Educational Strategies for Improved Enrolment into STEM Programs in Kenyan Technical and Vocational Education Training

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ABSTRACT

Advanced nations have focused a lot of attention and effort on establishing effective STEM educational practices and preparing students to enter the STEM workforce in recognition of the importance of the STEM workforce. Within the current educational paradigms, learning concepts like STEM (Science, Technology, Engineering, and Mathematics) continue to emerge. With its integrated approach that involves students in systematic inquiries that call for cross-disciplinary knowledge, STEM education is currently one of the most up-to-date subjects in line with 21st century learning. The purpose of this study was to investigate educational strategies for increased student enrollment at TVET colleges in Kenya. This research has used analysis of secondary data and review of several current literatures from different documents and articles. From the review, the researchers were able to conclude that that in order to increase the number of STEM students enrolled in TVET institutions in Kenya, these institutions should establish partnerships with relevant businesses to help them absorb the yearly production of new graduates into the labor market for internships and subsequent employment. In order to promote students' enrollment in STEM programs at tertiary institutions, the government of the Republic of Kenya should also run mentorship programs through the ministry of education. From primary to secondary and finally tertiary levels, this should start.

Keywords: Science, Technology and Engineering, Technical and Vocational Education, Enrollment

INTRODUCTION

Advanced nations have focused a lot of attention and effort on establishing effective STEM educational practices and preparing students to enter the STEM workforce in recognition of the importance of the STEM workforce. Numerous new, dynamic, and innovative learning strategies are still being developed as the global education sector continues to transform as a result of the paradigm shift from the traditional teacher-centered to learner-centered approach. Within the current educational paradigms, learning concepts like STEM (Science, Technology, Engineering, and Mathematics) continue to emerge.

With its integrated approach that involves students in systematic inquiries that call for cross-disciplinary knowledge, STEM education is currently one of the most up-to-date subjects in line with 21st century learning [1]. Many nations around the world, notably those in America, Europe, and Asia, have greatly advanced STEM education. One of the nations that has started to pursue educational reforms is Indonesia [2]. STEM education is now being taught in schools and colleges. According to the United States' policy agenda, STEM has emerged as the most cutting-edge (The Committee on STEM Education, 2018). Since 1990, the European Commission has made it a top priority, and several Western European nations have prioritized STEM while drafting their own national educational and industrial programs [3]. For many US states, the Next Generation Science requirements (NGSS) were created as a set of science subject requirements based on research. The standards include the basic disciplinary ideas, science and engineering methods, and cross-cutting concepts, which were first recommended in a Framework for K–12 Science Education [4].

The Korean Ministry of Education (MOE) and the Korea Foundation for the Advancement of Science and Creativity, on the other hand, launched a number of science education projects as a result of the publication and subsequent implementation of NGSS. The Korean Science Education Standards (KSES), which were released in 2019, came after the publication of Science for All Koreans in 2016. A group of educators with various backgrounds, including those in science education, engineering education, language education specialists, global civic education experts, and curriculum theorists, created KSES [5]. The KSES focuses on the NOS (Nature of Science) and related aspects by listing "nature of scientific knowledge and method," "integration of science," and "interaction between science and society" as its knowledge domains. It is intended as a foundation for the upcoming national science curricula, classroom-level practices, and out-of-school science education [5]. The idea of STEAM (A for "arts") was seriously considered throughout the formulation of the standards, and as a result, KSES commonly recommends "cross-subject integration" as a teaching strategy for learning objectives.

Additionally, as part of the larger curriculum reform, the Curriculum Guidelines of 12-Year Basic Education-Science (CGBE-S) were created [6]. The scientific core concepts, inquiry skills, and scientific attitude and nature of science are the three domains that make up the core literacy of the science curriculum standards. These domains are introduced in the rationale section, outlined in the core literacy section, elaborated in the learning performance and content section according to each grade level, and connected with essential literacy.

Although some of these ideas are not wholly new, there seems to be a lack of awareness of their connections and practical applications in TVET classrooms in Africa for resolving local, national, or regional issues. In order to possibly reform TVET, it is necessary to investigate how these new ideas and practices interact. Today's world is more complicated than ever before, and these new difficulties place new demands on the global education system. There has generally been an increase in understanding of the need to adapt and enhance student preparedness for effective functioning in the environment's high demands and constant change [7]. The complexity of the education system as a whole, the kind of changes and difficulties the system is facing, and the need to solve them must all be taken into account when TVET as a branch of education works together to handle these challenges. Therefore, the purpose of this study was to investigate educational strategies for increased student enrollment at TVET colleges in Kenya.

