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Research Article

An Assessment of Teachers' Competency and Students' Preparedness in STEM Education: The Case of Ilocos Norte Public Secondary Schools

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ABSTRACT

This study examined the level of teacher competency and student preparedness in Science, Technology, Engineering, and Mathematics (STEM) education in the Schools Division of Ilocos Norte. A descriptive research design was employed using total enumeration of all 99 STEM teachers handling Science, Mathematics, and Technology-related subjects in the 32 public secondary schools offering the STEM strand. Data collection was conducted during the first two months of the second semester of School Year 2025–2026, allowing assessment after the completion of first-semester requirements and alignment with recent 2025 educational literature. Data were gathered through adapted survey instruments consisting of Teacher Competency Checklist and Student Preparedness Checklist, both utilizing a 4-point Likert scale. The instruments were teacher-rated; both teacher competency and student preparedness were assessed based on teachers' perceptions. Quantitative data were analyzed using weighted mean and descriptive interpretation. Results showed that STEM teachers perceived themselves as very highly competent, with the highest ratings in the domains of classroom instruction and content and pedagogy, and as highly competent in the domain of qualification and training. Students are highly prepared in STEM education, as perceived by teachers in terms of academic knowledge, laboratory and technological skills, as well as attitude and study habits. The findings of this study are consistent with inquiry-based and social constructivist theories emphasizing learner-centered instruction and collaborative problem solving. The very high teacher ratings in hands-on learning, open-ended inquiry, and differentiated classroom strategies reflect recommended pedagogical practices. Likewise, students' high preparedness in study habits, persistence, and help seeking behavior supports literature showing that

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teacher competency influences students' preparedness in STEM education.

Keywords: *STEM education, Teacher competency, Student preparedness, Classroom instruction, Professional development, STEM teachers and students*

Background

The K to 12 Basic Education Program is considered as a major reform in the Philippine education system which aims to create a globally competitive curriculum. An important component of this program is the Science, Technology, Engineering, and Mathematics (STEM) strand in Senior High School (SHS) designed to equip students with advanced scientific process skills, deeper conceptual understanding, and practical application of knowledge while fostering scientific attitudes. The Philippine government, with the help of the Department of Science and Technology (DOST), has launched initiatives such as the Science for Change Program (S4CP), Project STAR, and the Philippine Science High School System (PISAY) to enhance STEM education in the country (Habacon, 2023). These programs demonstrate the government's recognition of the growing need for a skilled STEM workforce to support economic growth and drive innovation (Morales et al., 2022). In the context of the Fourth Industrial Revolution, the country must produce more experts in science, technology, engineering, and mathematics to remain globally competitive. Achieving this goal heavily depends on teachers' ability to effectively teach STEM concepts and prepare students for future participation in the STEM workforce (Bongco & David, 2020).

Effective STEM education is dependent on the competency of teachers, which is defined as the capacity to design and deliver instruction that addresses the needs of individual students and curriculum objectives. Competency in teaching involves high levels of content and pedagogical knowledge, classroom instruction, professional development, and formal qualifications (Salaguinto, 2024). However, most Filipino teachers are still struggling with significant challenges in the implementation of STEM education. In Cebu Province, most teachers are tasked with the responsibility of teaching STEM-related subjects without having specialized academic backgrounds . This is a challenge in classroom instruction. Most of these teachers lack the skills to communicate complex scientific and mathematical concepts effectively (Pino et al., 2025). The problem is further exacerbated by the limited availability of professional training and development for teachers. This is a problem for teachers since it hinders their ability to adopt innovative and inquiry-based teaching approaches. The results obtained by Ventista and Brown (2023) indicate that the limited availability of continuous professional training and development directly hinders the ability of teachers to adopt innovative and inquiry-based teaching approaches. Sustained professional development programs, according to You et al. (2025), result in the highest gains in STEM teaching effectiveness and student achievement but are not readily available to teachers in remote areas

Similar problem is also evident in Ilocos Sur, where teachers without specialized knowledge spend a lot of time studying on their own, without any time to learn effective teaching approaches. The lack of specialization is a problem, particularly in science and mathematics, where conceptual knowledge is essential for students to succeed (Javines & Azarias, 2024). This indicates that students are not exposed to specialized teaching that is necessary for them to acquire a good foundation in STEM education.

