number of problems including:

1. Disconnectedness of assessment practices from curricula demands, learning needs, and expectations, the situation which appeared to contribute in the failure of the assessment procedure to serve as stepping stones to higher levels of education.
2. Emergence of high-stakes assessment needs. This situation presents three major impacts: Reducing examinations to completely paper-pencil tests; reducing teachers into administrators of high-stakes testing of pupils'

achievements and gains; reducing schools to education centres which instead of performing the role of being centres for knowledge and skill acquisition, they are behaving as centres that train students to pass examinations; and reducing teacher autonomy over their students' expectations and achievements in learning.

3. Emergence of examination guided modes of teaching. This mode of teaching places more weight on teaching knowledge (content, facts, and principles) that is likely to be asked in final exams. As a result, the learning process has been fragmented and reduced into a process of memorising chunks of facts that leads teachers into pedagogies that emphasise rote learning.
4. Invalidity of assessment tools, visible in the tendency of national science examinations to measure what students have never learned. This results in a failure to adequately measure a full range of students' competencies, skills, knowledge and attitudes.

The prevalence of these problems appears to contribute in making science studies as undesirable courses of study, a situation which presents a need to address all assessment related problems. This aspiration appears to be important in that, the provision of quality SE in schools cannot produce positive impacts if SE processes are not effectively evaluated and monitored. According to Fensham and Rennie (2013) and Uwezo (2010), ineffective assessment procedures have a major negative impact on student learning as they are deemed to promote inadequate student learning, a reduced interest in science, and increased dropouts in science options in schools, the production of incompetent graduates, and a general failure to meet the learning desires of most learners.

Administrative efficiency of education sector

Educational efficiency was identified by most respondents as being an outcome of good and efficient administration within the education sector. Despite such relationship between education and administrative efficiencies most respondents believed that Tanzanian education was being dominated by organised interest groups, such as corrupt education bureaucracies with parents, individual teachers, and students being excluded from most of discussions about their schools' outcomes. The respondents expressed their concern about the limited involvement of education's stakeholders decision-making, and felt that educational decision making was being made by those who masqueraded themselves as advocates for

the well-being of learners when in fact they are not different from those who put self – interest before quality SE.

The educational administrative reports also revealed a problem of limited distribution of authority within the education policymaking sector, which appeared to be composed of only few ministry officials who were exceptional in that they had a final say in all matters relating to advocating what to teach and learn and how to do it (MoEVT, 2009).

Another noteworthy problem was related to the centralized type educational administration and management. The studies by Komba and Nkumbi (2008), MOEC (2009), and Ngimbudzi (2009) argue that centralized power in education leaves the power in hands of a few individuals, a situation which is potentially contrary to the ambition of improving the power relations among educational stakeholders, opening access, and thus ensuring quality SE attuned to stakeholder needs. While acknowledging that it is important to have a co-ordinating team for education matters, it also appears to be essential to have all stakeholders involved in education issues and decisions. Improvements could be made by closely monitoring SE progress, avoidance of interferences by individuals and interests groups, and empowering all key SE stakeholders to have a say on matters related to the education provided.

Effectiveness of collaborative patterns in education

Most respondents identified that collaborative patterns in education were necessary prerequisites and powerful aspects for resolving quality issues emanating from the day-to-day administration of educational institutions. In the context of this study most respondents felt that schools were hampered by ineffectual educational managers and leaders. In a similar line of view, one teacher said that “schools need educational leaders and managers who have the ability to nurture promising practices in learning, and the ability to live up to the expectations of the stakeholders about quality SE”. A common view among most respondents was that schools were staffed with leaders and managers without a vision for improving science learning experiences in their schools. Science alumni and parents felt this was contributing to the slowing down of the efforts to provide quality SE in schools.

Another noteworthy problem was a lack of communication between various groups in education. For example; the disconnectedness between science teachers and teachers of other disciplines within a

school, disconnect between the MoEVT departments, and between schools and parents. Most respondents felt that the decision-making was in the hands of a small minority, and that the majority of stakeholders were the silenced group. In their view, it appeared that a top down approach dominated the SE administration, a practice which they attributed to be responsible for a decrease in accountability, ownership and fulfilment of responsibility in education.

