An Investigation of the Science Technology Engineering and Mathematics (STEM) Initiative in the Zimbabwean Education System

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Abstract

Since 2015, the Zimbabwean media both electronic and print is awash with the government's reform in its education system that is inclined on STEM. This is an educational reform process that will be reviewed in 2026. This paper investigates the government's approach in implementing STEM through curriculum reform in ensuring that graduates are entrepreneurs and not job seekers. The study focused on the identification of the essence of human experiences about STEM in the participants' responses in the interviews and questionnaires. Twenty senior university managers and fifty STEM beneficiaries who were post-industrial university students were selected as participants. Subsequent policy statements from the education ministries have refined the direction of reform towards STEM. The results revealed that the industrialization of the economy and creation of employment is possible.

1. Introduction

During the past 27 years of teaching and administration, the researcher was involved with the issues of curriculum policy at both the implementation and the decision-making levels. The researcher's involvement in the development of strategic plans for the United College of Education (UCE) for 2000-2005 and the review of the National University of Science and Technology (NUST)'s strategic plan for the years running 2010-2015 and 2016-2020 in Bulawayo, Zimbabwe influenced this paper. The researcher observed with interest how departments at both institutions broke down education policies for teaching and learning but the products would not reflect the efforts. The majority of the graduates produced each year remain unemployed. The results of interviews to a number of graduates indicated a high rate of unemployment for highly trained graduates [13].

Since 1980, the highest unemployment rate was recorded in 2014 and many workers had been retrenched up to today. The government seemed to have bitten more than it could chew by nursing very high unemployment, the paper claims [7], [11]. One of the causes of high unemployment could be the disparity between education policy innovations and graduates' accessing of the work market. The Atlas of Global Development (2009) and the evaluation of The Industrial Development Policy (2012-2016) compiled by the Ministry of Industry and Commerce in Zimbabwe, discovered the mismatch between education policy and employment opportunities. The launch of this policy was intended to curb the problem of unemployment and strategic plans were formulated to create employment conditions [1], [7], [13].

There arose a need to find out how far the plans have been implemented and also find out what can be added to come up with more helpful interventions to curb unemployment. Stemitizing became one of the initiatives. The foundation of this initiative in the educational reform was anchored on the Nziramasanga Commission, 1999 and the economic blueprint: the Zimbabwe Agenda for Sustainable Socio-Economic Transformation (ZIMASSET) which triggered the current drive to reform and rationalize the education system. The government of Zimbabwe's thrust through STEM subjects was to industrialize the economy and create the much needed employment in line with ZIMASSET. STEM skills were envisaged to empower the young graduates through the promotion of science and innovation [7], [11].

2. Objectives

The overall purpose of the research was to investigate the initiative of STEM in the Zimbabwean education institutions and to come up with recommendations that would assist in optimising the opportunities, strengthen and improve on the learning outcomes. An attempt would be made to solve or minimise threats. The objectives were summed up as follows:

(i) A description of an understanding of the STEM initiative and explanation of its purpose.

(ii) An explanation of why the government took a move into the STEM direction.
(iii) Giving an outline of the outreach programmes of increasing the STEM students.
(iv) Identifying the strengths, weaknesses, opportunities and threats (SWOT) of STEM.

3. Materials and Methods

3.1. Methodology

The paradigm chosen for this study was a philosophical qualitative interpretive approach of the discussion on the STEM initiative whose results were anticipated in the industrialization of the economy and creation of employment. The interpretive qualitative approach involved analysing and understanding and "view(s) human beings as a subject of knowledge principally capable of reflection, (potential) rationality, discursive communication, and social interaction" [6]. The approach was determined by the researcher's interpretations, respect and loyalty in relation to the real life. It had a phenomenological focus on describing how life was experienced firsthand by twenty senior university managers and fifty STEM beneficiaries who were post-industrial university students that were selected as participants.

3.2. Instrumentation

Data was generated using semi-structured individual interviews and a questionnaire. The questionnaire had both open and closed ended questions in order to collect specific information and to allow participants to express themselves freely. During the interviewing process the participants were asked for more clarity and detail in order for the researcher to achieve a comprehensive understanding of their views on the STEM initiative. The targeted participants were sampled through a purposive sampling procedure. Purposive sampling represented participants who were known or judged to be good sources of information and were specifically sought out and selected for the sample (Burns & Grove, 2005). Twenty senior university managers and fifty STEM beneficiaries who were post-industrial university students were selected as participants. They were selected from three major universities: NUST in Bulawayo, Midlands State University (MSU) in Gweru and University of Zimbabwe (UZ) in Harare and industries in those three cities. The three cities were the most productive and had more industries. The major universities were the first to be established in these cities in Zimbabwe.