MATERIAL AND METHODS

This research has used analysis of secondary data and review of several current literatures from different documents and articles including National Bureau of Statistics, Educational Reforms in Kenya, Kenya National Examination Council, Ominde Report of 1964, Gachathi commission Employment Rates, Basic Education Acts, UN Agenda, Sustainable Development Goals, Enesco, UNICEF, CEMASTEA, STEM Education in South Africa, Kenya vision 2030, The United Nations Sustainable Development Goals and has condensed the findings on these documents.

RESULTS AND DISCUSSION

Following a thorough review of a number of documents, that some of the changes observed in the education sector over the past ten years can be attributed to structural changes that primarily affect the content, delivery methods, assessment procedures, learning approaches, environments, and learning climates. In the digital/information era, often known as the 21st Century, these changes accelerated and became more complex. As a result, the focus has changed from being on the instructor to being on the student [8]. The terminology used to describe class objectives has also changed from being performance- or outcome-based to being content-specific. The methods used to deliver lessons and the setting.

In nations with a strong STEM sector, assessments and evaluation methods have likewise evolved from knowledge- or content-based to authentic or performance-based, as well as from paper-and-pencil to computer-based [12]. They now have reached a significant milestone in the application of STEM. The vocational training facilities and other higher education institutions in Kenya should follow these nations' admirable lead in implementing the STEM. This can be done by organizing a coordinated effort between the various educational institutions, the government, and the ministry of education. The government must set aside cash to help higher institutions execute STEM initiatives successfully and smoothly. In contrast to competency-based evaluation, which prioritizes both process and product, product assessment is typically quick. In TVET, competency-based education and training (CBET) is quickly replacing time-based education and training (TBET), and local, national, or regional vocational qualifications are becoming the preferred form of accomplishment recognition. Long lectures, copying from books or lecturers' old notes, and other electronic or digital transfer methods are quickly displacing these practices. Constructivist, interactive, PBL, and other active learning strategies are quickly replacing traditional lecture or chalk and talk methodology. In place of many actual classrooms, social media is now one of the platforms for learning.

One needs to have additional skills and abilities in order to be able to teach using some of these learning approaches. The 15 qualities that an average 21st century TVET teacher or maker educator should have has been listed [9]. These qualities include being a learner-centered teacher/maker educator, a lifelong learner, a brand-new learner for the new technologies, a global-based thinking teacher, being able to use smart digital devices, being able to collaborate effectively with others, using social media for educational purposes, and being a welder. In order to become good teachers and maker educators, all teachers in this category should also have the following skills, [10]: the capacity to think outside the classroom box, get personal, tap into students' digital expertise, get involved and be real with projects, expect to give and receive help from students. They should also be adept at measuring or evaluating only the factors that truly count, collaborate with parents and their charges, and serve as sources of empowerment for the children rather than causes of their hardships. To declare with certainty that we have complied with all of these conditions is currently very difficult for all of us present. If so, the shifting requirements for work place skills and competences may put our jobs and the topic we teach (TVET) in a difficult situation and under serious threat. Therefore, the urgent appeal for changing the TVET system in Africa and other nations throughout the world is justified.

For one thing, Maker/STEM education encourages practical problem-solving and 21st century skills. It also encourages reflection on the connections between the various fields of study and how these connections affect and influence our lives. By making mathematics and science more applicable to what is being done in TVET, the integration of STEM education paths helps students become more interested in and understand STEM career TVET. As it stimulates and supports invention and creativity through the use of 21st Century learning abilities, including the 4Cs (i.e., Communication, Collaboration, Critical and Creative Thinking), the integration also aids students in expanding the TVET-STEM workforce pipeline.

Therefore, embracing, fusing, and integrating TVET with STEM or maker education principles is the appropriate and best way to reform the TVET system in Africa. The teachers of integrated STEM must get training through integratedand collaborative experiences if integrated STEM is to be successful.

From June 10–11, CEMASTEA hosted a two-day training for STEM Model School Principals in Nakuru. Enabling Principals Pedagogical Leadership for Effective Implementation of the STEM Pathway in the

Competency-Based Curriculum was the focus of the workshop. 101 principals representing the 103 STEM Model schools attended.

Understanding the STEM paths in light of CBC, supporting STEM education programs in their schools, and the necessity of continuing transformation into Centers of Excellence in STEM education were some of the themes under discussion. They implemented initiatives like maker spaces, improved the STEM climate in their schools by making it more welcoming, and integrated instruction for sustainable development.