With changing needs in Tanzanian education and the increasing number of schools, the respondents have arguably identified the need to have effective educational collaborations for effective, timely and rapid improvements and transformations in SE. Similar to the later view, Marion and Gonzales (2013), Smith and Piele (1989), emphasise the need for effective collaboration to ensure communication among diverse groups, and to encourage broader input, and sharing of power in decision making. In a similar tune Bybee and Fuchs (2006), and Bybee (2010) argue that effective collaborative patterns are essential because they bring educational leaders, managers and other stakeholders together in a forum of openness, communication and increased trust and accountability. This ambition is similar to encouraging a collective initiative with a focus on sense making and sense giving on issues related to education rather than dictating what others should do.

Effectiveness of government support

Government support in terms of funding and its willingness to invest in SE was considered by most respondents as being the heart for providing quality SE in schools. Despite the obvious necessity for the government to support SE programs in schools, the respondents felt that there was a lack of government commitment, negligence and unwillingness, toward developing quality SE in schools. One head of school said that

the funding for improving SE in schools was inadequate, unreliable, and insufficient and the commitment was mediocre, a situation which appeared to not only create inadequate and weak foundations for the SE system but also limiting the number of wishing to pursue science related subjects as their future careers.

Though the documents reviewed showed that the budget allocated for education sector in Tanzania has almost tripled over the last fourteen years from 15.3% of total budget in 1995/96, to 20% in 2013/14 placing it among the highest budgetary

allocations in sub-Saharan Africa (URT, 2013b); the heads of schools and science alumni identified that though there has been an increase in budgetary allocation in education, very little has been specifically allocated for the development of SE. For them such an increase has brought no change in the quality of SE in schools apart from increasing enrolments. As such it would have been expected that if schools only needed more money to improve, then with an increase in budgetary spending, students' achievements would have improved and the improvement which has never been realized.

It appears necessary that without stronger management of funds, and concerted efforts for making sure that such funds are effectively utilised and monitored, there is no reason to think that the next increase in budgetary allocation in education will improve the situation in schools. The report by hakielimu (2007) identifies that it is not enough to increase funds for improvement of quality education in schools without making concerted efforts to make sure that such funds are properly monitored and channelled into procuring the desired outcomes of quality education in schools.

Above all the studies by Hamilton, Mahera, Mateng'e and Machumu, (2010) and Hakielimu (2007) insist on the importance for the government to provide adequate support in terms of funding and making sure that there is a stronger management of funds to produce the expected educational outcomes. The failure to adequately fund the SE system seems to have a direct impact on its foundation and the country's vision to train future scientists. Given the need for funding and monitoring the funds to produce the expected educational outcomes; Rajani and Sumra (2003) consider important that though money is important, it is not everything in guaranteeing the provision of functional SE in schools, partly because the notable increasing number of schools and students in Tanzanian secondary schools can inevitably put a greater strain on the funding provided. As such it appears necessary to establish a realistic financial framework that would help in guiding all educational investments to focus only on those inputs that are likely to have a strong positive impact on learning.

Community support for students' learning

Most respondents identified that despite being obvious that improving quality SE in schools is the joint responsibility between the government and the community through effective partnership, there was a lack of involvement of the community in educational

matters. For example one parent mentioned that "*most of us parents are not involved in in the schools' programs apart from being notified about our responsibility to pay the school fees for our children*".

Science alumni and teachers felt that there was also a problem with home supervision and the lack of parental input in students' learning. In one hand most teachers revealed a practice whereby most parents had abandoned their primary responsibilities of raising their children in the way they would want them to be, by entrusting such vital responsibilities to the school. The parents on the other hand believed that they had to earn and support their families and in so doing the responsibility of their children's education was entirely left in the hands of the schools just because they had paid the school fees.

Most respondents identified that the school-community partnerships and parental involvement in students' education poorly existed in Tanzania JSS. Consequently, it appeared that schools were forced into putting in more efforts to manage the students' behaviour at the expense of quality education. With such poor partnership between schools and the community, the planning and implementation of school SE projects remain to be a major challenge. This view is supported in the studies by UNICEF (2000) and Uwezo, (2010) which argue that parental care for children and home supervision for their learning has become an issue in most homes. As such, Clark (1983) identifies the importance of community-school partnership and parental involvement in children's education because having such relationships in place creates the possibility of enhancing the children's cognitive development and performance.

