Mathematics teachers’ perceptions and implementation levels of STEM education in their classrooms: A case study of eleven secondary schools in Gweru District, Zimbabwe

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Abstract

The Government of Zimbabwe has recently pledged to fully fund the education of “O” Level graduates who choose to study science, technology, engineering and mathematics (STEM)-related subjects at “A” Level in public schools. Students can register for three or more subjects that include Mathematics, Biology, Chemistry and Physics. This is so because the government considers that if students are educated in these STEM subjects they may become critical thinkers and innovators who are able to produce goods and services that transform and sustain the economy. This study sought to provide answers to the following two questions; First, how do secondary school mathematics teachers perceive the idea of STEM education? Second, to what extent do they implement STEM education in their classrooms? This was done through a case study of eleven purposely selected secondary schools within a cluster in Gweru District, Zimbabwe. A structured questionnaire with some open ended questions was administered to 44 secondary school mathematics teachers comprising at least three from each of the selected schools. Thirty-four teachers returned the questionnaires. Data were analysed both quantitatively by calculating teachers’ STEM education perception levels and implementation levels and qualitatively by finding emerging trends and themes from their responses to open-ended questions. It was found that the secondary mathematics teachers in the selected schools in Gweru had neutral to negative perceptions or beliefs towards STEM, that they rated themselves low on STEM education implementation and said they did not know how to implement STEM education in their classrooms. It is recommended that STEM workshops for mathematics teachers be carried out and that teachers and students should perceive STEM education positively and implement it with an aim of bringing scientific and technological changes that improve the economy of Zimbabwe. The government should craft out a STEM education policy. The findings of the study are critical as they may assist STEM-teachers and mathematics educators on how to indigenise and ‘STEMITISE’ the Zimbabwe secondary school mathematics curriculum.

Keywords: Teachers’ perceptions, implementation level, STEM education, mathematics classrooms, scientific and technological change, ZimAsset.

Introduction

According to a parliamentary speech issued by the Zimbabwe Minister of Higher and Tertiary Education, Science and Technology Development, Hon. Prof. J.N. Moyo on 23 February 2016 (Parliament of Zimbabwe, 2016), the science, technology, engineering and mathematics (STEM) “initiative seeks to encourage ‘O’ Level school leavers who took their ‘O’ Level examinations in 2015 and
obtained Grade C or better in Mathematics, Biology, Physics and Chemistry to take a combination of these STEM subjects at ‘A’ Level or lower six in 2016. Where the 2015 ‘O’ Level school leavers register for a full combination of these STEM subjects, the Ministry will pay tuition fees, levies and boarding fees at Government, Mission and Council schools.” This is so because the government considers that if students are educated in these STEM subjects they may become critical thinkers and innovators who are able to produce goods and services that transform and sustain the economy. In this regard the government of Zimbabwe is committed to indigenise and STEMITISE the Zimbabwe secondary school mathematics curriculum. This is also in line with the Nziramasanga Commission (1999, pp. 347-348)’s recommendations that “…indigenous mathematical terms should be developed for use throughout the school system, …mathematics, science and technology should be strengthened by exposing pupils/students to situations in commerce and industry where they can observe and participate in their applicability, …a concerted effort should be made to put stimulating learning mathematics materials and qualified [and dedicated, innovative and industrious] teachers in disadvantaged areas.”

This study considers STEM education to be the simultaneous teaching and learning of all the STEM subjects and not just one of them during a session as has been the practice. STEM education implementation could involve written work, practical work, oral work, observation and field work. Challenges, however, could arise on the logistics and resources needed to implement STEM education and these could be addressed by the education authorities. What is of paramount importance is that learners and teachers need to move away from the ‘fixed mindset’ to the ‘growth mindset’ (Yu, Frempong and Winnaar, 2015) if they are determined to achieve new innovations. It would be interesting to investigate Zimbabwe secondary school mathematics teachers’ perceptions or dispositions towards STEM and how and to what extent they are implementing STEM education in their classrooms in line with the government’s ZimAsset initiative (Government of Zimbabwe, 2013).

