REPUBLIC OF KENYA

CEMASTEA

Research & Development Knowledge Management (R&D KM)

POLICY BRIEF:

IMPACT OF CEMASTEA INITIATIVES IN PROMOTING STEM EDUCATION IN KENYA

This research aimed at assessing the impact of CEMASTEA's initiatives in promoting Science Technology Engineering and Mathematics (STEM) education in STEM model secondary schools. The selected schools are expected to model best practices and an inviting STEM climate culture that spurs learners towards STEM-based careers. The transformation of schools to STEM model schools aims at improving leadership practices, teachers' pedagogical content knowledge and innovativeness. The resultant effect is increased uptake of STEM subjects by learners, greater participation in science and engineering fairs and ultimately increased enrolment in STEM related careers. The data was collected using questionnaires, interviews, lesson observation and focus group discussions. The data collected was analysed using mixed methods and the findings are expected to inform future interventions to the STEM model schools. It will also inform the formulation of policies aimed at promoting Science, Technology and Innovations (ST&I) in Kenya.

What was the issue?

Are CEMASTEA initiatives in supporting STEM model schools impactful?

This policy brief has been developed for "**IMPACT OF CEMASTEA INITIATIVES IN PROMOTING STEM EDUCATION IN KENYA"**. The focus of the study was to address the following research questions:

Specific Research Questions

1. How have the STEM initiatives influenced the perception and enrolment of learners in STEM education?

2. To what extent have teachers and learners developed ESD and STEM innovations for learning and community empowerment?
3. How has the school supported the development of STEM education?
4. What is the extent of integrating innovative pedagogies in teaching and learning of STEM subjects?

The objective of this policy brief is to position the research work and findings within the broader policy context, including policy strategies and inform decision- making processes.

The research findings revealed that the initiatives by CEMASTEA played a significant role in promoting STEM education. These findings are discussed under the following research objectives:

1) Influence of STEM initiatives on the perception and enrolment of learners in STEM education

i) **Increased enrolment in STEM subjects**

Analysis of self reports by career teachers in STEM model schools indicated an increase in learners' enrolment in STEM subjects in the period 2017 to 2021. The number of male learners who enroled in the three sciences increased steadily from 49.68% to 54.64%, while that of female learners increased from 34.31% to 36.89%. The percentage of learners who enroled for other STEM subjects like home science, computer studies, agriculture, power mechanics, woodwork, art and design, building and construction, electricity and metal work remained relatively below 30%. This may be attributed to schools regulating the number of learners taking these subjects due to limited resources that are required to support the teaching and learning of these subjects. However, the number of learners who enrol in these subjects would be higher if resources were to be increased.

ii) **Improved KCSE performance**

To establish the impact of CEMASTEA's initiatives to promote STEM education, Kenya Certificate of Secondary Education (KCSE) performance in the period 2017 to 2021 was also considered. The performance of the STEM subjects in the national examinations from the year 2017 to the year 2021 was relatively good. In biology, the

performance recorded a significant improvement from a score of 3.668 for male learners to 5.731, and from a score of 3.249 to 5.399 for female learners. The scores in mathematics, chemistry and physics improved in the years 2017 to 2019, but dropped in the years 2020 and 2021. This may be attributed to the prolonged closure of schools and the subsequent school crash programme during and post COVID-19 pandemic period. The scores in home science improved from 7.922 for male learners to 8.293, and 8.35 to 8.965 for the female learners. The same was replicated in agriculture (5.721 to 8.271 for male learners, and 5.846 to 6.37 for female learners), and in computer studies (9.928 to 10.33 for male learners, and 9.597 to 9.613 for female learners).

iii) **Increased number of learners who selected STEM related careers**

The findings from the document analysis also gave the proportion of form 4 graduates who chose STEM related careers at post-secondary in the year 2017 to 2021. With the exception of the post-COVID-19 pandemic year (2021), the findings show that there was a steady increase in the proportion of learners who enroled to pursue STEM related careers at post-secondary. This proportion increased from 46.84% to 64.063% for the male graduates and from 35.83% to 41.788% for the female graduates.

iv) **Learners ability to transfer knowledge and skills to real life**

From the findings, the majority of the teachers reported to involve the learners in the STEM and Education for Suistainable Development (ESD) projects. Some of the projects in which the learners are involved include rabbit rearing, making dust bins and incinerators, planting of trees and flowers, preparing detergents, and growing vegetables. Through the promotion of STEM education, the learners are able to transfer the knowledge and skills acquired from involvement in these projects to real life situations.

v) **Promotion of conducive learning environment**

In the STEM training conducted by CEMASTEA, teachers and principals from STEM model schools are usually taken through a session on how to create an inviting school climate. The research considered the physical environment of the school, the relationship between staff and learners, the systems put in place to run the school, the school programs and policies governing the institution. The findings on assessment of

these characteristics showed that most of the STEM model schools have an inviting school climate.

vi) **Provision of learning resources**

School principals concurred that resources donated by CEMASTEA have been instrumental in integration of ICT in lesson delivery, not only for STEM subjects but also for other disciplines. The equipment donated by CEMASTEA included; microscopes, test tubes, models, thermometers, Hoffman apparatus and other high end apparatus, which as reported by Principals, are effectively being used by learners and teachers in the laboratories.