In Ilocos Norte, the situation is the mirrors these challenges in STEM education. As stated by Antonio et al. (2024), teachers lack skills in teaching methods, especially in classroom assessment. They rely too much on the traditional assessment using multiple-choice type of test. This methos is not capable of measuring higher-order thinking skills, which are needed in STEM education. Some teachers are also not practicing inquiry-based instruction due to the inadequate teaching materials and access to laboratory facilities, which are important for hands-on and technology-based learning. Current reports from the DOST-SEI (2024) and DepEd Regional Office I (2024) have confirmed that there is a shortage of laboratory equipment, internet connectivity, and professional training opportunities among schools and teachers. The presence of out-of-field teachers also affects instruction, making it difficult to sustain student engagement and performance (Cabusor & Antonio, 2025). These challenges limit teachers' ability to sufficiently prepare students for the demand of STEM education, both in high school and college.

On the other hand, student preparedness pertains to the "knowledge, skills, and attitudes required for success" (Shen, 2017). For STEM students, being prepared means having a strong foundation in basic academic knowledge, laboratory and technological skills, and a positive attitude towards learning. However, despite the structural changes in the K to 12 curriculum, many Senior High School students are still struggling in STEM education. Alvarez (2024) noted that many STEM-strand students shift to non-STEM college courses, indicating a gap between the curriculum goals and the students' actual preparedness. Likewise, Jaggy et al. (2025) noted that the lack of systematic instruction and opportunities affects students' motivation to stay in STEM.

These findings indicates the relationship between teacher competency and student preparedness. As Moleta and Yango (2023) proved, teacher competency significantly influences students' academic preparedness and confidence, while Rafanan et al. (2020) found that quality teaching practices are important in instilling students' long-term interest in STEM careers. Nguyen (2025) also reiterated that teacher competence and good teaching delivery are among the best predictors of students' performance in STEM globally.

However, despite the efforts of different stakeholders, some challenges still exist that impede the full attainment of the goals of STEM education. The most recent assessment by DepEd identified that, despite the improvements in enrollment and outreach activities, there are still inconsistencies in the implementation of these activities due to inequities in resource allocation, teacher training, and regional differences in the implementation of programs (Department of Education, 2025). Furthermore, the lack of a systematic approach to professional development has also contributed to the widening gap in competencies. This is exacerbated by the existing problem of "out-of-field" teaching, wherein teachers are assigned to teach subjects outside of their field of specialization. This is a grave concern with respect to the quality of education and may lead to a significant gap in pedagogical content knowledge (Pino et al., 2025). The digital divide that existed during the pandemic also exposed the lack of technological readiness of teachers, particularly in rural areas (Saldívar-Almorejo et al., 2024).

These systemic problems highly affect student preparedness in various regions. According to Fernando et al. (2019), most Senior High School STEM graduates, are not adequately prepared in terms of content knowledge when they enter the university. This lack of preparedness is often associated with high attrition rates in STEM education. Most students, including those who have graduated from the STEM strand, have difficulty coping with the requirements of college STEM education. The academic stress and the absence of foundational knowledge led students to drop out before finishing their degree (Rubas, 2023). This issue is considered as an indicator of the deep-seated educational inequities that hinder the full realization of STEM education. Thus, if these gaps are not addressed, the nation may be deprived of its future scientists, engineers, and innovators who are essential to its economic growth.

Given these realities, data-driven and context-specific interventions are urgently needed. While national policies are important, they also need to be supplemented by localized research and strategies that are tailored to address the specific challenges that divisions like Ilocos Norte face. Problems such as a lack of proficiency in essential teaching practices (Antonio et al., 2024), out-of-field teaching, and a lack of resource utilization (Cabusor & Antonio, 2025) need to be addressed in a manner that is specific to their context, rather than a generic policy response. While these issues point to possible vulnerabilities in the implementation of STEM education, they also pose important questions about how teachers perceive their own competence in resource-constrained educational settings and how this translates to their students' preparedness.

