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Navigating Integrated Stem Learning Environments (ISLES) through the lens of the faculty and students of Philippine Science High School Cagayan Valley Campus

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Abstract

This study examined the perceptions of faculty members and students of the Philippine Science High School–Cagayan Valley Campus (PSHS-CVC) regarding Integrated STEM Learning Environments (ISLEs). Specifically, it investigated how both groups perceive key constructs associated with integrated STEM education and explored the relationships among these constructs through correlation analyses. The study also identified challenges encountered by faculty members in designing and implementing ISLEs and determined the institutional and professional support needed to facilitate their effective integration. A survey research design employing a descriptive–correlational approach was utilized to collect both quantitative and qualitative data from faculty members and students through structured questionnaires with open-ended responses. Results revealed that faculty members demonstrated highly positive perceptions toward integrated STEM education. Teachers reported very high levels of self-efficacy and strong beliefs in their capacity to effectively teach STEM, along with high levels of technology integration, inquiry-based instructional practices, and strong adherence to 21st-century teaching and learning attitudes. Correlation analyses indicated significant relationships among faculty perception constructs, particularly between self-efficacy and student–teacher relationships ($r = 0.914$), self-efficacy and integrated STEM approaches ($r = 0.743$), and technology use and integrated STEM approaches ($r = 0.916$). These findings suggest that teacher confidence, technological competence, and positive teacher–student relationships play vital roles in the successful implementation of ISLEs. Students also expressed high to very high perceptions across the examined constructs, including self-efficacy, learning strategies, technology use, classroom climate expectations, and student–teacher relationships. Correlation analyses among student constructs showed strong interconnections, particularly between technology use and academic expectations, and between learning strategies and self-efficacy. Despite these positive perceptions, faculty members identified several implementation challenges, including time constraints, limited resources, ICT knowledge gaps, and policy limitations. They also emphasized the need for capacity-building programs, improved technological infrastructure, institutional support, and strengthened collaborative networks. Overall, the findings underscore the importance of sustained institutional support, professional development, and resource provision to effectively implement integrated STEM learning environments.

Keywords: integrated stem learning environments, self-efficacy, student-teacher relationship

Navigating Integrated Stem Learning Environments (ISLES) through the lens of the faculty and students of Philippine Science High School Cagayan Valley Campus

1. Introduction

Educators encounter a wide range of challenges in the classroom on a daily basis. From planning instructional activities to implementing them effectively, each stage of the teaching process demands considerable effort, creativity, and professional commitment. Teachers are expected to design meaningful learning experiences that not only align with curriculum standards but also respond to the diverse needs, abilities, and learning styles of their students. Consequently, educators must continuously refine and adapt their teaching strategies to ensure that instruction remains relevant, engaging, and effective in promoting meaningful learning outcomes. Despite spending long hours delivering lectures, facilitating discussions, and guiding hands-on learning activities, teachers often engage in reflective practice to evaluate the effectiveness of their instruction. They critically examine whether the lessons achieved the intended objectives, whether students demonstrated satisfactory performance in assessments, and whether the strategies employed were appropriate for the learners' needs. Through this reflective process, educators identify areas for improvement and make necessary adjustments to their instructional approaches. Such continuous reflection and refinement form an integral part of the cyclical process of improvement that characterizes effective teaching and learning.

Similarly, learners face their own set of challenges within the classroom environment. Educational institutions expect students to comprehend complex concepts, apply interdisciplinary knowledge, and perform diverse academic tasks collaboratively. At the same time, students must adapt to varying instructional approaches used by different teachers and adjust to the learning environments in which they operate. These demands require learners to develop flexibility, critical thinking, and collaborative skills in order to succeed academically. Together, the dynamic interactions between teachers' instructional practices and students' learning experiences shape the overall effectiveness of the educational process. The rapid technological advancements and complex global challenges of today's generation have led educational systems to shift from traditional teaching-learning processes such as memorization and independent content delivery towards a more interdisciplinary, problem-based, and student-centered approaches. These approaches emphasize fostering Science, Technology, Engineering, and Mathematics (STEM) proficiency and promoting economic growth, innovation, and sustainability.

