# ENHANCING STUDENTS' INTEREST IN TECHNICAL VOCATIONAL EDUCATION AND TRAINING THROUGH RE-EMPHASIZING OF SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS CONCEPTS IN TEACHING METHODS

**Ezema Anastasia N. & Umaru, Kolo Ibrahim**

Department of Agricultural Education, University of Nigeria, Nsukka.

annezema31@gmail.com; 07034494720; ibrahimkolou12@gmail.com, 07031596502

## Abstract

This paper examined the need for enhancing students' interest in Technical Vocational Education and Training (TVET) through the integration of Science, Technology, Engineering, and Mathematics (STEM) concepts in teaching methods. The study was carried out in Enugu State. Four research questions guided the study. The descriptive survey research design was employed in the study. The population was 208, comprising 126 students and 82 federal and state staff of vocational and technical education in the research state. simple random sampling techniques were used to select 116 respondents, which comprises 85 students and 31 staff. The instrument for data collection was a questionnaire developed by the researcher through an extensive literature review. The questionnaire had 32 item statements, which was structured using Likert scale of Highly Agree, Agree, Disagree and Highly Disagree. The research instrument was validated by three experts in the Faculty of Vocational and Technical Education, University of Nigeria, Nsukka. The reliability of the instrument was ascertained through a pilot-test by sampling 7 Vocational and Technical Education lecturers, 21 students of federal and state staff of vocational and technical education in Anambra State which was outside the study area. Cronbach's Alpha was used to measure the internal consistence of the pilot test and 0.72 value were obtained showing the consistence and reliability of the instrument. Data collected were analyzed using mean scores and standard deviations to answer the research questions while t-test statistics was used to test the null hypotheses. The findings of this study revealed among others that vocational education lecturers need to embrace and take very serious the STEM content in TVET Education. Several roles needed by STEM to boost TVET were also identified coupled with the challenges that could be faced in carrying out this and possible solution were also captured in this study. From the findings of the study it was recommended that schools and training institutions should revise their TVET curricula to include more STEM-related contents and hands-on activities that encourage innovation and exploration. Regular training and workshops should be provided to educators to equip them with the knowledge and skills to effectively integrate STEM into their teaching practices.

**Keywords**: Students' Interest, TVET, STEM, Teaching methods.

## Introduction

Technical Vocational Education and Training (TVET) plays a pivotal role in equipping students with practical skills and competencies essential for the workforce. However, in many regions, including Nigeria, TVET has often been perceived as a less prestigious educational pathway compared to traditional academic routes. According to Dare (2021) most of the

students who enroll in TEVET are perceived to be academically poor. This perception has led to declining enrollment rates and limited interest among students offering TVET. According to UNESCO-UNEVOC (2013) TVET comprises education, training and skill development relating to a wide range of occupational fields, production, services and livelihoods. It encompasses educational programs that focus on imparting practical skills and knowledge related to specific trades or occupations. According to White (2020) these programs are designed to prepare individuals for employment in various sectors, including manufacturing, construction, information technology, and healthcare. It engages the students in the learning that will be encounter in the real life and equip them with employability mindset and skills.

In Nigeria, institutions such as polytechnics and vocational schools offer TVET programs aimed at bridging the skills gap in the labor market. Gerde et al (2022) noted that despite its significance, TVET has faced challenges in attracting students. Factors such as societal stigma, limited exposure to career opportunities, and inadequate infrastructure have contributed to the underrepresentation of TVET in educational choices. Similarly, TVET have been seen as a dumping ground to those who are not academically vibrant and other issues which have affected the enrolment and interest of students in the area (Dare, 2021). The negative perception of Technical and Vocational Education and Training (TVET) remains a significant challenge globally, particularly in developing countries. This perception is often rooted in long-standing societal biases that equate academic education with higher prestige, while viewing vocational paths as a last resort for those who are academically underperforming (Okolie et al., 2023). Such stigma leads to lower enrollment rates in TVET programs and diminishes the societal value placed on skilled trades and technical occupations.