The CEMASTEA director, Mrs. Jacinta Akatsa, urged the principals to invite STEM activities that boosted interest in and enrollment in STEM courses in her remarks. She urged them to set up systems that would assure follow-ups and promote the transfer of acquired information and skills because she recognized the potential benefits of a supportive teaching and learning environment. The participating principals created an action plan that included specifics about the programs they planned to implement. These included lesson planning, ICT integration, and STEM projects and programs as well as CBC Junior Secondary preparation.

Immediately upon independence, the Ominde Commission was established. The principal suggestion of the 1964 Ominde Report was that the curriculum be updated to make it more applicable to children in Kenya. Additionally, there was supposed to be a bigger focus on practical themes. The Commission advised that education be structured in connection to employment prospects in order to create the personnel that was required [11]. Although these suggestions were useful, they did not address the situated vision of practical education that had already been developed. Education was not considered as a means of mind liberation but rather as a means of exploiting others, especially the illiterate, by certain Kenyans who believed that it was their turn to replace the colonists. Although the commission also paid attention to the teenagers' ability to find employment after receiving their VET training.

Additionally, the Republic of Kenya's government needs to expand the job options available to STEM educators. Comparable nations with strong STEM sectors share a high regard for teachers and a high bar for admittance. They have solid STEM meritocratic career frameworks that value teachers' interests above all else, which has really aided them in the implementation process. Finland serves as a notable example, where all teachers are required to hold a Master's degree, teaching is more difficult to enter than most other professions, and the best instructors are compensated to work in school districts that serve pupils from low-income families and those who have the most learning difficulties. School instructors are held in high regard, receive higher pay, and have more merit-based career paths than those found elsewhere. Similar to this, STEM teachers in China obtain wage raises through discipline-specific CPD programs rather than based on seniority. China's teachers must show a rising standard of work in order to advance.

These nations have an unwavering dedication to disciplinary standards. They do not link teaching with merely overseeing classes and receiving credentials. They emphasize learning. It is assumed that STEM professors will only teach in that discipline and that discipline alone. The most effective nations have also put in place active programs for curriculum and pedagogy reform that are aimed at making science and mathematics more interesting and applicable through problem-based and inquiry-based learning, as well as by placing an emphasis on creativity and critical thinking.

The greatest STEM classes in Australia also features these elements. In order to improve the emphasis on creativity and design, South Korea's principal program for increasing participation and achievement in STEM has embraced the arts [12]. The course is known as STEAM. These more student-centered strategies are being used without watering down thesubject matter.

The Republic of Kenya's government must also create a strategic national STEM policy framework. The development of strategic national STEM policy frameworks in STEM-strong nations has created the ideal environment for a variety of initiatives, including: centralized curriculum reform and funding; world-class university programs; the recruitment of foreign science talent and new doctoral cohorts; decentralized

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program initiatives; partnerships and engagement that connect STEM activities in vocational and higher education with industry; and decentralized program initiatives. The shared national STEM agenda is frequently advanced and resourced by institutes, centers, or other organizations that have been specially established to lead, facilitate, or inform STEM programs. The STEM strategies and practices of other nations offer an informative window through which we can better make adjustments on critical areas like other countries to improve STEM practices and provide many potentially useful ideas for developing STEM strategies in Kenya, despite the fact that very few international policies and educational practices can be easily transferred into the Kenyan context.

In order to increase students' interest in and attitudes toward STEM fields, the government of the Republic of Kenya must implement methods that increase youth knowledge of STEM fields and careers associated to them. This is due to the widespread perception among Kenyan youth that STEM courses are only appropriate for pupils who scored poorly on the KCSE. Initiatives that focused on students' attitudes and identities made up a sizable portion of the strategy mix in the majority of nations. Initiatives to raise understanding of the nature of STEM jobs were also included in order to boost student enrollment in STEM courses [13].

According to the findings, techniques and programs might be improved and expanded in order to increase students' favorable attitudes toward studying mathematics and science as well as STEM-related jobs and occupations. Such tactics would need to consider the variety of circumstances that kids may be in, such as their gender, ethnicity/cultural background, SES status, and naiveness. First, awareness efforts to improve the general public's understanding of STEM career alternatives and the nature of STEM labor, as well as to inform young people of the variety of potential future STEM lives and identities. Second, educational strategies that encourage children to learn math and science while cultivating favorable attitudes about STEM-related vocations. Third, role models can be found in the form of student interactions with working STEM professionals or online narrative presentations of STEM professionals (like those found on the Science and Technology Education Leveraging Relevance (STELR) website of the Academy of Technological Sciences and Engineering (ATSE). Fourth, advise on choosing a job that includes pictures of people with STEM-related occupations is given to math and science instructors as well as career teachers at informational seminars. The inclusion of pictures of people with careers in STEM in educational resources is the last point.