In order to meet the expectations of institutions for both teachers and students, teachers play a critical role in promoting engagement and delivering effective STEM instructions. Teachers must create learning environments that foster the integration of STEM subjects, encourage interdisciplinary collaboration, and provide students with authentic learning experiences that model real-world experiences (Paderna & Monterola, 2021). These learning environments, referred to as Integrated STEM Learning Environments (ISLEs), serve as effective platforms in developing STEM competencies and interest of students. Integrated STEM learning environments are contexts of learning in which students are immersed in applying more than one discipline of STEM in solving real-world problems (Yang & Baldwin, 2020). Unlike traditional STEM education where the four disciplines are taught in silos (English, 2016), ISLEs promote interdisciplinary connections, enabling students to develop not only a better understanding of STEM concepts but also an appreciation and increase in interest in pursuing STEM careers (Christensen & Knezek, 2017). While ISLEs promise numerous opportunities and advantages to both students and teachers, successful implementation of these environments also poses several challenges.

In the Philippines, STEM was popularized as a strand in the senior high school program of the Basic Education Curriculum under the Enhanced Basic Education Act of 2013 (Paderna & Monterola, 2021). However, like most nations, STEM education in the Philippines is still predominantly taught independently or in separation. The poor performance of Filipino students in both science and mathematics based on international and national assessments (Paderna & Monterola, 2021) justified the immediate call for substantial reforms and innovations in STEM education in the country. In the specific context of the Philippine Science High School System (PSHSS), these concerns are similarly reflected. Teachers face challenges in implementing interdisciplinary STEM instruction due to curriculum limitations and a lack of structured integration across the disciplines. With the school's mission to establish a recognizable brand of STEM education through high-quality and diverse academic programs, teachers are then highly encouraged to deliver quality STEM instruction that allows students to become globally competitive STEM professionals. While efforts have already been made to achieve such mission, the gap between the intended and actual learning outcomes remains. While isolated efforts have been made to integrate STEM concepts into student research projects and electives, a fully developed and systematically implemented ISLE has yet to be realized.

This study was anchored on the 2030 Agenda of the United Nations, specifically the Sustainable Development Goal 4 on Quality Education. This goal aimed to ensure inclusive and equitable quality education and to promote lifelong learning opportunities to people through effective teaching strategies and supportive learning environments (UN, 2015). Additionally, this study also supported the strategic goals of PSHSS on strengthening STEM education by delivering quality STEM education through innovative and research-based instructional practices (PSHSS, n.d.). Finally, this research was also aligned with the research agenda of Nueva Vizcaya State University, particularly on disciplinary intersection through Science, Technology, Engineering, Arts and Mathematics (STEAM) education and instructional design and learning sciences (NVSU College of Teacher Education, 2019). By analyzing how integrated STEM learning environments are perceived by faculty snd students, this study can contribute to understanding how interdisciplinary instructional design can be done and how it can potentially enhance the learning experiences and outcomes of students, thereby promoting data-driven developments in STEM education.

While international research had widely explored the potential and challenges of ISLEs, there remains a lack of local studies that examine how these learning environments are perceived, understood, created or implemented by teachers and students within the country's basic education system. Moreover, there is little evidence on how integrated STEM learning can be designed in a way that is feasible, meaningful, and effective in the unique context of Philippine Science High School. These gaps must be addressed to inform future curriculum development and support the professional development of teachers in STEM integration. This study aimed to explore the perceptions of faculty and students regarding integrated STEM learning environments, particularly within the context of the Philippine Science High School System. Specifically, this study sought to answer the following questions:

1. What are the perceptions of both faculty and students about integrated STEM learning environments in terms of the following constructs: self-efficacy and beliefs, teaching outcome expectations, use of technology, STEM teaching strategies, 21st-century teaching attitudes, knowledge on integrated STEM approaches, and student-teacher relationships?

2. What are the perceptions of the students about integrated STEM learning environments in terms of the following constructs: self-efficacy and beliefs, academic journey expectations, use of technology, STEM learning strategies, 21st-century learning attitudes, classroom climate expectations, and student-teacher relationships?