4. Ethical Considerations

The participants signed consent forms to show that they agreed to participate on the basis of confidentiality and anonymity. They were fully informed of the purpose of the research. The questionnaire was totally anonymous and voluntary and the participants were assured that it was used sorely for the purposes of the research. They were told that they would end the interview at any time they wanted to and that the information they provided would be treated in the strictest confidence. Their names would not be written on the form or mentioned in the research report, and would never be used in connection with any of the information given against their wish. Their information would help in providing evidence and further generation of knowledge and understanding of the new STEM initiative in Zimbabwe. The purpose of the initiative was to enable students gain the knowledge and skills they need to compete in the global marketplace and help in establishing sustainable innovations for the industries and for sustainable socio-economic transformation in the country.

5. Data Collection and Analysis

Interviews were transcribed and data analysed with comparisons and rigorous discussions. Descriptive analyses and mostly thematic content analysis were used in the analysis based on the findings. Thematic content consists of analysis identifying, analysing and reporting patterns within data and organises and describes data in a detailed manner [2]. The key issues in the responses were based on the voicing of opinions and participants to provide feedback concerning STEM as an initiative of the government to curb unemployment and for industrialisation. The media also helped revolutionized the promotion of STEM careers in response to ZIMASSET's human capital objectives. Out of the twenty senior university managers interviewed, 10 were males and 10 were females.

Table 1. Qualifications of Participants

Qualification	Number
PhD	15
Masters Degree (Including PhD Candidates)	5
Post Industrial Attachment students	50

Out of the fifty STEM beneficiaries who were post-industrial university students, 25 were males and 25 were females. The purpose was to have a

gender balance and gender perspective and also ensured that every manager and student had an equal chance of being selected.

Table 1 shows that 15 participants were PhD holders and 5 of them had Masters Degrees and the two categories were the university leaders. The 50 students had just returned from their industrial attachment in order to complete their last year of study at the universities.

Table 2. Outline of University Programmes

Programme	Number
Science	15
Technology	13
Engineering	12
Mathematics	10

Table 2 shows that the 50 students who were participants belonged to the 4 STEM programmes.

6. Results

The results are arranged into four distinctive sections based on the objectives of the study.

6.1. Understanding of STEM and its Purpose

Regarding the question that elicited the participants' understanding of STEM and its purpose, the general responses from all male and female participants showed that there was a perception that STEM was a good initiative and they all agreed on the following three observations:

(i) STEM was an acronym understood to mean *Science Technology Engineering and Mathematics* and the description of subjects, courses and programmes varied from school, college and university levels. Science subjects were studied in the school system including Biology, Chemistry, Computer Science, Mathematics, Physics and Food Science; Technology involved Wood Technology, Metal work, Technical Drawing, Building Technology; Engineering was not taught in schools per se but was found in Mathematics and Science subjects and embedded in college and university courses and programmes. Mathematics was taught in schools up to university level.

(ii) STEM is not new but it had been in the traditional system but it becomes a new initiative in the sense of being a new paradigm shift and focus in what Parawira [2016, page 1] calls integrated manner interdisciplinary and applied approach". The purpose was to show students how the skills and concepts of STEM could be used in problem solving and to help them have hands on experience and apply knowledge to work and life after school.

(iii) The expectation of the progression of STEM was agreed upon by all respondents to be from start to finish in the schooling years of any individual. It should be from infant and preschool education, to primary school where basic sciences match the concepts taught since the grounding was required at an early age. STEM concepts should be introduced in the curriculum. STEM should then progress to secondary schools, technical and vocational colleges and universities. The initiative would help close the gap between the products of education and training and the industry where there appears to be a mismatch of the two and there is a record of high unemployment. It would then take strides in curbing unemployment and improve the industrialization process since the graduates would be expected to have acquired innovations that provide practical solutions to problems [5].

6.2. The Need for the Move of STEM

In response to the question why there was a need for the move of STEM, the respondents alluded to the fact that the move for STEM was an initiative as a result of the recorded data collected in 2015: Mathematics was one of the lowest pass rates in the country with only 29,891 passing it out of a total of 114,236 that sat for the exam; A few students took up some key STEM subjects such as Physics and Chemistry. The same trend was noticeable in general for all STEM subjects (except Mathematics and Geography); In general, more students sat for art and commercial subjects like History, Religious Studies, Literature, Accounts and Commerce than do STEM subjects; Those huge disparities meant that even though the Physics and Chemistry pass rates seemed higher – 86% and 58% respectively – than the English Language pass rate of just 27%, the comparison did not tell the full story.

Very few students took up Physics and Chemistry, and are star students who are generally expected to pass the subjects. On the other hand, every student, whether they are good at it or not, were required to sit for the English exam; The STEM subject that had the most students sitting was Geography [17]. Preliminary results from this study show that the industrialization of the economy and creation of employment is possible in a stemitized education system.

6.3. Outreach Programme to Increase the Number of STEM Students

The objective of the multimedia outreach programme was hoped to increase the number of STEM students who will enroll in STEM degree programmes at the country's universities in 2018. There is an increased uptake by students for STEM degree programmes at the country's universities. The media has revolutionized the promotion of STEM careers in response to ZIMASSET's human capital objectives. There is great potential in government to continue creating STEM skills that are critically needed for the country's new industrialization thrust and the focus of the Ministry of Higher and Tertiary Education, Science and Technology Development (MHTESTD) to becoming the anchor in addressing issues of unemployment in the country, through empowerment of young people in the promotion of science and innovation. These results provide some information that helps us see where more effort is needed in ensuring that Zimbabwe produces more STEM graduates at college and university level. The aim is to inculcate the interest or just the number of people that take up STEM careers.