Assessing both teacher competency and student preparedness in the Schools Division of Ilocos Norte offer empirical findings to inform future interventions and policy-making to improve STEM education in the division. In creating data on the factors that affect teacher competency and student preparedness, this research study sought to inform areas for improvement or sustainment in STEM teacher competency and student preparedness in Ilocos Norte. Ultimately, this research study contributes to improving the quality and competitiveness of STEM education in the Schools Division of Ilocos Norte and helps support the overall objectives of national development.

Methods

Research Design

This study employed a descriptive research design. This design described two primary variables: STEM teachers' competency, in terms of content and pedagogy, classroom instruction, and qualification and training, and STEM students' preparedness in STEM education, in terms of academic knowledge, technological and laboratory skills, and attitudes and study habits.

Population and Sampling Procedure

The population of this research consisted of all STEM teachers in the Schools Division of Ilocos Norte who were handling Science, Mathematics, and Technology-related subjects across the 32 public secondary schools that offered the STEM strand for School Year 2025–2026. This study employed total enumeration method and teacher-respondents came from different public secondary schools within each of the zones of the division: East, North, South, and Central. The number of schools offering STEM and the distribution of STEM teachers per zone for School Year 2025–2026 are as follows: 14 schools and 48 teachers (East); 7 schools, 15 teachers (North); 5 schools and 11 teachers (South); 6 schools and 25 teachers (Central).

Research Instrument

This study employed a survey questionnaire consisting of three parts to gather data on teacher competency and student preparedness in STEM education. The instrument was adapted from Moleta and Yango (2023) and Tolentino et al. (2024). Certain modifications were made to suit the context of this study.

Before the implementation of the survey, the reliability and validity of the adapted survey questionnaire were determined through pilot testing and expert validation. The survey questionnaire was subjected to content validation by experts in science, technology, engineering, and mathematics education, to determine the appropriateness, clarity, and relevance of each item. The ratings of the experts were used to calculate the Content Validity Index (CVI), which resulted in a value of 0.88, signifying strong content validity. After which, a pilot test was conducted among a small number of STEM teachers from non-participating schools to determine internal consistency. The reliability of the instrument was determined using Cronbach's alpha, which resulted in a value of 0.81, signifying good internal reliability.

The instrument was composed of three parts: (1) the profiling section, (2) the Teacher Competency Checklist, and (3) the Student Preparedness Checklist. The Teacher Competency Checklist was organized into three domains: (a) content and pedagogy, (b) classroom instruction, and (c) qualification and training. While, the Student Preparedness checklist was also organized in three domains: (a) academic knowledge, (b) laboratory and technological skills, and (c) attitudes/study habit. Responses were measured using a 4-point Likert scale, allowing teacher participants to indicate their level of agreement with the following descriptions: 4 (Strongly Agree); 3 (Agree); 2 (Disagree); 1 (Strongly Disagree). An informal interview was conducted for triangulation purposes.

Data Gathering Procedures

Before the data gathering process, the research proposal was submitted to and evaluated by the University Research Ethics Review Board (URERB) of Mariano Marcos State University. This was done to ensure the safety and well-being of the respondents. The researcher started gathering data after the ethical clearance to conduct the research was granted by the URERB.

Request letters were forwarded to the superintendent of Schools Division of Ilocos Norte to formally seek permission to conduct the research study in the division's public secondary schools and to obtain the necessary data on the population of the study.

To ensure participation of teachers from the different schools, formal letters were given to the principals of the 32 public high schools offering the STEM strand. The letters discussed the purpose and process of the research, and formally asked for the principals' permission to allow their teachers to participate in the study.

After obtaining the principals' consent, the researcher began the formal process of obtaining informed consent from teacher-respondents. The consent forms were carefully distributed to the teacher-respondents after they were thoroughly informed about the purpose of the research, the process of data gathering, the potential risks and/or benefits of the research, how confidentiality would be maintained, and that their participation in the research was completely voluntary. All respondents were also given ample time to review their consent forms and make a decision to participate in the research process.