3. Are there significant correlations among the constructs for faculty perceptions about integrated STEM learning environments: self-efficacy and beliefs, teaching outcome expectations, use of technology, STEM teaching strategies, 21st-century teaching attitudes, knowledge on integrated STEM approaches, and student-teacher relationship?

4. Are there significant correlations among the constructs for student perceptions about integrated STEM learning environments: self-efficacy and beliefs, academic journey expectations, use of technology, STEM learning strategies, 21st-century learning attitudes, classroom climate expectations, and student-teacher relationships?

5. What challenges do teachers encounter that limit their design and implementation of an integrated STEM

learning environment?

6. What support do teachers need to create and implement an integrated STEM learning environment?

2. Related Literature

This study is grounded in several key theoretical foundations, including Constructivist Learning Theory, Situated Cognition Theory, and the Integrated STEM Education framework (Kelley & Knowles, 2016).

One of the most significant reminders for teachers in designing learning experiences is that knowledge is not directly transmitted from the teacher to the student; learners must construct knowledge on their own based on their experiences. This view of learning, coined as constructivism, considers the learner as an active participant in the knowledge acquisition process (Bada & Olusegun, 2015). Constructivist views of learning have historical roots dating back to the 1920s, with notable contributions from Dewey (1929), Bruner (1961), Vygotsky (1962), and Piaget (1980), among others. Constructivism is a teaching-learning approach based on the idea that learning is the result of mental construction. Students learn by combining new information with what they have already acquired. Constructivist theorists believe that learning is affected by the environment or context in which students learn, as well as their beliefs and attitudes.

According to Tam (2000, as cited in Bada & Olusegun, 2015), a constructivist learning environment is a context in which teachers and learners share knowledge and authority. In addition, it is an environment where the teacher acts as a facilitator, allowing students to learn in small groups. In this kind of learning environment, learning is viewed as an active process of information transmission through meaning-making, based on experiences, collaboration, and reflection. In the ISLE context, the constructivist theory emphasizes the role of students as active agents in solving authentic problems. The existing knowledge they acquire from multiple disciplines of STEM becomes a key tool for solving authentic problems, thereby constructing new information. In connection with this study, the teaching-learning strategies and 21st-century teaching-learning attitudes of the students and teachers are explored, adapted to fit the context of an integrated STEM learning environment. Additionally, as constructivist learning environments encourage learners and teachers to share authority, the student-teacher relationship is considered one of the key constructs in determining the perceptions of both students and teachers about ISLEs.

Another theory, the Social Cognitive Theory (SCT), proposed by Albert Bandura (1977) , provides a comprehensive framework for this study, enabling an understanding of how individuals acquire knowledge within social contexts. While SCT primarily focused on observational learning, acquiring knowledge by observing others, it has since evolved to encompass key psychological constructs, such as self-efficacy, motivation, self-regulation, and reciprocal determinism (Schunk & DiBenedetto, 2023). The central focus of SCT is the concept of self-efficacy, which refers to an individual's awareness of their capabilities to carry out specific behaviors. According to this theory, behavior is shaped by the interaction of various factors, such as outcome expectations—the individual's belief that their actions lead to their desired outcomes. In the ISLE context, self-efficacy and outcome expectations are used as constructs to determine how teachers and students perceive integrated STEM learning environments. For students, classroom climate expectations - or how they would expect a classroom environment in an integrated STEM learning environment would be considered as one of the constructs in the study.

Recent research studies on this theory include technology-mediated learning theory, which posits that the teaching-learning process between teachers and students can be enhanced through the use of technology, utilizing digital technologies and educational technologies in the classroom as aids for a more effective teaching-learning process (Bower, 2019). Thus, another construct that measures the teachers' and students' use of technology in the classroom is included in the study. Another important framework for this study is the Integrated STEM Education Framework by Kelley and Knowles (2016), which provides a structural and pedagogical perspective on how ISLEs can be created and realized. It highlights the growing concern to break down the boundaries of teaching the four disciplines of STEM and promote meaningful integration of these disciplines through collaborative, problem-based learning activities. It caters to educational researchers and educators, serving as a guide for conducting studies related to integrated STEM education.