One of the major contributing factors to this negative perception is the limited awareness about the potential of TVET to lead to successful and fulfilling careers. Many parents and students believe that vocational training offers fewer opportunities for upward mobility compared to university education (Boateng & Ofori-Atta, 2022). Additionally, inadequate infrastructure, outdated curricula, and weak linkages with industry further reinforce the belief that TVET is inferior to conventional academic education (UNESCO, 2022). Media portrayal also plays a role in shaping public opinion. In many countries, media coverage tends to glorify white-collar professions while marginalizing technical and vocational careers. This creates a societal narrative that undervalues the contributions of TVET graduates to economic and national development (Eze & Okonkwo, 2023). Furthermore, policy neglect and underfunding by governments contribute to the underdevelopment of the TVET sector, making

it less attractive to prospective students. Despite efforts by UNESCO and other global bodies to rebrand and promote the value of TVET, these negative perceptions persist. To overcome them, there is a need for strong advocacy, curriculum reforms, industry partnerships, and investment in modern training facilities that align with labour market demands. There is also need to re-emphasize on STEM concept into TVET since TVET cannot effectively function without practical; science

STEM education emphasizes the integration of scientific principles, technological tools, engineering practices, and mathematical reasoning into educational system. STEM, an acronym for Science, Technology, Engineering, and Mathematics, represents an interdisciplinary approach to education that integrates these four fields into a cohesive learning paradigm. Rather than treating each subject in isolation, STEM education emphasizes their interconnectedness and promotes active, hands-on learning that mirrors real-world challenges (Umar et al 2024). The goal of STEM is to cultivate learners who are capable of critical thinking, problem-solving, and innovation skills that are increasingly vital in a technology-driven global economy. By encouraging inquiry, exploration, and application, STEM helps students not only understand scientific and technical concepts but also develop the confidence to apply this knowledge in diverse contexts. As the demand for digital literacy and technical expertise rises across all sectors, STEM education has become essential in preparing individuals to meet the evolving needs of the workforce especially among the TVET students. Incorporating STEM concepts into TVET programs can provide several benefits. According to Berisha (2020), industries are increasingly seeking professionals with a strong foundation in STEM disciplines and embedding STEM into TVET, students acquire skills that are directly applicable to current job market demands. Huang et al (2022) noted that in development of critical thinking**,** STEM education encourages problem-solving, innovation, and analytical thinking. These skills are transferable across various occupations and enhance students' adaptability in dynamic work environments. Graduates with STEM-integrated TVET qualifications are better positioned to secure employment in high-demand sectors, leading to improved career prospects (Petrova 2021).

To effectively integrate STEM concepts into TVET, several strategies can be employed. Chude et al (2019) stated that there is need to revise existing TVET curricula to incorporate and re-emphasize on STEM subjects, ensuring that they are relevant to the specific trades or occupations offered. This may involve re-emphasizing on courses in robotics, coding, renewable energy, and data analysis. There is also need to **e**quip TVET instructors with the

necessary skills and knowledge to teach STEM subjects effectively (Hubbard et al 2015). Professional development programs and workshops can enhance teachers' proficiency in delivering interdisciplinary content. Similarly, establish partnerships with industries to provide students with real-world applications of STEM concepts. Internships, apprenticeships, and collaborative projects can bridge the gap between theoretical learning and practical experience. Leverage digital tools and platforms to facilitate STEM learning. Virtual simulations, online resources, and interactive software can enhance student engagement and understanding of complex concepts (Mintii, 2023).

To bring STEM concept into full utilization in TVET, there is need to conduct an outreach program to inform students, parents, and communities about the benefits of STEM-integrated TVET. Highlighting success stories and showcasing career opportunities that can shift perceptions and encourage enrollment. Williams (2018) observed that several countries have successfully implemented STEM integration in TVET, yielding positive outcomes. R-emphasizing on STEM concept will ensures that students acquire both theoretical knowledge and practical skills, making them highly employable. Singapore's Institute of Technical Education (ITE) has integrated STEM into its curricula by offering specialized programs in areas such as aerospace engineering and information technology. Collaboration with industries ensures that the training aligns with market needs. In Kisumu County, Kenya, a study identified factors influencing students' enrollment in STEM programs within TVET institutions. Socioeconomic factors, parental education levels, and personal motivation were found to significantly impact students' choices. Addressing these factors through targeted interventions can enhance enrollment rates in STEM-integrated TVET programs (Bowan, 2020; Velychko et al., 2022 and Umar et al., 2024).