To ensure efficiency and avoid disruptions in the normal school program, data was collected using electronic methods in the form of self-administered questionnaires that were designed to collect quantitative data from all participants. The questionnaire consisted of a 4-point Likert scale checklist in which teacher competency was self-reported and student preparedness was teacher-rated; both variables were rated by teachers and not the students themselves. The questionnaires were mainly administered through Google Forms. However, in cases when respondents failed to respond, an alternative method was used. The researcher personally visited the respondents to collect data. The respondents were given clear instruction on how to complete and submit their responses. This method ensured that data was comprehensively and accurately collected.

During the data collection process, ethical considerations were strictly upheld to ensure the protection of rights and welfare of the participants. Confidentiality was maintained to safeguard the privacy of all participants. All the information collected were confidential, and the participants were assured of their anonymity. Voluntariness was also emphasized, which ensured that participants were aware of their right to participate in or withdraw from the study without any penalty. The researcher also adhered to the principle of informed consent to ensure that the participants had an opportunity to make their own decisions. Data protection procedures were also strictly observed, and all the data was stored safely to prevent any breaches. Finally, the study was conducted in a way that ensured maximum benefits and minimal harm.

After the data had been collected, it was analyzed using statistical procedures. The results were also presented in a clear and objective manner, ensuring accurate and transparent reporting.

Notably, the data gathering process took place exclusively during the first two months of the second semester of School Year 2025 – 2026. This timeframe was chosen to assess teachers and students after they had completed the first semester's curriculum, ensuring that the findings reflect a high degree of instructional and academic maturity. Furthermore, this period allowed the researcher to validate the results against the latest 2025 research findings in the field of STEM education.

Data Analysis

The analysis of data for this research study was done using descriptive statistics. The weighted mean was employed to describe the level of teachers' competency students' preparedness in STEM education. To describe the competency of STEM teachers, the following ranges of means with their corresponding descriptions were employed: 3.50-4.00 (Very

Highly Competent); 2.50-3.49 (Highly Competent); 1.50-2.49 (Moderately Competent); 1.00-1.49 (Not Competent).

Whereas, to interpret the STEM students' preparedness for STEM education, the following range of means with their corresponding descriptive interpretations were used: 3.50-4.00 (Very Highly Prepared); 2.50-3.49 (Highly Prepared); 1.50-2.49 (Moderately Prepared); 1.00-1.49 (Not Prepared).

Ethical Considerations

Throughout the study, ethical principles were adhered to. The study upheld the principle of confidentiality by ensuring that the privacy of the participants was strictly protected. All the data collected was considered confidential and anonymity was maintained to prevent the linkage of individual responses to specific participants. The study also adhered to the principle of voluntary participation by ensuring that the participants were free to take part or withdraw from the research at any time they want without any penalty. The principle of informed consent was also been strictly followed. Participants were provided with all the necessary information so they could make an informed decision. The security of the data was critically been considered, with all the data stored in a computer being protected from any unauthorized access.

Result and Discussion

Level of Teachers' Competency

Table 1 presents the level of teachers' competency in terms of content and pedagogy, classroom instruction, and qualification and training. The results indicate that teachers' overall level of competency in STEM education is Very Highly Competent (VHC), with an overall mean of 3.55. This suggests that STEM teachers in the Schools Division of Ilocos Norte generally perceive themselves as well-equipped in delivering instruction, managing classrooms, and applying pedagogical strategies aligned with STEM learning goals. Despite the systemic challenges highlighted in the literature, such as the prevalence of out-of-field teaching, limited access to laboratory facilities, and reliance on traditional assessment practices, the very high competency ratings reported in this study may be explained by the self-reported nature of the instrument and the contextual realities of teachers. Self-perception tend to capture teachers' confidence in their day-to-day instructional practices rather than their alignment with ideal or resource-intensive STEM standards. In resource-constrained settings such as the Schools Division of Ilocos Norte, teachers may develop adaptive strategies, pedagogical flexibility, and resilience that allow them to function effectively despite structural limitations. Moreover, teachers may perceive themselves as highly competent within the bounds of what is feasible in their teaching context, even when broader systemic issues persist.