The framework centers on learning theories and pedagogies that facilitate the achievement of key learning outcomes in integrated STEM. The framework encourages educators to remain true to the nature of the STEM disciplines as applied to real-world contexts. Thus, they must possess strong content and pedagogical content knowledge to design learning environments that enable students to make connections among STEM disciplines through authentic experiences, helping them learn the underlying concepts and skills in a meaningful way, rather than solely through direct instruction. Based on this framework as well as the constructivist theory, the teachers' knowledge of integrated STEM approaches is considered a construct for determining teacher perceptions about ISLEs. This framework also served as the basis for addressing the challenges and opportunities for the design and implementation of integrated STEM learning environments.

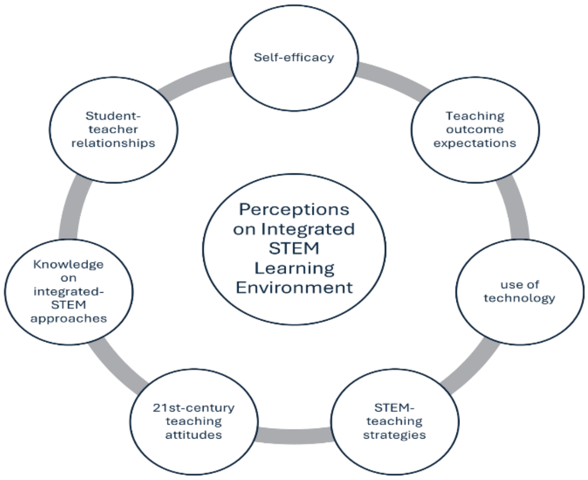

Figure 1. *The Paradigm of the Study (Faculty)*

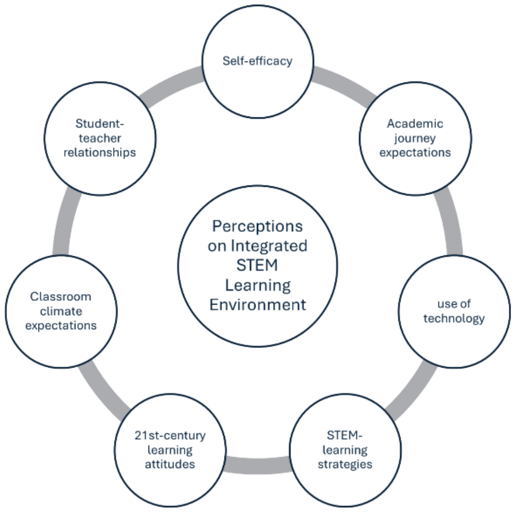

Figure 2 *The Paradigm of the Study (Students)*

Self-efficacy and beliefs refer to a teacher's confidence to teach STEM while teaching outcome expectations refer to the teacher's belief, in general, that student-learning in STEM subjects can be influenced by teacher actions. The use of technology construct refers to how teachers integrate technology in their instructions and/or assessments. Moreover, STEM teaching strategies refer to how often teachers use instructional strategies used in STEM education while 21st-century teaching attitudes reflect on the mindset of teachers about 21st-century learning which exercise the 21st-century skills of students (Friday Institute for Educational Innovation, 2012). Student-teacher relationships, on the other hand, refer to how teachers perceive the importance of communication, interaction, and connection with students in a classroom. Knowledge on integrated STEM approaches measures the awareness of the teachers about different STEM integration practices in the classroom as characterized in a STEM learning environment (Yang & Baldwin, 2021).