While integrating STEM into TVET offers numerous benefits, several challenges must be addressed. According to Baporikar (2015), limited access to modern equipment and facilities can hinder the effective delivery of STEM education. Investment in infrastructure is crucial to provide students with hands-on learning experiences. Traditional teaching methods and curricula may resist the incorporation of STEM concepts if it is not capture in the curriculum. Stakeholders must be engaged in the process to ensure a smooth transition. Initiatives to promote inclusivity and diversity are essential (Desimone & Garet, 2015). **Hence,** continuous evaluation and adaptation of STEM-integrated TVET programs are necessary to keep pace with technological advancements and industry requirements.

**Statement of the Problem**

Technical and Vocational Education and Training (TVET) plays a critical role in equipping students with practical skills and competencies essential for national development and global competitiveness. However, a persistent challenge in many educational systems, particularly in developing regions, is the lack of student interest in TVET programs. This disinterest is often rooted in the perception that TVET is inferior to conventional academic pathways, offering limited opportunities for career advancement. Despite efforts to promote vocational education, students frequently view it as a fallback option rather than a viable first choice. This negative perception contributes to low enrollment rates and reduced motivation among learners, hindering the full potential of the TVET sector in addressing unemployment and fostering industrial growth.

A key factor contributing to the declining interest in TVET is the limited integration of engaging and forward-looking teaching methods that reflect current technological trends. Many TVET institutions still rely on traditional rote-based instruction, which does not resonate with the experiential and inquiry-based learning preferences of today's students. As industries increasingly demand workers who are digitally literate and capable of problem-solving and innovation, the gap between classroom instruction and real-world requirements becomes more apparent. Students often fail to see the relevance of their training to contemporary technological advancements, resulting in apathy and disengagement from technical education programs.

The underutilization of Science, Technology, Engineering, and Mathematics (STEM) concepts within TVET curricula further exacerbates the problem. STEM offers a dynamic framework for teaching that emphasizes practical application, critical thinking, and interdisciplinary problem-solving skills that are vital in modern technical careers. Yet, in many cases, STEM is not adequately emphasized in the design and delivery of TVET courses, leaving students without the foundational knowledge and enthusiasm needed to succeed in technical fields. Therefore, there is an urgent need to re-emphasize STEM concepts in TVET teaching methods as a strategy to enhance student interest and engagement.

**Purpose of the Study**

The general purpose of the study was to determine the ways of enhancing student interest in TVET through re-emphasizing of STEM concept in teaching methods. Specifically, the study sought to determine:

1. The STEM concepts needed to enhance students' interest in TVET

2. Ascertain the role of STEM in boosting TVET
3. Find out the possible challenges of integrating STEM concept in TVET
4. Suggest possible solution to the problem of integrating STEM concept TVET

**Research Questions.**

The following research questions guided the study

1. What is the STEM concepts needed to enhance students' interest in TVET
2. What is the role of STEM in boosting TVET
3. What is the possible challenges of integrating STEM concept in TVET
4. What is the possible solution to the problem of integrating STEM concept TVET

**Hypotheses**

1. There is no significant difference in the mean ratings of the responses of male and female lecturers on the STEM concept needed to enhance students' interest in TVET.
2. There is no significant difference in the mean ratings of the responses of male and female lecturers on the role of STEM in boosting TVET.
3. There is no significant difference in the mean ratings of the responses of male and female lecturers on the possible challenges of integrating STEM concept in TVET.
4. There is no significant difference in the mean ratings of the responses of male and female lecturers on the possible solutions to the problem of integrating STEM concept TVET.

**Methodology**

The study was carried out in Enugu state. The descriptive survey research design was employed in the study. The population was 208 comprising 126 students and 82 federal and state staff of vocational and technical education in the research state. simple random sampling techniques were used to select 116 respondents that comprises 85 students and 31 staff. Instrument for data collection was a questionnaire developed by the researcher through an extensive literature review. The questionnaire had 32 item statements, which was structured using Likert scale of Highly Agree, Agree, Disagree and Highly Disagree. The research instrument was validated by three experts in the Faculty of Vocational and Technical Education, University of Nigeria, Nsukka. The reliability of the instrument was ascertained through a pilot-test by sampling 7 Vocational and Technical Education lecturers, 21 students of federal and state staff of vocational and technical education in Anambra State which was outside the study area. Cronbach's Alpha was used to measure the internal consistence of the pilot test and 0.72

value were obtained showing the consistence and reliability of the instrument. Data collected were analyzed using mean scores and standard deviations to answer the research questions. A criterion mean score of 2.50 was set for decision on the following real limit of numbers were used for decision: mean score of 3.50 – 4.00 was termed strongly agreed, 2.50-3.49 for agreed, 1.50 – 2.49 was termed low extent, while 0.50-2.49 was termed very low extent. t-test statistics was used to test the null hypotheses at 0.05 level of significant.