In terms of content and pedagogy, the composite mean of 3.59 (VHC) indicates that teachers believe they possess sufficient content knowledge and are capable of explaining complex STEM concepts in accessible ways. High ratings on items related to checking prior understanding, asking guiding questions, planning differentiated instruction, and fostering a safe environment suggest the use of learner-centered approaches. These practices are consistent with constructivist and inquiry-based models of STEM instruction, which emphasize guided inquiry, problem-based learning, and data-informed teaching to promote deeper conceptual understanding and higher-order thinking (Anchunda & Kaewurai, 2025; Martynenko et al., 2023).

The Classroom Instruction domain obtained the highest composite mean of 3.64 (VHC), indicating that teachers perceive instructional delivery their strength. High ratings on hands-on activities, collaborative learning, technology integration, and individualized support suggest that teachers provide varied and engaging learning experiences. These instructional practices are recognized as indicators of high-quality STEM classrooms that support student engagement, critical thinking, and persistence, particularly in inclusive learning environments (Huang et al., 2022; Martynenko et al., 2023).

Qualitative insights from the informal interviews explains these very high self-ratings in content, pedagogy, and classroom instruction. Teachers described their instructional competence as grounded in experience-based, learner-centered practices, emphasizing clear explanations, scaffolding, differentiated instruction, and the use of real-world examples. They reported regularly adjusting instruction, providing repeated opportunities for mastery, and guiding students through complex concepts using step-by-step approaches and hands-on activities. These narratives reinforce the quantitative findings by illustrating how teachers implement learner-centered strategies within their classroom contexts.

In contrast, Qualification and Training yielded a slightly lower composite mean of 3.41 (HC), indicating greater scope for improvement relative to the other domains. Interview data clarify this pattern, as teachers acknowledged that many STEM educators do not possess postgraduate-level or highly specialized degrees, therefore they require sustained, targeted training to strengthen their competence. However, in cases when formal training opportunities are not given, they rely on collaboration and mentoring sessions to strengthen their competence. Teachers emphasized during the interview process that continuous professional learning opportunities, such as seminars, specialized training programs, Learning Action Cell (LAC) sessions, classroom observations with coaching, and structured peer collaboration, are essential for improving content mastery, laboratory skills, and instructional confidence. Similar patterns are reported in recent studies, which note that many STEM teachers, especially at the secondary level, have strong practical teaching skills but limited advanced specialization in their specific STEM field (Rodríguez et al., 2024; Gümüş & Altan, 2025).

Nevertheless, teachers expressed high to very high competence in engaging in collaboration, undergoing professional learning, and integrating STEM content with best pedagogical practices. This reflects the importance of continuous professional development (CPD) for STEM teachers. Recent meta-analyses and reviews show that sustained, content-focused CPD has a significant positive effect on STEM teachers' self-efficacy and instructional practices (Zhou et al., 2023; Gümüş & Altan, 2025).

Table 1. Mean ratings on the level of teachers' competency.

Domains		Statements	Teachers' Rating	
			Mean	DI
Content and Pedagogy	1.	I have strong content knowledge in my field of specialization.	3.57	VHC
	2.	I can explain complex STEM concepts in a way that students can understand.	3.44	HC
	3.	I use problem-based learning pedagogies in my STEM teaching.	3.52	VHC
	4.	I include opportunities in STEM curriculum for students to engage in open-ended inquiry.	3.57	VHC
	5.	I regularly use assessment data to adjust my teaching strategies and support student learning in STEM.	3.55	VHC
	6.	I use adequate resources (e.g., equipment, technology) to support effective STEM education.	3.38	HC
	7.	I try to find out if students understand their past lessons before teaching a new lesson.	3.74	VHC
	8.	I ask questions that help students understand STEM lessons.	3.78	VHC
	9.	I plan differentiated instruction to meet the diverse needs of STEM students.	3.58	VHC
	10.	I create a safe and supportive environment for students to take risks and learn from mistakes in STEM.	3.77	VHC
		Composite Mean	**3.59**	**VHC**
Classroom Instruction	11.	I contribute opportunities for hands-on experience.	3.68	VHC
	12.	I can be a mentor or advisor.	3.69	VHC