For the students, their self-efficacy, outcome expectations, learning strategies, use of technology, 21st-century learning attitudes, classroom climate expectations, and student-teacher relationships were considered as constructs in exploring their perception of integrated STEM learning environments. Student self-efficacy and beliefs refers to their confidence to understand STEM concepts, applying knowledge gained across the STEM disciplines, and completing STEM-related tasks individually or collaboratively. Academic journey expectations refer to the student's belief that certain actions lead to desired results – how classroom experiences contribute to their academic growth and future STEM careers. Use of technology refers to the extent to which students use digital tools and educational technologies in the classroom. STEM learning strategies, on the other hand, refer to how students actively participate in understanding and applying STEM concepts while 21st-century learning attitudes reflect the students' preparedness to collaborate, use technology, and participate in inquiry-based learning environments (Friday Institute of Educational Innovation, 2012). Classroom climate expectations refer to students' perceptions of how supportive, collaborative, respectful, and engaging learning environments are expected to be (Fairhurst et al., 2021). Meanwhile, student-teacher relationships reflect how students perceive the importance of communication, interaction, and connection with mentors are.

Collectively, the constructs mentioned across both groups represent the cognitive (self-efficacy and beliefs, expectations), instructional (teaching and learning strategies, use of technology), attitudinal (21^{st}-century skills), and environmental (classroom climate expectations and student-teacher relationships) dimensions of integrated STEM learning environments. The interconnection of these constructs reflects the complex and dynamic nature of ISLEs.

3. Methodology

This study employed a survey research design incorporating both closed-ended and open-ended questions to examine the perceptions and experiences of faculty members and students regarding integrated STEM learning environments (ISLEs). Survey research involves systematic procedures in which researchers administer questionnaires to a portion of a population to describe attitudes, opinions, behaviors, or characteristics of the broader group (Creswell & Guetterman, 2021). Although surveys commonly utilize quantitative items such as Likert-scale statements, open-ended questions may also be included to capture deeper insights from respondents (Creswell & Guetterman, 2021). The use of surveys is particularly valuable in identifying current educational trends, attitudes, and practices among educators, including their self-efficacy, knowledge, and classroom implementation of integrated STEM approaches. As noted by Yang and Baldwin (2020), examining these constructs helps policymakers and educational leaders determine the necessary support systems for teachers in designing and implementing effective integrated STEM learning environments. Furthermore, incorporating qualitative responses allows respondents to articulate their experiences and perspectives, thereby enriching the interpretation of quantitative findings and providing a deeper understanding of the challenges and possible strategies associated with implementing ISLEs (Bartram, 2019).

This study also utilized a descriptive-correlational approach to address the research objectives. Descriptive research aims to systematically characterize the population or phenomenon under investigation (Singh, 2023), while correlational research examines the relationships among two or more variables within a single group without manipulating them (Devi et al., 2023). When combined, descriptive-correlational research describes variables using statistical measures and determines the degree of association among them without experimental intervention (Clarete et al., 2023). This approach was appropriate for the present study because it enabled the researcher to describe the respondents' perceptions and explore the relationships among the constructs related to integrated STEM learning environments within the natural educational setting of the Philippine Science High School–Cagayan Valley Campus (PSHS-CVC).

The research was conducted at PSHS-CVC, located in Masoc, Bayombong, Nueva Vizcaya, by the end of the 2024–2025 school year. Established in 1996 and transferred to its current location in 2010, the institution serves as a specialized secondary school that emphasizes science and technology education. The target population consisted of 57 faculty members and 683 students enrolled during the academic year. Guided by the framework of Bujang and Baharum (2016) for correlation studies, the sample included 16 faculty members and 83 students, exceeding the minimum sample sizes required to detect statistically meaningful correlations. This ensured adequate statistical power and reduced the likelihood of Type II error.

Data were collected using separate survey questionnaires for faculty and students, adapted from validated instruments such as the Teacher Efficacy and Attitudes toward STEM (T-STEM) Survey (Friday Institute for Educational Innovation, 2012) and the Classroom Emotional Climate Questionnaire (Fairhurst et al., 2023). The instruments underwent expert validation and reliability testing, achieving acceptable reliability coefficients above 0.80. The questionnaires employed a five-point Likert scale to measure constructs including self-efficacy, teaching and academic expectations, use of technology, instructional strategies, 21st-century attitudes, classroom climate, and student–teacher relationships, along with open-ended questions to capture perceived challenges and possible strategies.