**Result**

The results of the study were obtained from the research questions answered and hypotheses tested through data collected and analyzed.

**Research Question 1:** What are the STEM concepts needed to enhance students' interest in TVET ?

**Table 1: Mean rating, standard deviation and t-test analysis of the responses of TVET lecturers and students on theSTEM concept needed to enhance students' interest in TVET**

| S/N | Item Statement | $\bar{x}$ | SD | t-cal | Remark |
|---|---|---|---|---|---|
| 1 | Understanding how different energy sources work — vital for electrical, mechanical trades and other areas. | 2.87 | 1.80 | 0.55 | RQ, NS |
| 2 | Using basic statistics to make decisions — important for quality control, agriculture tech, etc. | 3.19 | 1.70 | 0.90 | RQ, NS |
| 3 | Applying math to real-world problems in industries like carpentry, plumbing, and tech. | 2.56 | 1.60 | 0.54 | RQ, NS |
| 4 | Incorporating green building, recycling methods, and sustainable agriculture. | 3.07 | 0.56 | 0.56 | RQ, NS |
| 5 | Integrating how students can start their own businesses based on their technical skills. | 2.66 | 1.80 | 0.53 | RQ, NS |
| 6 | Teaching about solar panel installation, wind turbines — growing fields for TVET. | 3.35 | 0.90 | 0.55 | RQ, NS |
| 7 | Engaging students in STEM concept through innovative teaching method | 3.29 | 1.70 | 0.56 | RQ, NS |
| 8 | Providing instructional materials relating to STEM which could inspire the TVET students | 2.55 | 1.70 | 0.57 | RQ, NS |
| 9 | Emphasizing on scientific application while adopting STEM concept in teaching TVET students | 3.08 | 0.51 | 0.58 | RQ, NS |

Key: X=mean, SD=Standard deviation, Cal=t-calculated, Required, NS= Not significant

Data presented in Table 1 revealed that the mean of the 9 items ranged from 2.55 to 3.35. This shows that each and all of the items had a mean value above the cutoff point of 2.50, which indicated that all 10 items are the STEM concepts needed to enhance students' interest

in TVET through teaching methods. The table also revealed that each and all the items had their standard deviation ranging from 0.51 to 1.90; this shows that the respondents were not far from the mean and one another in their responses. The result of the test of hypothesis in Table 1 indicated that each of the items had its calculated t-value lower than the table value of 1.96. This shows that there was no significant difference in the mean ratings of lecturers and students on the STEM concepts needed to enhance students' interest in TVET through teaching methods. Therefore, the hypothesis of no significant difference was upheld for all 13 items.

**Research Question 2:** What are the roles of STEM in boosting TVET?

**Table 2: Mean rating, standard deviation and t-test analysis of the responses of TVET lecturers and students on the role of STEM in boosting TVET**

| S/N | Item Statement | $\bar{x}$ | SD | t-cal | Remark |
|---|---|---|---|---|---|
| 1 | STEM encourages practical activities, which match the skills focus of TVET. | 3.43 | 1.63 | 0.60 | RQ, NS |
| 2 | STEM activities train students to tackle real-world technical challenges | 2.88 | 1.72 | 0.51 | RQ, NS |
| 3 | STEM teaching connects classroom knowledge with real-life applications. | 2.65 | 1.52 | 0.53 | RQ, NS |
| 4 | Exposure to STEM broadens students' understanding of available TVET career paths. | 3.45 | 1.61 | 0.52 | RQ, NS |
| 5 | TVET students learn to analyze, evaluate, and improve technical processes. | 2.65 | 1.60 | 0.50 | RQ, NS |
| 6 | STEM methods boost numeracy, essential in areas like carpentry, mechanics, and ICT. | 3.15 | 1.72 | 0.61 | RQ, NS |
| 7 | STEM prepares students for industries driven by rapid technological change | 2.75 | 1.63 | 0.53 | RQ, NS |
| 8 | Understanding scientific principles strengthens technical proficiency. | 3.28 | 1.51 | 0.53 | RQ, NS |
| 9 | STEM-based teaching ensures students can use ICT tools in modern TVET sectors | 2.95 | 1.52 | 0.56 | RQ, NS |
| 10 | STEM promotes skills that help students create and manage small businesses | 2.55 | 1.62 | 0.58 | RQ, NS |
| 11 | Teaching eco-friendly practices in TVET prepares students for green jobs | 3.20 | 1.41 | 0.57 | RQ, NS |
| 12 | STEM ensures TVET programs meet current market and technological demands. | 2.85 | 0.54 | 0.59 | RQ, NS |
| 13 | STEM projects teach students to overcome failure through trial and error. | 3.40 | 1.60 | 0.65 | RQ, NS |