Domains	Statements	Teachers' Rating	
		Mean	DI
	13. I utilize collaborative learning strategies (e.g. think-pair-share, group discussion) in my STEM classroom.	3.75	VHC
	14. I am doing activities to contribute to the level of preparedness of students for a career in STEM.	3.69	VHC
	15. I provide individualized support and feedback to help students succeed in STEM.	3.55	VHC
	16. I effectively integrate technology into STEM lessons to enhance learning.	3.65	VHC
	17. I create a classroom environment that is respectful of individual differences.	3.75	VHC
	18. I utilize a variety of resources, including manipulatives, models, and simulations.	3.52	VHC
	19. I rephrase explanations in different ways to ensure student comprehension.	3.74	VHC
	20. I use a variety of scientific models and representations to enhance understanding.	3.42	HC
	Composite Mean	**3.64**	**VHC**
Qualification and Training	21. I have an advanced level of academic qualification in a STEM discipline.	3.10	HC
	22. I collaborate with other STEM teachers in the school.	3.43	HC
	23. I undergo training and professional learning opportunities to support my STEM teaching.	3.36	HC
	24. I am confident in my ability to teach STEM subjects.	3.40	HC
	25. I support collaborative learning for STEM education purposes using indicators of students' learning outcomes and the level of their engagements.	3.54	VHC
	26. I understand that identifying teachers' perceptions of scientific literacy is essential for raising students' scientific literacy.	3.66	VHC
	27. I am knowledgeable in terms of my subject matter.	3.53	VHC
	28. I am highly qualified and trained to teach STEM subjects.	3.18	HC
	29. I am knowledgeable in obtaining, evaluating, and communicating information.	3.46	HC
	30. I demonstrate the ability to effectively integrate STEM content knowledge with pedagogical best practices to foster student learning and engagement.	3.45	HC
	Composite Mean	**3.41**	**HC**
	Overall Mean	**3.55**	**VHC**

Legend:	**Range of Means**	**Descriptive Interpretations (DI)**
	3.50 – 4.00	Very Highly Competent (VHC)
	2.50 – 3.49	Highly Competent (HC)
	1.50 – 2.49	Moderately Competent (MC)
	1.00 – 1.49	Not Competent (NC)

Overall, the results in Table 1 indicate that teachers in the division are pedagogically strong and instructionally effective, as reflected in their very high self-ratings in classroom instruction and learner-centered strategies. However, the Qualification and Training domain obtained the lowest composite mean, with the item on advanced academic qualifications scoring only 3.10, suggesting that not all teachers possess postgraduate or specialized STEM degrees. This pattern implies a distinction between teachers' strong instructional confidence and their formal academic credentials. Qualitative insights explains that teachers' high self-perceived competence is grounded in practical experience, adaptive strategies, and localized teaching knowledge developed through daily classroom practice rather than advanced formal training. Teachers reported relying on scaffolding and contextualized instruction to effectively address classroom realities and diverse student needs. Also, the relatively lower ratings in qualification and training highlight the need for sustained, specialized professional development and stronger institutional support. Taken together, these findings suggest that while STEM teachers in the Schools Division of Ilocos Norte are instructionally resilient and pedagogically capable, further investment in advanced formal training and systemic support is essential to sustain and enhance high-quality STEM instruction (J & Ramnath, 2025).

Level of Student Preparedness in STEM Education

Table 2 shows the level of student preparedness in terms of academic knowledge, laboratory and technological skills, and attitudes/study habits. Table 2 reveals that teachers generally perceive students in STEM education as highly prepared (HP), with an overall mean of 3.35. Across the three domains, students are rated as possessing the fundamental competencies needed to engage in STEM learning, with particularly strong ratings in the affective and self-regulatory aspects. This finding is consistent with recent STEM preparedness frameworks that highlight the interplay of cognitive, technical, and non-cognitive skills for college and career readiness (Huang et al., 2022).