6.4. SWOT Analysis

The responses to the SWOT analysis of Stem from all participants revealed the following:

(i) Strengths and Opportunities

The programme to fees for 'A' Level STEM students came as a big relief to parents and guardians of the beneficiaries. The move was a great motivator for qualifying students and also for the lower levels of students from Form 4 to below as they would aspire to do well in the STEM subjects in order to benefit in future. The initiative also helped in erasing and/or minimizing negative attitude towards the Mathematics and Science subjects in particular.

(ii) Weaknesses and threats

There had been numerous reports of the serious shortages of physical, financial and human resources in implementing the initiative to teach and train in STEM. There were still elements of the negative attitudes towards the Mathematics and Science subjects and some students although capable would not enroll in the STEM subjects and programmes. Most of them when asked why that kind of reaction, they ascribe it to the issue of unemployment where the local job market still would not absorb the numerous previous STEM graduates. There were fewer schools that offered STEM subjects and the issue of points at 'A' Level still paralyzed the initiative in the sense that some universities still demanded high points for STEM programmes.

7. Discussion

The discussion mainly focused on issues surrounding STEM and the departure from the Arts and Humanities which have traditionally played a role in training of the mind. The discussions on STEM subjects which have strategic economic importance and are a key result area of the MHTESTD. The discussions emphasized priority areas where students taking up STEM subjects at Advanced Level and STEM courses at university level should be afforded free education by the government. However, the Zimbabwe Manpower Development Fund (ZIMDEF) is financing the STEM initiative. The programme is hoped to address the issues of unemployment and will also empower young people through the promotion of science and innovation. STEM is an education grouping used throughout the world. It benefitted the students in the United States and Australia where young adults are equipped with the necessary skills for the economy of the future.

In as much as the STEM programme is a good initiative some stakeholders in the education sector have expressed mixed feelings over the programme. Education experts say that the programme is very noble and is a step in the right direction but emphasize that the programme must contribute meaningfully to the current situation, be relevant to current circumstances and be an initiative that seeks to emphasize the importance of practical subjects. The programme came at a time when the nation was on a mission to achieve economic recovery. The researcher feels privileged to be researching on a similar topic in order to make contributions to the development of the country. The idea in theory is very good but falls short when it comes to practice. The argument is that the responsible authorities did not make enough consultations. There was need for the responsible authorities to consult the stakeholders, for example, students, parents and teachers [4]. The gap between the researcher, stakeholders and the government needs to be dealt with by consulting and involving as much stakeholders as possible.

The move by the government is expected to embark on the program to enhance the quality and number of skilled personnel in STEM. Mawere, 2013 also had recommended the reducing or elimination of the incidence of Mathematics and Science education dropouts. If the policy makers should place value in the employability skills it could help the industry as the skills are important for the modern economy. Some graduates and their

employers say more could be done to develop the students' wider skills and attributes, including team-working, communication, leadership, critical thinking and problem solving. These are known collectively as employability skills.

8. Recommendations

The study recommends STEM subjects that have strategic economic importance and should be a priority based on needs assessed by MHTESTD. For the impact to be felt, Zimbabwe should aim at producing more STEM graduates at college and university level. It is so much a priority that students taking up STEM subjects at A Level receive free education from the government. While the ministry may justify the entry point of student into STEM, the study identified the gap where the introduction of STEM education should start at early child development level through the portals of primary and high school to prepare students' informed choices of careers for entry into tertiary level. The MHTESTD should create a Monitoring and Evaluation unit for periodic and systematic review of STEM initiatives to determine the needs of students and employers. The study recommends tertiary institutions to keep track of trends in the local and global industries. New knowledge will be generated and the recommendations will be used to bring transformation in the higher education institutions, industry, individual prospective students and policy makers.

The study seeks to create a synergy where industry could be re-engaged in the re-designing of the curricula in order to solve problems and bring a lasting change [12]. The experts maintain that the fastest growing and highest earning careers in the future will be in STEM fields, hence, the need to encourage school, colleges and universities to stemitise. Amongst a number of recommendations for action: placing employability at the centre of the organizations' strategic planning; widening access to work placements; and promoting real and equal partnerships between employers and higher education institutions will be highly recommended.

9. Conclusion

The call to stemitise clearly is a key development in government policy to encourage educational institutions and employers to work together to develop approaches that contribute to graduate employability. The process should start earlier by inviting students to enrol in STEM subjects, courses and programmes. In order for the system to become more efficient and responding to market needs, the government, employers and individuals must all engage more in skills development.The study concludes that in order for the system to become more efficient and responding to market needs, the government, employers and individuals must all engage more in skills development. All the stakeholders should be encouraged to engage in critical thinking, problem solving, creative and collaborative skills, and ultimately the connections between the school, workplace, community and the global economy should be established.

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