The Republic of Kenya's government must also ensure that there is a sufficient job market for STEM graduates with a clear understanding of the roles that their education and training play in the workplace. Clear information about the final destinations of STEM graduates and the contribution of STEM education to a range of professions is lacking in Kenya. Data on the qualifications of STEM teachers are also lacking. Data on STEM graduates' final destinations (whether for a diploma, first degree, postgraduate study, or postgraduate research) is crucial. Defining the roles of STEM education and training in relation to jobs that require a STEM degree, jobs that are outside of the field but still fall under the umbrella of the subject, and jobs that don't require a STEM degree but may still benefit from the skills and knowledge of STEM graduates in a more general way.

Additionally, the government needs to prioritize STEM education at the primary and secondary levels of instruction. This is due to the fact that early childhood and elementary schooling lay the groundwork for STEM competency. This shows that primary teachers' confidence and competency in their ability to teach science and mathematics need to be increased (Technical).

One example would be a program similar to that of the United Kingdom, in which trained expert mathematics leaders are in charge of overseeing the methods and techniques used in teaching mathematics in their schools and creating the necessary learning resources. Because of their solid foundation from primary and secondary levels, this will later increase learners' interest in considering STEM related degrees when they join postsecondary institutions.

By TVETs like the Technical University of Mombasa, mentorship programs that support female engagement in STEM are urgently needed. In Kenya, it has long been believed that men should take the majority of STEM courses. Due to this, fewer female students are enrolling in STEM courses at postsecondary institutions. Numerous nations have seen improvements in women's engagement in STEM thanks to mentoring initiatives. Bringing together young women with accomplished female STEM professionals (including scientists, engineers, mathematicians, and computing specialists) to provide an accurate understanding of STEM vocations and access to female role models are just a few examples of mentoring programs of this type. Such interactions with STEM professionals could begin as early as primary school and persist steadily throughout education and training for early careers. Higher education institutions can also create curriculum plans and professional development that could increase teacher understanding of enticing girls to seek careers in STEM fields.

Additionally, each institution of higher education must set up partnerships with pertinent businesses to offer internship and employment opportunities to its students in related sectors. Successful partnership efforts show the critical significance of partnerships in fostering innovation in school mathematics and science in a number of STEM-strong nations. Developing an awareness of the size, scope, and range of STEM-related partnership and enrichment projects is one method for approaching STEM collaborations. Coordinate the dissemination of information on pertinent activities, and create guidance for science groups, business and industry leaders, and educational administrators on how to manage these effectively.

DISCUSSION

The statistics above show that the majority of the nations that have integrated STEM education into TVETs have put in place a number of measures to guarantee the employability of their graduates. its collaboration with pertinent businesses has given its STEM students access to internship and employment possibilities. Successful partnership projects in several nations with strong STEM sectors highlight the crucial role that partnerships play in fostering innovation in their TVET institutions. In contrast, students from Kenyan TVET universities continue to have difficulty securing attachment with the few, very competitive employers that are accessible. After graduation, employment is not a guarantee for those who are fortunate enough to gain such prospects for attachment in these companies. There are fewer students enrolled in STEM-related courses at this school as a result of this seriously lowering their morale.

While some TVET institutions, like the Technical University of Mombasa, have made an effort to implement mentorship programs that promote female participation in STEM education, the majority of these institutions still need to take such programs into consideration if they hope to increase the enrollment of both male and female students in STEM programs.

In order to generate a sufficient job market for STEM graduates with specific roles for STEM education and training in connection to the workplace, these institutions must also collaborate with the government. Clear information about the final destinations of STEM graduates and the contribution of STEM education to a range of professions is lacking in Kenya.

In order to advance a rich and equitable society, Kenya, like other modern societies, has a bold goal for its own growth that calls for a populace that is innovative, tech-savvy, and globally connected. A 'constructive alignment' of higher education pedagogy with STEM is required if these critical, creative graduates are to be produced. Coordinated action will be needed to overcome the interconnected constraints that are now impeding the establishment of a rich and supportive learning environment for students as part of this transition of the higher education system. As was said before, there are numerous developments and positive movements related to STEM in place. In a variety of universities, efficient academic staff development programmes have been established to control STEM enrollment. Across the nation, courses have begun to embrace strategies like problem-based learning, constructive alignment, the employment of student learning mentors, and alternate forms of assessment like portfolios.