For academic knowledge, the composite mean of 3.30 (HP) indicates that students are perceived to have a good foundation in core STEM disciplines (Physics, Chemistry, Biology) and in Mathematics. While they are rated as prepared in basic mathematical concepts and in interpreting graphs, tables, and charts, the relatively lower means in solving complex, non-routine problems suggest that higher-level problem-solving skills can still be improved. Qualitative insights clarify this finding as teachers emphasized that students benefit from structured scaffolding, tutoring, and mentorship, which help them navigate complex concepts, build confidence, and strengthen problem-solving skills. However, these supports are not always uniformly available, which may contribute to the moderate preparedness in non-routine tasks. International assessments and recent STEM studies similarly report that many students perform better on routine items than on complex, higher-order tasks (OECD, 2021; Mullis et al., 2020).

Teachers also perceive that STEM students participate in research or project-based work and can communicate ideas effectively, which aligns with current STEM frameworks emphasizing investigation, communication, and collaboration as central competencies (Anchunda et al., 2025). However, the moderate ratings on preparedness for internships and experience with complex problem-solving suggest that opportunities for authentic, real-world STEM tasks and industry/community exposure are still limited – an issue highlighted as a challenge in many secondary STEM programs globally (Martynenko et al., 2023). This is further supported by qualitative insights of teachers where they highlighted that schools should promote STEM-focused programs, clubs, and competitions to motivate students to engage in scientific exploration beyond the classroom. Furthermore, partnerships with universities, industries, and research centers can give students real-world exposure and deepen their appreciation for the relevance of STEM in solving global challenges.

In terms of laboratory and technological skills, the composite mean of 3.28 (HP) indicates that students are generally comfortable following laboratory procedures, using equipment safely, and adapting to common digital tools such as multimedia presentation platforms. However, lower ratings were noted in independently designing experiments, troubleshooting experimental problems, understanding programming concepts, and creating simple databases. Qualitative insights strongly illuminate these gaps. Teachers repeatedly emphasized that meaningful STEM learning requires access to well-equipped laboratories, updated materials, reliable internet connectivity, and sufficient time for hands-on experimentation. The limited facilities, inadequate equipment, and constrained instructional time often force experiments to be conducted in classrooms rather than proper laboratories, reducing opportunities for extended inquiry and independent design. Thus, while students may demonstrate procedural familiarity with laboratory work and basic technology use, deeper inquiry skills and computational thinking remain underdeveloped due to structural and resource-related constraints. This finding aligns with studies showing that frequent technology use does not automatically translate into advanced computational and design competencies (Harangus & Kátai, 2020; Gasaymeh & Al-Mohtadi, 2024).

The attitudes and study habits domain obtained the highest composite mean of 3.46 (HP), with several indicators falling within the very highly prepared (VHP) range, particularly in persistence, adaptability, help-seeking behavior, and learning from mistakes. Qualitative evidence strongly supports this result. Teachers consistently described students as motivated, goal-oriented, and eager to succeed in STEM, especially when supported by encouraging teachers, mentoring relationships, and a learning environment where asking questions is welcomed. Teachers further highlighted students' resilience, willingness to seek help, and capacity to manage academic responsibilities, particularly when exposed to supportive programs such as STEM clubs, seminars, competitions, scholarships, and career guidance initiatives. These findings align with Dimal (2025), who reported strong links between positive attitudes, perseverance, effective study habits, and sustained performance in STEM subjects.

Comparing the three domains, the findings suggest that students' attitudes and study habits are relatively stronger than their academic and laboratory/technological skills. This implies that, while students may still be developing advanced conceptual and technical competencies, they already have the motivation, resilience, and self-management skills to cope with the demands of STEM education. This is consistent with the study of Walck-Shannon et al. (2021) stating that such affective strengths can help students gradually overcome gaps in academic knowledge and technical skills over time, provided that institutional resources, experiential learning opportunities, and instructional supports are strengthened.

Table 2. Mean ratings on the level of student preparedness in STEM education.