Theoretical Framework

This study is guided by the change strategies theory (Henderson, Beach and Finkelstein, 2011 as cited in Borrego and Henderson, 2014). Agents of change may be teachers, educators, education authorities, policy makers or researchers. According to Borrego and Henderson (2014), the four categories of change were developed by Henderson, Beach and Finkelstein (2011) and these are (a) Disseminating: Curriculum and pedagogy- (where the change agent’s role is to tell/teach individuals about new teaching conceptions and/or practices and encourage their use), (b) Developing: Reflective teachers- (where the change agent’s role is to encourage/support individuals to develop new teaching conceptions and/or practices), (c) Enacting: Policy- (where the change agent’s role is to enact new environmental features that require/encourage new teaching conceptions and/or practices), and (d) Developing: Shared vision- (where the change agent’s role is to empower/support stakeholders to collectively develop new environmental features that encourage new teaching conceptions and/or practices. In this study teachers’ perceptions about STEM could be taken to fall in categories (b) and (d) while their implementation levels of STEM may fall in categories (a) and (c). Although this model was used to explain theories of change at higher education levels, it was felt that it could also be extrapolated to secondary school level to explain similar issues of change since disseminating curricula, developing reflective
teachers, enacting policy and developing shared vision are important ideas that need to be implemented whether at secondary or higher education levels.

This study may also be hinged on the perspectives of STEM integration and teachers’ perceptions and practices (Wang, Moore, Roehrig and Park, 2011). According to Wang et al. (2011), teachers in different STEM disciplines have different perceptions about STEM integration and that leads to different classroom practices. However, the benefits of STEM integration have been documented and these are making students better problem solvers, innovators, inventors, self-reliant, logical thinkers, and technologically literate (Morrison, 2006). Teachers and students need to be supported to effectively implement STEM education (Stohlmann, Moore and Roehrig, 2012) and when educators and teachers change their practices and perceptions about STEM, positive educational outcomes may be reflected (Honey, Pearson and Schweingruber, 2014).

When supported teachers and students should have positive beliefs and attitudes about STEM and should work diligently in implementing STEM education at various levels. STEM education in schools is intended to prepare future workers with strong scientific, technological and mathematical skills that help to improve the economy of a nation (Ejiwale, 2013). However, Honey, Pearson and Schweingruber (2014) opine that there is lack of an agreed theoretical framework for understanding integrated STEM education. The reason could emanate from researchers’ different understandings of the concept of integration. According to Lantz Jr. (2009) people perceive STEM integration to encompass enquiry-based teaching and learning, problem-based learning, performance-based teaching and learning, digital curriculum and digital teaching technologies or formative or summative assessment with task and non-task specific rubrics. However, Honey, Pearson and Schweingruber (2014, p. 23) say integration, “… may include different combinations of the STEM disciplines, emphasize one discipline more than another, be presented in a formal or informal setting, and involve a range of pedagogical strategies.” What could be the definition of STEM integration in the Zimbabwean context?

**Conceptual Framework**

The conceptual framework or critical questions or ideas guiding this study are how Zimbabwean teachers view STEM, the challenges of implementing STEM education in the classrooms and possible suggestions to overcome the challenges. According to Lantz Jr. (2009), the concept STEM education as a meta-discipline was coined by Morrison (2006) and reinforced by Tsupsos (2009). Moon and Singer (2012) as cited in Gonzalez and Kuenzi (2012, p. 2), say STEM should focus on “an assemblage of practices and processes that transcend disciplinary lines and from which knowledge and learning of a particular kind emerges.” In Zimbabwe STEM subjects are generally believed to be Mathematics, Physics, Chemistry and Biology and these are normally taught as single independent subjects. Most secondary school teachers in Zimbabwe are subject specialists and it might be difficult for them to integrate the STEM subjects during their teaching. Because teachers might not be able to overcome the challenges to successful implementation or integration of STEM within their classrooms, this might cause them to have negative perceptions or dispositions towards STEM.
STEM Situation in Zimbabwe