However, even those institutions that are at the vanguard of progressive practice struggle to make these reforms general. The Association for Faculty Enrichment of Learning and Teaching (AFELT), a grassroots networking organization of institutional leaders in academic development and quality assurance, was founded in 2014 with the goal of advocating for initiatives to improve teaching and learning across the nation. It has the potential to transform the system for the better by increasing capacity, assuring academic staff buy-in, and creating a venue for the exchange of new ideas to increase STEM enrolment. If systemic changes are to occur and have a lasting impact, these initiatives and innovations need to be nourished and encouraged. It was also found that participation in STEM programmes has not been significantly impacted by institutional or national campaigns. Staffing and infrastructure, governance, and pedagogical culture are three categories of barriers that have been identified. Reforms in institutional organization, teaching and learning cultural interactions, and the material conditions of STEM enrollment are three things that need to be addressed at the same time.

CONCLUSION

The majority of this study consisted of a desk-based literature review. The material consists of both academic and grey literature that has been researched online. The first report for reviewing literature involved reviewing the literature that was used for earlier reports. A literature search was conducted for STEM education resources in Kenya and in sub-Saharan Africa and the world. There is good work on STEM education from which lessons can be learned. The current body of literature offers a clear picture of the difficulties in providing high-quality STEM education in Kenya and sub-Saharan Africa. goals for development, effective policies, and strategic plans and activities drawn from the literature already in existence.

In conclusion, it is important to note that in order to increase the number of STEM students enrolled in TVET institutions in Kenya, these institutions should establish partnerships with relevant businesses to help them absorb the yearly production of new graduates into the labor market for internships and subsequent employment. In order to promote students’ enrollment in STEM programs at tertiary institutions, the government of the Republic of Kenya should also run mentorship programs through the ministry of education. From primary to secondary and finally tertiary levels, this should start.

REFERENCES

1. Tikly, L., Joubert, M., Barrett, A. M., Bainton, D., Cameron, L., & Doyle, H. (2018). Supporting secondary school STEM education for sustainable development in Africa. University of Bristol, Bristol Working Papers in Education Series. Retrieved August, 30, 2020.
2. Khotimah, R. P., Adnan, M., Ahmad, C. N. C., & Murtiyasa, B. (2021, February). Science, Mathematics, Engineering, and Mathematics (STEM) education in Indonesia: A literature review. In Journal of Physics: Conference Series(Vol. 1776, No. 1, p. 012028). IOP Publishing.
3. National Academies of Sciences, Engineering, and Medicine. (2018). Indicators for monitoring undergraduate STEM education. National Academies Press.
4. National Academies of Sciences, Engineering, and Medicine. (2018). Graduate STEM education for the 21st century. National Academies Press.
5. Park, W., Wu, J. Y., & Erduran, S. (2020). The nature of STEM disciplines in the science education standards documents from the USA, Korea and Taiwan: Focusing on disciplinary aims, values and practices. Science & Education, 29, 899-927.
6. Akala, W. J., & Changilwa, P. K. (2018). Status of Technical and Vocational Education and Training

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TVET) in Post-secondary Education in Kenya. Journal of Popular Education in Africa, 2(7), 15-25.

7. Geng, S., Law, K. M., & Niu, B. (2019). Investigating self-directed learning and technology readiness in blending learning environment. International Journal of Educational Technology in Higher Education, 16(1), 1-22.
8. McCowan, T. (2018). Quality of higher education in Kenya: Addressing the conundrum. International Journal of Educational Development, 60, 128-137.
9. Palmer, L., Briggs, C., McFadden, S., Zini, G., Burthem, J., Rozenberg, G., … & Machin, S. J. (2015). ICSH recommendations for the standardization of nomenclature and grading of peripheral blood cell morphological features. International journal of laboratory hematology, 37(3), 287-303.
10. Akala, B. M. M. (2021). Revisiting education reform in Kenya: A case of Competency Based Curriculum (CBC). Social Sciences & Humanities Open, 3(1), 100107.
11. McCowan, T. (2018). Quality of higher education in Kenya: Addressing the conundrum. International Journal of Educational Development, 60, 128-137.
12. Song, J., Kang, S. J., Kwak, Y., Kim, D., Kim, S., Na, J., & Joung, Y. J. (2019). Contents and features of'Korean Science Education Standards (KSES)'for the next generation. Journal of the Korean Association for Science Education, 39(3), 465-478.
13. Akala, W. J., & Changilwa, P. K. (2018). Status of Technical and Vocational Education and Training TVET) in Post-secondary Education in Kenya. Journal of Popular Education in Africa, 2(7), 15-25.