The survey was administered online through Google Forms on May 6, 2025, with separate links distributed to faculty and students through official school email accounts. The first section of the form included an informed consent statement outlining the purpose of the study, voluntary participation, confidentiality measures, and the right of participants to withdraw at any time. Responses were collected until the end of May 2025. Data were subsequently cleaned and anonymized prior to analysis to ensure confidentiality and compliance with ethical guidelines established by the Philippine Health Research Ethics Board (2022).

For data analysis, descriptive statistics such as mean, standard deviation, and frequency distribution were used to present the levels of perception among respondents. Spearman rank correlation analysis was employed to examine the relationships among the constructs measured through Likert-scale items. In addition, Gaussian graphical models were utilized to visualize the network of relationships among variables (Bhushan et al., 2019). Statistical analyses were conducted using Jamovi, an open-source statistical software, at a 5% level of significance. Qualitative responses from open-ended questions were subjected to thematic analysis using Airtable, where themes were identified through systematic coding, and those mentioned by at least 50% of respondents were considered the major themes of the study.

4. Results and Discussion

This study examined the perceptions of faculty members and students of the Philippine Science High School–Cagayan Valley Campus (PSHS-CVC) regarding Integrated STEM Learning Environments (ISLEs). Specifically, the research sought to determine how both groups perceive key constructs associated with integrated STEM education and to explore whether these constructs are interrelated through correlation analyses. In addition, the study investigated the challenges faced by faculty members in designing and implementing ISLEs and identified the forms of institutional and professional support needed to facilitate their effective integration in the school. To achieve these objectives, the study employed a survey research method that gathered both quantitative and qualitative data. Quantitative data provided measurable insights into the perceptions of faculty members and students across various constructs, while qualitative responses from open-ended questions allowed participants to articulate their experiences, concerns, and suggestions regarding the implementation of integrated STEM learning environments.

The results of the study revealed that faculty members demonstrated highly positive perceptions of integrated STEM teaching and learning. In particular, teachers reported very high levels of self-efficacy and strong beliefs in their ability to teach STEM effectively. Self-efficacy reflects teachers' confidence in their capacity to plan, implement, and evaluate instructional activities related to STEM integration. Such confidence is essential in innovative learning environments where interdisciplinary connections and problem-based learning approaches are required. Alongside this, teachers also reported high levels of teacher outcome expectancy, indicating their belief that effective instruction can significantly influence students' academic achievement and learning outcomes in STEM-related subjects.

In addition, faculty members reported high levels of technology use in their classrooms, suggesting that digital tools and technological resources are already integrated into their instructional practices. The teachers also indicated a strong emphasis on inquiry-based and authentic learning strategies, which are essential features of integrated STEM education. Inquiry-based instruction encourages students to investigate real-world problems, formulate questions, and explore solutions through critical thinking and experimentation. Authentic learning tasks, meanwhile, allow students to apply knowledge from different STEM disciplines to meaningful and practical contexts. These instructional strategies reflect teachers' commitment to fostering student-centered and experiential learning environments that align with the principles of integrated STEM education.

Furthermore, faculty members expressed very high regard for 21st-century teaching and learning attitudes, emphasizing the importance of creativity, collaboration, communication, and critical thinking in preparing students for future challenges. Teachers also reported high levels of STEM pedagogical knowledge, which indicates their understanding of how STEM concepts can be effectively integrated across disciplines. Another notable finding was the strong perception of positive student–teacher relationships, highlighting the importance of trust, respect, and supportive interactions within the classroom. Such relationships play a crucial role in promoting student engagement, motivation, and meaningful participation in learning activities.

The correlation analyses conducted among the faculty perception constructs revealed significant relationships that provide deeper insights into the dynamics of integrated STEM teaching practices. One of the most notable findings was the strong correlation between teachers' self-efficacy and student–teacher relationships ($r = 0.914$). This result suggests that teachers who possess higher levels of confidence in their teaching abilities are more likely to foster stronger and more positive relationships with their students. Confident teachers may be better able to facilitate discussions, guide collaborative learning, and provide constructive feedback, all of which contribute to a supportive classroom environment. In addition, self-efficacy was also strongly correlated with integrated STEM approaches ($r = 0.743$). This indicates that teachers who believe in their instructional capabilities are more inclined to embrace interdisciplinary teaching practices and implement integrated STEM activities in their classrooms.