Effectiveness of educational policy

Most of respondents were in agreement on the idea that the effectiveness of educational policies in education requires good alignment with educational targets. It appears necessary that education policies need to be clear and the development processes highly driven by science and technological inventions based on such policies. Despite of such necessity one science alumni said that "*the Tanzanian education policy in practice is highly ineffective in a sense that its objectives have not been realized for seventeen years since its inception*". Similar to this view, most respondents identified that there was a failure of the policy to support the delivery of quality SE in schools. This failure was attributed as being an outcome of the following factors:

- Absence of political will and focused improvement of SE,
- Unrealistic and often confusing goals surrounded by political motives,
- Fragmentation in implementing policy recommendations, and inadequate funding.
- The celebration of the “Bora Elimu” slogan (Just Education) rather than “Elimu Bora” (Quality Education);
- Too much focus on quantitative rather than qualitative aspects of SE;
- The failure to create an avenue for all key education stakeholders to participate in education matters;
- The visions and focus of SE being not developed from common beliefs and values of the public for the sake of connecting SE to the public daily lives, a situation which creates disharmony of interests with all involved in the process of implementation, and inefficient and ineffective evaluative processes of the policy in practice.

In spite of several national SE programmes, and structural reforms launched at different times, most respondents identified that promised positive impacts had not occurred. This situation showed to have contributed in raising some concerns among respondents who appeared to start questioning the authenticity of the educational policy in practice by searching for reasons why their educational system had not been successful in answering the existing educational challenges.

Similar to the findings the literature identifies that the politicising of educational policy is one of the reason behind the failure of most science education systems including Tanzania, both in realising appropriate educational outcomes, and the failure to successfully translate educational objectives into expected educational outcomes (Fensham, 2008; Weaver, 2011). Either two major policy challenges are identified to be harmful in realizing the desire to provide quality SE in Tanzania. These include the attainability and clarity of policy goals. Fensham (2009), Hamilton, et al (2010) and OECD-GSF report (2006) contend that in realising the desired educational targets, it is important to closely scrutinize the policy statements and declarations to ensure a clear and shared focus where everybody understands the goals to be attained and the roles to play in achieving such visions.

CONCLUSION

The preceding discussion has shown that in the stakeholders’ views, a large number of factors impede the provision of quality SE in Tanzania. At the strategic level, there is the lack of government support in terms of funding and resources, and present SE policies are ineffective. Further, the language of instruction and learning is problematic, and the mandated curriculum is irrelevant and unresponsive to the students learning needs and future aspirations.

At a local level, community support for schooling is less than adequate. At a school level, there are both teacher and teaching issues and student and learning issues. Too fewer science teachers are available for the task required, and those who are teaching are underpaid, often poorly trained, and using ineffective pedagogical approaches. School management and leadership, assessment procedures, and examination focused teaching create their own challenges. Students are struggling with language proficiency, a situation which appears lead towards students being not interested in what current SE offers.

As noted in this study the challenges of providing quality SE in Tanzanian JSS are mainly context-specific. This situation suggests that the solutions that are likely to help in improving the quality of SE have to come from within the local context. While the need for developing quality SE in schools demands urgent action, the efforts to achieve such an ambition require a rigorously holistic re-orientation; re-polishing, re-engineering and rebranding of the SE sector. This initiative would include a reflective way of assessing the reasons for failures to:

1. Develop necessary science knowledge and skills among learners for a future career in the field.
2. Prepare students either for careers in science or as citizens who can confidently engage with science related issues.

Barriers to quality SE are many. Partnerships among stakeholders need to be strengthened. Resources need to be gathered, and scientists, practitioners, policymakers, decision-makers and all stakeholders need to work collaboratively to find solutions to the challenges presented in this study. Looking together, in the same direction, and pulling together too appears to be the way forward for improving the provision of quality SE in Tanzanian JSS.

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