In Zimbabwe today the agriculture and mining sectors are considered to be the major backbone of the economy underpinning economic growth (Government of Zimbabwe, 2013) and therefore knowledge of STEM subjects can help in the investment in research, science and technology for agricultural and mining development. There is no doubt that Zimbabwe considers STEM disciplines and science and technology skills as key drivers for economic growth as highlighted in the ZimAsset plan (Government of Zimbabwe, 2013). Therefore, according to the Zimbabwe Mail (Wednesday, 27 January 2016) Zimbabwe government has offered to pay for free full fees for students who register for STEM subjects at lower sixth level in public schools in 2016, but Chimuka (2016) says the programme excludes other STEM-related subjects like Computer Science which is important for technological development. In Zimbabwe today, STEM integration normally focuses on the S and M of STEM rather than the ‘S, T, E, and M’ of STEM. This study proposes STEM education and integration to mean the simultaneous teaching and learning of STEM-related subjects with the aim of producing students and future workforce who are innovative, creative, productive, and diligent hard workers. Through these attributes the students and school graduates should be able to develop and sustain the Zimbabwe economy. Gambanga (2016) also says that there is need for resource mobilisation and skills development rather than just enrolling students for free high school education. How will the Government ensure that after the STEM students graduate, there will not be any ‘brain drain’ to greener pastures outside the country? Students and parents need the right attitudes towards STEM while teachers need sufficient resources and knowledge to impart the right attitudes and skills to the students. There is also debate about which ministry should own STEM and at what level STEM should be introduced (The Herald, 29 April 2016). At the moment it appears that there is no policy to guide the Zimbabwe government on the STEM programme.

Statement of the problem

It appears the Government has been in a hurry to fund the education of STEM students without having a STEM policy, without sufficient research evidence of Zimbabwe teachers’ perceptions towards STEM and without capacitating teachers on how to implement STEM. The problem is that the desired outcomes might not be achieved leading to wastage of the country’s financial resources.

Purpose of the study

The purpose of the study was to investigate secondary school mathematics teachers’ perceptions and implementation levels of STEM education in their classrooms. Challenges that these teachers faced were also investigated and findings were aimed at helping to indigenise and STEMITISE the Zimbabwe secondary school mathematics curriculum so that scientific and technological changes could be found to help improve the Zimbabwe economy.

Research questions

1. To what extent do secondary school mathematics teachers perceive the concept of STEM education?
2. What are the secondary school mathematics teachers’ implementation levels of STEM education within their classrooms?

3. What challenges do secondary school mathematics teachers face as they endeavour to implement STEM education within their classrooms?

4. How can these challenges be overcome?

Materials and methods

Research design, sampling and instruments

This study employed a survey research design. In this design, a case study of eleven purposely selected secondary schools within a cluster in Gweru District, Zimbabwe was undertaken. At each school at least four structured questionnaires with some open ended questions were given to the Head of Mathematics Department (HOD Maths) to administer to his/her mathematics teachers. The HOD Maths was requested to first of all give at least two questionnaires to his/her ‘O’ and ‘A’ Level teachers and the remainder to other mathematics teachers at the school. If needed extra copies of the questionnaires could be made. The questionnaire had three sections of which Section A had six questions asking for biographical data, Section B had six structured and open-ended questions asking for teachers’ perceptions about STEM and Section C had seven structured and open-ended questions asking for teachers’ implementation levels of STEM education within their mathematics classrooms. A five-member team involving mathematics teachers and researchers checked the research instrument and were satisfied with its validity and consistency.

Data analysis procedure

The structured questions were of the five-point Likert type with positive responses coded 5 and 4 for SA and A (Strongly Agree, Agree), neutral responses coded 3 for U (Undecided) and negative responses coded 2 and 1 for D and SD (Disagree, Strongly Disagree). For the teachers’ perceptions towards STEM sub-items, total scores ranging from 5 to 12 were taken to indicate negative perceptions, total scores from 13 to 18 were taken to indicate neutral perceptions while total scores from 19 to 25 were taken to indicate positive perceptions. For the mathematics teachers’ implementation levels of STEM education sub-items, total scores ranging from 4 to 10 were taken to indicate low implementation levels, total scores from 11 to 15 were taken to indicate average or moderate implementation levels while total scores from 16 to 20 were taken to indicate high implementation levels. Open-ended items were analysed question by question by noting, counting and categorising similar and different responses on their own. Thus, data were analysed both quantitatively by calculating teachers’ STEM education perception levels and implementation levels and qualitatively by finding emerging trends and themes from their responses to open-ended questions. The mixed methods design was ‘sequential’ where the ‘qualitative’ informed the ‘quantitative.’ (Comber, n.d.)