Another important finding from the faculty data was the strong correlation between technology use and integrated STEM approaches ($r = 0.916$). This result highlights the significant role that technology plays in facilitating interdisciplinary learning and problem-solving activities. Digital tools, simulation platforms, data analysis software, and collaborative online environments can support students in exploring complex STEM concepts and working together to address authentic problems. The strong relationship between these constructs suggests that teachers view technology not merely as a supplementary tool but as an integral component of effective integrated STEM instruction. Overall, these findings indicate that teacher confidence, technological competence, and positive teacher–student relationships are key factors that influence the successful implementation of integrated STEM learning environments.

From the perspective of students, the results likewise demonstrated positive perceptions across the various constructs examined in the study. Students reported high levels of self-efficacy, indicating confidence in their ability to learn and succeed within integrated STEM learning environments. Such confidence is essential for students engaging in interdisciplinary learning tasks that often require problem-solving, collaboration, and the integration of knowledge from multiple subject areas. Students also expressed very high expectations regarding their academic journey within integrated STEM environments, reflecting optimism about the potential benefits of such learning experiences. Moreover, students reported very high perceptions of technology use within the integrated STEM learning environment, suggesting that they recognize the importance of digital tools and technological resources in supporting learning activities. Technology enables students to access information, conduct research, visualize complex concepts, and collaborate with peers, all of which enhance their learning experiences in STEM-related subjects. In addition, students indicated high levels of confidence in their learning strategies, suggesting that they are capable of adapting to interdisciplinary tasks that require independent inquiry, teamwork, and problem-solving.

The findings also revealed that students demonstrated very high levels of 21st-century learning attitudes, including openness to innovation, collaboration with peers, and the willingness to explore new ideas. Students also reported very positive perceptions of classroom climate expectations and student–teacher relationships, highlighting the importance of a supportive and inclusive learning environment. When students perceive the classroom as safe, collaborative, and intellectually stimulating, they are more likely to participate actively in learning activities and engage meaningfully with integrated STEM tasks. Correlation analyses conducted among student perception constructs further revealed strong interconnections among several variables, particularly between technology use and academic journey expectations, as well as between learning strategies and self-efficacy. These findings suggest that students who perceive technology as an integral component of their learning environment also tend to have higher expectations for their academic development. Similarly, students who possess effective learning strategies tend to demonstrate stronger confidence in their ability to perform STEM-related tasks. These relationships highlight the importance of technology integration, supportive classroom environments, and student confidence in shaping meaningful learning experiences within integrated STEM contexts.

Despite the generally positive perceptions expressed by both faculty members and students, the study also identified several challenges that may limit the effective implementation of integrated STEM learning environments. Faculty members reported difficulties related to time constraints and curriculum pressures, which often make it challenging to design interdisciplinary lessons that require extensive planning and coordination. Teachers also noted limited resources and gaps in ICT knowledge, which can hinder the effective integration of technology into STEM instruction. Additionally, some faculty members expressed concerns about their own knowledge and confidence in implementing integrated STEM approaches, as well as student-related challenges, such as varying levels of preparedness and engagement. Other concerns included limitations in collaborative practices and institutional policies, which may restrict opportunities for interdisciplinary teaching and innovation.

In response to these challenges, faculty members identified several forms of support that would facilitate the successful implementation of integrated STEM learning environments. Among the most frequently mentioned supports were capacity-building programs and professional development opportunities, which would enable teachers to strengthen their knowledge and skills in integrated STEM pedagogy. Faculty members also emphasized the need for adequate resources and technological infrastructure, including access to digital tools, laboratory equipment, and learning materials. Additionally, teachers highlighted the importance of institutional and collegial support, such as collaborative planning time, administrative encouragement, and supportive school policies that promote interdisciplinary teaching practices. Finally, faculty members recommended strengthening linkages and knowledge-sharing mechanisms, including partnerships with external organizations, professional learning communities, and collaborative networks that can support the continuous improvement of integrated STEM practices.