Key: X=mean, SD=Standard deviation, Cal=t-calculated, Required, NS= Not significant

Data presented in Table 2 revealed that the mean of the 13 items ranged from 2.55 to 3.40. This shows that each and all of the items had a mean value above the cutoff point of 2.50, which indicated that all 12 items are the role of STEM in boosting TVET through the teaching method. The table also revealed that each and all the items had their standard deviation ranging from 0.54 to 1.72; this shows that the respondents were not far from the mean and one another in their responses. The result of the test of hypothesis in Table 2 indicated that each of the items had its calculated t-value lower than the table value of 1.96. This shows that there was no significant difference in the mean ratings of lecturers and students on the role of STEM in boosting TVET through teaching method. Therefore, the hypothesis of no significant difference was upheld for all the 13 items.

**Research Question 3:** What are the possible challenges of integrating STEM concept in TVET through teaching method?

**Table 3: Mean rating, standard deviation and t-test analysis of the responses of TVET lecturers and students on the possible challenges of integrating STEM concept in TVET.**

| S/N | Item Statement | $\bar{x}$ | SD | t-cal | Remark |
|---|---|---|---|---|---|
| 1 | Students see how science, tech, engineering, and math interact in real work | 2.88 | 1.70 | 0.51 | RQ, NS |
| 2 | Shortage of lab equipment, technology tools, and instructional materials. Setting up modern labs and tech centers can be very expensive. | 3.28 | 1.12 | 0.54 | RQ, NS |
| 3 | Some instructors prefer old ways and are hesitant to adopt STEM approaches | 3.15 | 1.82 | 0.56 | RQ, NS |
| 4 | TVET curricula may not be flexible enough to incorporate dynamic STEM content | 2.66 | 1.76 | 0.58 | RQ, NS |
| 5 | STEM projects often require more time than traditional lessons allow. | 3.32 | 0.90 | 0.54 | RQ, NS |
| 6 | Most of the TVET students are weak in basic STEM subjects struggle with advanced concepts. | 3.15 | 1.81 | 0.56 | RQ, NS |
| 7 | Some students may not see the relevance of STEM to their chosen trade. | 2.64 | 1.73 | 0.57 | RQ, NS |
| 8 | Imported STEM models may not always fit into local industries or students' realities | 3.18 | 0.91 | 0.91 | RQ, NS |

Key : $\bar{x}$=mean, SD=Standard deviation, t-Cal=t-calculated, Required, NS= Not significant

Data presented in Table 3 revealed that the mean of the 8 items ranged from 2.64 to 3.38. This shows that each and all of the items had a mean value above the cutoff point of 2.50, which indicated that all 8 items are possible challenges of integrating STEM concepts in TVET

through the teaching method. The table also revealed that each and all the items had their standard deviation ranging from 0.84 to 1.91; this shows that the respondents were not far from the mean and one another in their responses. The result of the test of hypothesis in Table 3 indicated that each of the items had its calculated t-value lower than the table value of 1.96. This shows that there was no significant difference in the mean ratings of lecturers and students on the possible challenges of integrating STEM concepts in TVET through the teaching method. Therefore, the hypothesis of no significant difference was upheld for all 8 items.