Results and discussion

A total of forty-four questionnaires were administered, but only 34 were completed and returned resulting in a response rate of 77.3%. This response rate was deemed satisfactory and the data analysis process could commence.
Biographical Data

Table 1: Showing % for the biographical data of the respondents (Questions 1 to 5), n=34

<table>
<thead>
<tr>
<th>Category</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>67.6%</td>
<td>32.4%</td>
</tr>
<tr>
<td>Age in years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below 20yr</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>20-30yr</td>
<td>17.6%</td>
<td></td>
</tr>
<tr>
<td>31-40yr</td>
<td>26.5%</td>
<td></td>
</tr>
<tr>
<td>41-50yr</td>
<td>32.4%</td>
<td></td>
</tr>
<tr>
<td>51-60yr</td>
<td>23.5%</td>
<td></td>
</tr>
<tr>
<td>Above 60yr</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>Highest education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>'O' Level only</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>'A' Level</td>
<td>23.5%</td>
<td></td>
</tr>
<tr>
<td>Diploma/Certificate</td>
<td>23.5%</td>
<td></td>
</tr>
<tr>
<td>Bachelors' degree</td>
<td>61.8%</td>
<td></td>
</tr>
<tr>
<td>Masters' degree</td>
<td>14.7%</td>
<td></td>
</tr>
<tr>
<td>Any other</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>20.6%</td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>52.9%</td>
<td></td>
</tr>
<tr>
<td>Widowed</td>
<td>14.7%</td>
<td></td>
</tr>
<tr>
<td>Divorced</td>
<td>5.9%</td>
<td></td>
</tr>
<tr>
<td>Separated</td>
<td>5.9%</td>
<td></td>
</tr>
<tr>
<td>Level currently teaching</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Form 1</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>Form 2</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>Form 3</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>Form 4</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>Form 5</td>
<td>26.5%</td>
<td></td>
</tr>
<tr>
<td>Form 6</td>
<td>23.5%</td>
<td></td>
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</tbody>
</table>

Table 1 shows that more male than female mathematics teachers responded to the questionnaires. The majority of the teachers (55.9%) had an age range of 41-60 years. Also the majority (61.8%) had a bachelor's degree while the highest academic qualification was a masters' degree (14.7%). Married teachers comprised the majority (52.9%) of the respondents with the minority (5.9%) being divorced and separated. The levels currently being taught were Form 4 (‘O’ Level), Form 5 (Lower Sixth Level) and Form 6 (Upper Sixth or ‘A’ Level). It can be noted that teachers teaching these levels (Form 4-Form 6) were the right ones to respond to the questionnaires since the Government had adopted the idea of financing the education of ‘O’ Level graduates who had chosen to register for science and mathematics subjects at Form 5 Level (and above Form 5 at a later stage).

Question 6 asked about the respondents’ teaching experience in years. Their experiences ranged from 3 to 27 years, the majority having an experience above 12 years and the average experience being 16.8 years. It can be concluded that most of the respondents had sufficient experience, maturity and relevant qualifications in the teaching of mathematics and thus could provide relevant and reliable information.

Teachers’ perceptions about STEM (Questions 7-12)

Table 2 shows that, for Questions 7-11, the majority (73.5%) of teachers had neutral to negative perceptions towards STEM while few (26.5%) had positive perceptions. The average teachers’ perception level was 17. The reason for the larger number of teachers with neutral to negative perceptions could be that STEM is a relatively new concept within the secondary school system and probably few or no teachers have been inducted about STEM. The fact that there were some teachers with positive perceptions could be due to the fact that the general public considers mathematics and science subjects to be more useful and applicable to one’s day to day living than other subjects.