Domains		Statements	Teachers' Rating	
			Mean	**DI**
		The STEM students…		
Academic Knowledge	1.	have a strong foundation in the principles of Physics, Chemistry, and Biology.	3.14	HP
	2.	can effectively analyze and interpret data from graphs, charts, and tables.	3.32	HP
	3.	feel confident in their understanding of fundamental mathematical concepts.	3.20	HP
	4.	feel confident in their problem-solving and critical thinking skills.	3.22	HP
	5.	can solve complex mathematical problems.	3.11	HP
	6.	conducted research that has prepared them for STEM education.	3.30	HP
	7.	can communicate their ideas clearly and concisely, both verbally and in writing.	3.42	HP
	8.	are engaging in or participating in STEM-related projects/initiatives that support their STEM education.	3.43	HP

Domains	Statements	Teachers' Rating	
		Mean	DI
	The STEM students…		
	9. have experience working in a team to solve STEM problems or complete a project.	3.41	HP
	10. are participating/about to participate in STEM-related internships that will help them to pursue their career goals.	3.39	HP
	Composite Mean	**3.30**	**HP**
Laboratory and Technological Skills	11. are comfortable working in a laboratory setting, following safety protocols.	3.45	HP
	12. can use laboratory equipment accurately and safely.	3.34	HP
	13. can follow laboratory procedures, including those complex experimental setups.	3.38	HP
	14. can design and conduct experiments independently.	3.16	HP
	15. can troubleshoot problems that arise during experiments.	3.14	HP
	16. can create and present information effectively using multimedia tools.	3.43	HP
	17. can adapt to using new digital tools and software with relative ease.	3.45	HP
	18. can troubleshoot basic technical issues with digital devices and software they commonly use for their studies.	3.24	HP
	19. can understand basic programming concepts and can create simple code relevant to STEM applications.	3.15	HP
	20. can design a simple digital database to address a STEM-related problem.	3.07	HP
	Composite Mean	**3.28**	HP
Attitudes/ Study Habits	21. have clear college goals.	3.27	HP
	22. have a distinct desire to succeed in college STEM courses.	3.44	HP
	23. are motivated and quick to get things done.	3.43	HP
	24. are organized and disciplined in their study habits (If something needs to be done, they do it promptly).	3.38	HP
	25. know how to seek help and support when needed to overcome academic challenges.	3.51	VHP
	26. know the importance of not giving up and sticking through difficult times.	3.60	VHP
	27. can adapt to new learning environments and challenges.	3.53	VHP
	28. can balance their academic pursuits with other responsibilities.	3.35	HP
	29. can take responsibility for their decisions, for they are good decision maker/s.	3.43	HP
	30. can learn from their mistakes and grow as learners.	3.61	VHP
	Composite Mean	**3.46**	**HP**
	Overall Mean	**3.35**	**HP**

Legend:	**Range of Means**	**Descriptive Interpretations (DI)**
	3.50 – 4.00	Very Highly Prepared (VHP)
	2.50 – 3.49	Highly Prepared (HP)
	1.50 – 2.49	Moderately Prepared (MP)
	1.00 – 1.49	Not Prepared (NP)

Overall, the results in Table 2 indicate that students are generally well-prepared for STEM education, especially in terms of attitudes and study habits, but there is room to further strengthen higher-order academic, laboratory, and technological skills. Both the quantitative and qualitative findings highlights that student preparedness in STEM is not solely an individual attribute but an outcome shaped by instructional practices, institutional resources, and supportive learning environments.

While students demonstrate strong motivation and preparedness to engage, sustained improvements in academic and technical preparedness require consistent access to hands-on learning, updated facilities, structured scaffolding, and authentic STEM experiences. These findings underscore the need for continued emphasis on inquiry-based and problem-based instruction, authentic laboratory experiences, integration of computational thinking, and industry- or community-linked STEM projects so that students' positive dispositions are translated into advanced STEM education preparedness (Anchunda et al., 2025).

Conclusion

Considering the results of the study, the following conclusions were drawn.

STEM teachers generally perceived themselves very highly competent in content and pedagogy as well as classroom instruction. While highly competent in qualification and training.

Whereas, in terms of student preparedness, teachers perceived STEM students are highly prepared in terms of academic knowledge, laboratory and technical skills, and attitude and study habits.

Thus, this study concurs with the social constructivist theory, which states that knowledge is actively built through interaction, inquiry, and collaborative classroom experiences, leading to improved student motivation, preparedness, and persistence in STEM education.

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