**Research Question 4:** What are the possible solutions to the problem of integrating STEM concept in TVET?

**Table 4: Mean rating, standard deviation and t-test analysis of the responses of TVET lecturers and students on possible solutions to the problem of integrating STEM conception TVET**

| S/N | Item Statement | $\bar{x}$ | SD | t-cal | Remark |
|---|---|---|---|---|---|
| 1 | Organize regular STEM workshops and training for TVET instructors | 3.37 | 1.83 | 0.56 | RQ, NS |
| 2 | Collaborate with industries for internships, mentorships, and equipment donations. | 2.85 | 1.65 | 0.51 | RQ, NS |
| 3 | Adapt STEM teaching using affordable tools and indigenous resources. | 2.68 | 1.77 | 0.54 | RQ, NS |
| 4 | Blend STEM concepts with current vocational subjects rather than creating new ones | 2.79 | 1.59 | 0.61 | RQ, NS |
| 5 | Introduce special programs to encourage more female participation | 3.47 | 1.76 | 0.54 | RQ, NS |
| 6 | Use project-based, inquiry-based, and experiential learning strategies | 3.35 | 1.72 | 0.51 | RQ, NS |
| 7 | Manage large class sizes by dividing students into smaller working groups | 3.25 | 1.60 | 0.76 | RQ, NS |
| 8 | Teach STEM ideas using simple, clear language suitable for vocational learners | 2.88 | 1.72 | 0.51 | RQ, NS |
| 9 | Offer remedial classes or bridge programs before introducing advanced STEM topics | 2.77 | 1.56 | 0.80 | RQ, NS |
| 10 | Create simple, practical rubrics for evaluating STEM-based TVET projects | 2.98 | 1.74 | 0.50 | RQ, NS |
| 11 | Regularly assess and improve STEM initiatives based on feedback and results | 2.91 | 1.66 | 0.55 | RQ, NS |

Key: X=mean, SD=Standard deviation, Cal=t-calculated, Required, NS= Not significant

Data presented in Table 4 revealed that the mean of the 11 items ranged from 2.77 to 3.47. This shows that each and all of the items had a mean value above the cutoff point of 2.50,

which indicated that all 8 items are possible solutions to the problem of integrating STEM concepts in TVET through teaching methods. The table also revealed that each and all the items had their standard deviation ranging from 0.56 to 1.81; this shows that the respondents were not far from the mean and one another in their responses. The result of the test of hypothesis in Table 4 indicated that each of the items had its calculated t-value lower than the table value of 1.96. This shows that there was no significant difference in the mean ratings of lecturers and students on the possible solutions to the problem of integrating STEM concepts in TVET through teaching methods. Therefore, the hypothesis of no significance difference was upheld for all the 11 items.

**Discussion of Findings**

The findings of the study on the concept needed to enhance students interest in TVET through teaching methods revealed that there is need for teachers to engage students on how to ask questions, investigate, and find solutions, understanding how different energy sources work which is vital for electrical, mechanical trades and other areas, using basic statistics to make decisions that is important for quality control, agriculture tech, etc, applying math to real-world problems in industries like carpentry, plumbing, and tech, incorporating green building, recycling methods, and sustainable agriculture, Integrating how students can start their own businesses based on their technical skills, teaching about solar panel installation, wind turbines for growing fields for TVET, Engaging students in STEM concept through innovative teaching method, providing instructional materials relating to STEM which could inspire the TVET students and emphasizing on scientific application while adopting STEM concept in teaching TVET students. The findings of this study align with Ainslie and Huffman (2018) who noted that STEM concepts are not well rooted in the TVET curriculum, hence the authors noted that such concept like basic science should be incorporate into the TVET to enable the students to learn faster the scientific principles that are in STEM. Similarly, the findings agreed with Bowan (2020) who noted that students' enrolment in TVET should be accompanied by their qualification in a science subject. the author observed that having a background knowledgeable in science qualifies someone for the STEM concept. Hence, enrolment into TVET should be for those who have a science background at the secondary school level or thereabout.