In particular, Question 8 asked the mathematics teachers whether they agreed to having attended a workshop on STEM before. Of the respondents, 58.8% strongly disagreed while 41.2% disagreed. In a study in America, Knezek, Christensen and Tyler-Wood (2015) found out that pre-service
teacher education candidates and middle school students had less positive attitudes towards STEM whilst teachers and educators in STEM-supported programmes had high positive attitudes towards STEM education and STEM careers. Therefore, if teachers and teacher educators are engaged in STEM-supported programmes or workshops, their dispositions, perceptions or attitudes towards STEM might be enhanced and they may be able to build their students’ STEM-beliefs and attitudes and increase students’ knowledge and productivity in the STEM areas. It is up to teacher educators to raise mathematics teachers’ awareness and perceptions about STEM in the Zimbabwean context.

Question 12 asked the respondents to write any comments about their perceptions on STEM. The respondents were of the opinion that most of the students join the STEM programme just because it is free and not for passion, hence students’ commitment levels are low. One teacher lamented thus, “The ministry and government are too ambitious to introduce STEM … they should induct the teachers first and provide the resources.” The majority of the teachers pointed out that they had not been made aware of the concept of STEM and yet students were already enrolled for it. How then would they be able to implement STEM? However, other teachers depicted some positive attitudes towards STEM when they said, “… it is important, it initiates creativity and open-mindedness in children and brings about technological advancement. Children may be innovative and design new technology for use in society.” These teachers, in line with Gambanga (2016), suggested that STEM funding should be extended up to tertiary level and policies to curb brain drain should be put in place. The teachers commented that STEM should include other disciplines such as Agriculture, Mining and Telecommunications. These ideas are in line with Chimuka (2016) who suggested that the Zimbabwe STEM programme should also include Computer Science which is the most important subject for the 21st Century.

The responses mentioned above relating to Question 12 were then grouped into the following themes or main ideas, the percentage of respondents who pointed them out being shown in brackets (): importance of STEM education (29.4%), composition of STEM-related subjects or disciplines (14.7%), attitudes towards STEM (14.7%) and who or what level to be involved in STEM programmes (41.2%). The percentages indicate that ‘who or what level to be involved in STEM programmes’ was considered to be the most critical, followed by ‘the importance of STEM education.’ The themes ‘composition of STEM-related subjects or disciplines’ and ‘attitudes towards STEM’ were viewed similarly (14.7%).

Teachers’ implementation levels of STEM in their classrooms (Questions 13-19)

Table 3 shows that, for Questions 13-16, the majority of teachers (85.3%) had low to moderate implementation levels of STEM education while the minority (14.7%) had high levels. In particular, Question 16 asked the teachers whether they agreed to having attended a workshop on STEM education implementation. They all disagreed. The teachers were then asked to ‘self-rate’ their level of STEM education implementation on

<table>
<thead>
<tr>
<th>Category</th>
<th>Low level</th>
<th>Average/Moderate level</th>
<th>High level</th>
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<tbody>
<tr>
<td>Total score</td>
<td>4-10</td>
<td>11-15</td>
<td>16-20</td>
</tr>
<tr>
<td>Respondents</td>
<td>26.5%</td>
<td>58.8%</td>
<td>14.7%</td>
</tr>
</tbody>
</table>
a scale of 1 to 10 (Question 17) and the average score was 4.3. This also shows that teachers’ STEM education implementation levels were generally low.

The reasons for the low rating could be deduced from the challenges to STEM education implementation that the teachers listed in Question 18. The challenges were grouped into the following themes or main ideas, the percentage of respondents who pointed them out being shown in brackets ():

1. Lack of knowledge about STEM education implementation (8.8%).
2. Lack of resources such as time, textbooks and e-learning materials (41.2%).
3. Negative attitude of teachers and students (23.5%).
4. Concept of STEM not introduced to teachers (8.8%).
5. STEM introduced to weak students (e.g., pass at ‘O’ Level with ‘C’ symbol) making syllabus coverage difficult (17.7%).

For example, one particular teacher echoed:

People are still acclimatised to academic achievement. Some students with weak passes in ‘O’ Level maths are enrolled for ‘A’ Level maths, making it difficult for the teacher to teach STEM to the weak students and thus delaying syllabus coverage.

Ejiwale (2013) views the challenges to successful STEM education implementation as ‘barriers.’