2) Extent to which teachers and learners have developed ESD and STEM innovations for learning and community empowerment

It was observed that STEM model schools had several completed and ongoing ESD projects. These were solar energy installations, bio digester, sinking of boreholes, purifying and bottling water, bakery and soap making. Most schools had fish, poultry, animal farming and crop farming activities. These were used to substitute diet as well as selling to staff and the community. The projects also promoted the learning of STEM subjects.

3) School support in the development of STEM education

i) **Career guidance program**

To support development of STEM education, most of the schools have put in place a career guidance program headed by a career master. In these programs, professionals in various STEM related fields are usually invited to guide the learners on the requirements of their dream careers. This helps them to make informed career decisions.

ii) **Development of learners' industrial skills**

The research revealed that schools supported learners' involvement in innovative activities which enhanced their industrial skills. The activities included carpentry work like making furniture such as chairs. Learners in some schools were doing tailoring work like making garments, dresses, shirts, and aprons. Other innovations by learners included water harvesting projects, making improvised nets for catching

insects, making biogas, inventing a machine for cutting cabbage, making natural yoghurt, making detergents, designing and making dust bins, and incinerators.

iii) **Environmental conservation programs**

Schools supported learners in environmental conservation programs. This was evident in the well-maintained flower gardens and trees within the school compound which, as reported, were maintained by the learners. Other projects in which learners were involved include prevention of soil erosion, and recycling and reusing non-biodegradable materials. The bio-degradable waste products were used to make compost manure for farming. These enhanced learners' environmental conservation skills.

iv) **Promotion of innovations in teaching and learning of STEM subjects**

Schools have provided a supportive environment for innovative teaching and learning for STEM education. The research findings showed that learners participated in the sourcing and development of teaching and learning resources for STEM subjects

4) Extent of integrating innovative pedagogies in teaching and learning of STEM subjects

i) **Inquiry Based Learning Practices and application of 5E Instructional Model**

The findings of the lessons observed revealed that teachers are applying inquiry based learning (IBL) in their classroom practice, but majorly the confirmatory level of inquiry. It was evident that the tasks provided in lessons provoked learners' creativity, critical thinking and problem solving. These lessons provided opportunities for learners to relate application of concepts learned to real world problems. The aspects of the 5E Instructional model (engage, explore, explain, extend and evaluate) were evident in the lessons observed by the researchers. However, some of the lessons were, to a large extent, teacher-centred where teachers tended to dominate in the demonstration and hence limiting learners' effective engagement with the components of the 5E Instructional model.

ii) **ICT Integration**

Responses from the teachers questionnaire affirm that ICT integration is one of the key skills that the teachers have gained from STEM training offered by CEMASTEA. Teachers reported that they are applying ICT skills in their practice.

iii) **Connecting ESD and STEM to the learning process**

The research sought to establish how the knowledge gained by learners from the classroom is transferred to generate ESD and STEM Projects. It was evident from the findings that these projects were used in the teaching and learning processes. For instance, in one of the schools, learners heated waste plastic materials, and used the molten plastic to form carbon and hydrogen models which teachers were using to teach structures of hydrocarbons in Chemistry.

Recommendations

Based on the findings of this study, the following are the recommendations.

1) MoE should purposefully equip the STEM model schools with the necessary ICT infrastructure in order to enable the teachers to integrate ICT in the learning process as well as enhance research.
2) The Board of Management of schools should provide the necessary facilities /resources for teaching and learning of STEM subjects.
3) The Government should purposefully equip the STEM model schools to attain the universal standards of an ideal STEM model school.
4) CEMASTEA should establish a well-structured school-based after-training monitoring and support program to support teachers in the classroom practice and in the development of ESD and STEM projects for learning

Conclusion

It was evident that CEMASTEA's initiatives in promoting STEM education in Kenya are effective if well implemented. However, there will be a need to implement the various recommendations below for continuous improvement of the interventions and impact in schools.

References

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2) Nguyen, T. P. L., Nguyen, T. H., & Tran, T. K. (2020). STEM education in secondary schools: Teachers' perspective towards sustainable development. *Sustainability (Switzerland)*, *12*(21), 1–16. https://doi.org/10.3390/su12218865