The findings of the study on the role of STEM in boosting TVET revealed that STEM encourages practical activities, which match the skills focus of TVET, STEM activities train students to tackle real-world technical challenges, STEM teaching connects classroom

knowledge with real-life applications, exposure to STEM broadens students' understanding of available TVET career paths, TVET students learn to analyze, evaluate, and improve technical processes. Students become comfortable with digital tools needed in modern trades, STEM methods boost numeracy, essential in areas like carpentry, mechanics, and ICT STEM prepares students for industries driven by rapid technological change. STEM-based teaching ensures students can use ICT tools in modern TVET sectors. The findings of this study is in line with Huang (2022) who noted that TVET is a veritable tools for engaging students in a skill acquisition, hence, there is need to properly engage them with STEM concept which will enable them to embrace some science concept for better learning enhancement. Similarly, the findings of the study is in line with Umar et al (2024) who noted that certain roles that could help the STEM to function properly in TVET related area include STEM methods to boost numeracy that is essential in areas like carpentry, mechanics, and ICT; STEM prepares students for industries driven by rapid technological change; STEM-based teaching ensures students can use ICT tools in modern TVET.

The findings of the study on the possible challenges of integrating STEM concept in TVET revealed that there is shortage of lab equipment, technology tools, and instructional materials. Similarly, setting up modern labs and tech centers can be very expensive, some instructors prefer old ways and are hesitant to adopt STEM approaches, too many students make it hard to implement hands-on STEM activities, TVET curricula may not be flexible enough to incorporate dynamic STEM content, STEM projects often require more time than traditional lessons allow, (Students weak in basic STEM subjects struggle with advanced concepts, technical STEM materials are often in complex language, challenging for students, Imported STEM models may not always fit local industries or students' realities. The study is in line with Velychko et al (2022) who found out that even though STEM concept will enhance TVET learning, a lot of challenges could be a hindrance towards actualizing this goal. Such challenges as noted by Velychko et al (2022), could range from financial to technical issues. The findings of Aldehmash et al (2021) support the present findings, noting that a lot of industries where TVET ought to partner with are lacking in the society, hence enrolment in TVET becomes a very big issue, coupled with integrating STEM in the area. Aldehmash et al (2021) noted that since the enrolment of students in TVET is an issue, the integrating of STEM in the area will further increase the poor enrolment since most of the students are afraid of certain science concept or subject.

The findings of the study on the possible solutions to the problem of integrating STEM concept in TVET revealed among the following that there is need to organize regular STEM workshops and training for TVET instructors, collaborate with industries for internships, mentorships, and equipment donations, adapt STEM teaching using affordable tools and indigenous resources, blend STEM concepts with current vocational subjects rather than creating new ones, introduce special programs to encourage more female participation, use project-based, inquiry-based, and experiential learning strategies, Manage large class sizes by dividing students into smaller working groups, teach STEM ideas using simple, clear language suitable for vocational learners and create simple, practical rubrics for evaluating STEM-based projects. The findings is in line with Desimone and Garet (2015) who found out that STEM being a global concept could be blended into the curriculum of TVET to enable it function properly. The authors observed that routine organization of seminar for TVET staff and students on the mode of application of STEM concept in TVET will go a long way. Williams (2018) also noted that there is need to collaborate with industries for internships, mentorships, and equipment donations, adapt STEM teaching using affordable tools and indigenous resources, blend STEM concepts with current vocational subjects rather than creating new ones, among others.

## Conclusion

Integrating STEM concepts into TVET is a strategic approach to enhance student interest and engagement in vocational education. By aligning TVET programs with industry needs and contemporary educational trends, students are better prepared for the workforce. However, successful integration requires collaborative efforts from educational institutions, industries, policymakers, and communities. The study found out that the concept needed to enhance students' interest in TVET through teaching includes understanding how different energy sources work, which is vital for electrical, mechanical trades and other areas, using basic statistics to make decisions that are important for quality control, agriculture tech, etc. Several roles needed by STEM to boost TVET were also identified, coupled with the challenges that could be faced in carrying out this and possible solutions were also captured in this study. Therefore, through concerted actions, STEM-integrated TVET can contribute to the development of a skilled and adaptable workforce, driving economic growth and innovation.

## Recommendations

1. Schools and training institutions should revise their TVET curricula to include more STEM-related content and hands-on activities that encourage innovation and exploration.
2. Regular training and workshops should be provided by relevant authorities to equip them with the knowledge and skills to effectively integrate STEM into their teaching practices.
3. TVET scholars should incorporate technology, experiments, and project-based learning to make TVET subjects more interactive and relatable for students.
4. TVET instructors should collaborate with industries, STEM organizations, and technical experts to provide mentorship, internships, and exposure to real-world applications of TVET.

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