Ejiwale (2013, pp.64-69) lists ten barriers to successful STEM education implementation and these are:

1. Poor preparation and shortage in supply of qualified STEM teachers.
2. Lack of investment in teachers’ professional development.
3. Poor preparation and inspiration of students.
4. Lack of connection with individual learners in a wide variety of ways.
5. Lack of support from the school system.
6. Lack of research collaboration across STEM fields.
7. Poor content preparation.
8. Poor content delivery and method of assessment.
9. Poor condition of laboratory facilities and instructional media.
10. Lack of hands-on training for students.

Respondents in this study pointed out similar barriers related to items 1, 2, 3 and 5 above.

Question 19 asked respondents to comment about STEM education implementation and to suggest the way forward or strategies for improvement. The respondents suggested that mathematics teachers should change teaching approaches to accommodate slow learners in their classrooms, STEM ideas should be marketed to all stakeholders before implementation, and that teachers should be given knowhow pertaining STEM.

One particular teacher said, “People need more education on the subject. Teachers need thorough preparation and should attend workshops for proper implementation.” Another teacher was of the opinion that students in rural areas and girls are not willing to take up science and mathematics subjects because of the belief that they are difficult. Such views pertaining girls and deprived populations were also echoed by Modi, Schoenberg, and Salmond (2012, p.29) who recommended that, “Support and encouragement for STEM interest from adults, including parents, teachers, relatives, and mentors, goes a long way with girls” (including African-American and Hispanic ones) and that these girls can help to change the world through STEM.

Comments and recommendations for Question 19 given by the respondents were grouped into the following themes or main ideas, the percentage of respondents who pointed them out being shown in brackets ():

1. Girls and under-privileged populations not willing to take up STEM (11.8%).
2. Need for mathematics teachers to change teaching approaches through attending workshops (38.2%), marketing STEM ideas to all stakeholders (11.8%), teachers to have positive attitudes towards STEM (11.8%) and ‘No idea’ (26.4%).
Suggestions given by the teachers in this study also agree with those pointed out by North Carolina State Board of Education (2012, p.12) who said:

As the ‘point of the spear’ for STEM education, the state must invest in professional development, tools and certification that allow for teachers and school leaders to master the integrated practices, pedagogy and curriculum to advance the STEM skills, attributes and learning for all students. Whether project-based, problem-based, Socratic, inquiry-based, virtual or other methods, teachers need access to these resources before entering the classroom to meet the demands of STEM education and improve instruction.

To overcome the barriers to successful implementation of STEM education in Zimbabwe, there is need for the Ministry of Primary and Secondary Education and Ministry of Higher and Tertiary Education, Science and Technology Development to craft a STEM Education Policy or Strategic Plan. Within this Strategic Plan an effort should be made to “reform the structure of teacher preparation” (Gonzalez and Kuenzi, 2012). Such a STEM policy might cover areas like gender, under-privileged populations, labour market, teacher quality and assessment techniques (Gonzalez and Kuenzi, 2012), among others.

**Conclusion**

Based on the findings of this study it is concluded that:

1. Secondary mathematics teachers in the selected schools in Gweru have neutral to negative perceptions or beliefs towards STEM,
2. Secondary mathematics teachers in the selected schools in Gweru generally have low implementation levels of STEM education in their classrooms,
3. Secondary mathematics teachers in the selected schools in Gweru have not been inducted (through workshops) on the concept of STEM and STEM education implementation,
4. There is no clear government policy on STEM-related issues, and
5. The study was limited to a cluster of schools in Gweru and therefore the findings cannot be generalized to all secondary mathematics teachers in Zimbabwean schools.

**Recommendations**

The study recommends that:

1. STEM attitudes, beliefs and perceptions of secondary school mathematics teachers in Gweru should be boosted through workshops or in-service training,
2. Secondary school mathematics teachers in Gweru should be assisted on how to implement STEM education within their classrooms,
3. There is need for education authorities and other stakeholders to provide adequate knowledge (through workshops), resources and manpower necessary for implementation of STEM education by teachers and educators at various levels,
4. The Zimbabwe government should come up with a clear policy on STEM education, STEM monitoring and evaluation and related issues, and
5. Since the concept of STEM and related issues are relatively new in Zimbabwe, further research should be carried out.

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