Overall, the findings of this study indicate that both faculty members and students hold positive perceptions toward integrated STEM learning environments. Teachers demonstrate strong confidence in their instructional capabilities and recognize the importance of technology, collaboration, and innovative teaching strategies. Likewise, students express optimism, confidence, and readiness to engage in interdisciplinary learning experiences supported by technology and positive classroom relationships. However, the study also highlights the need for sustained institutional support, professional development, and increased resource allocation to ensure the successful implementation of integrated STEM education. Addressing these challenges will enable schools to fully realize the potential of integrated STEM learning environments in preparing students with the knowledge, skills, and competencies necessary for the demands of the 21st century.

5. Conclusion

The results of the study led to the following conclusions:

- Teachers at PSHS-CVC are highly confident and highly equipped with strong pedagogical knowledge and commitment to implement integrated STEM approaches. However, gaps remain in knowledge on assessment practices, interdisciplinary lesson design, and access to resources.
- Students perceive ISLEs to be highly engaging, relevant, and technology-driven. While students have high expectations of their learning journey in ISLE, they also perceive it to enhance collaboration, authentic learning experiences, and problem-solving skills.
- Challenges such as time constraints, limited resources, and inadequate institutional alignment pose as threats to the whole or actual implementation of integrated STEM learning environments, despite the faculty's strong willingness and positive perceptions towards these learning environments.

- Supports needed by faculty members for the successful implementation of ISLEs include capacity building for interdisciplinary and technology-enhanced teaching, provision of resources and infrastructure, institutional and collegial support for collaboration, and strengthening connections both internal and external.

These findings affirm that a supportive, technology-driven, and collaborative culture for learning and teaching is necessary to sustain ISLEs within the Philippine Science High School System.

Recommendations - The results of the study and its conclusion led to several recommendations for the benefit of the students, teachers, school leaders, other stakeholders, as well as future researchers.

- The school shall create professional development opportunities focusing on integrated STEM pedagogies, interdisciplinary designing of lessons, and creation of assessments for learning. Furthermore, the school, albeit the system, shall enhance access to laboratory equipment, ICT, and digital resources or educational technologies that support technology-based, problem-based, or project-based learning. The system should also revisit curriculum mapping and policy alignment to allow flexible scheduling and encourage interdisciplinary collaboration across subject teachers. Lastly, to encourage collaboration and increase knowledge and confidence in integrating STEM not only in STEM disciplines but also in humanities subjects, co-teaching or mentoring sessions across disciplines can be conducted.

- Teachers should be given opportunities to engage in continuous learning through professional development opportunities and peer collaboration to design inquiry-based, authentic, and interdisciplinary lessons. They should have opportunities to leverage digital tools not only for content delivery but also for creativity, design, and real-world applications, thereby strengthening the relevance of subjects taught in real-world contexts among students. Teachers are also encouraged to foster independent learning and risk-taking opportunities among students by creating safe learning spaces where experimentation and failure are part of the process. Lastly, teachers are highly encouraged to integrate formative assessments that measure not only knowledge of content but also foster students' collaboration, innovation, and problem-solving skills.

- Students should be given opportunities to actively participate in collaborative STEM projects and utilize technology responsibly to enhance problem-solving and creativity. They should also be encouraged to develop self-regulated learning habits such as goal-setting, time management, and reflection to strengthen their 21st-century skills. Lastly, students shall be given opportunities – either autonomously or through teacher-guidance- to seek interdisciplinary connections between STEM subjects and real-world challenges to cultivate innovation and adaptability.

- Future researchers may conduct longitudinal or comparative studies across different PSHS campuses or even DepEd schools to examine variations in ISLE perception and/or implementation. Researchers may also explore intervention-based research that can evaluate the effects of specific professional development or technology-enhanced instructional programs. Others may investigate student learning outcomes and performance indicators beyond perceptions to assess the actual effect of integrated STEM learning environments or evaluate the effectiveness of ISLEs in schools. Additionally, researchers may also explore or evaluate the different strategies involved in implementing ISLEs in schools.

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