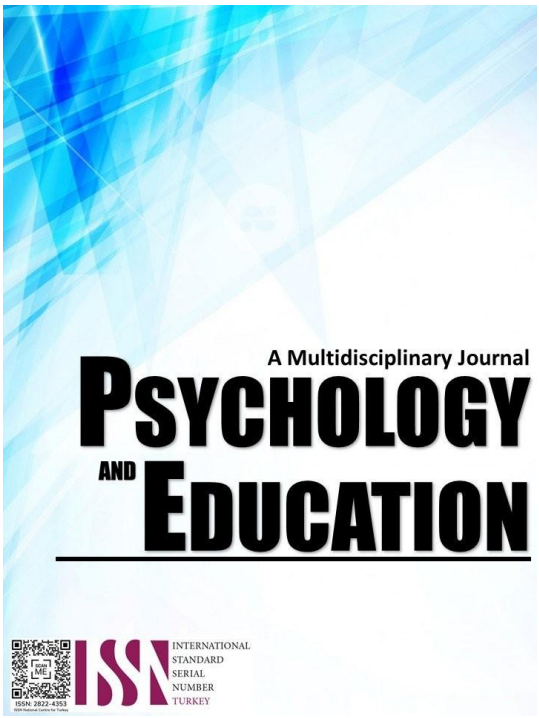
STEMULATING ENTREPRENEURIAL MINDS: INNOVATIVE PEDAGOGICAL PRACTICES FOR INTEGRATED LEARNING IN KIAMBA DISTRICT, SARANGANI PROVINCE



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Research Article

STEMulating Entrepreneurial Minds: Innovative Pedagogical Practices for Integrated Learning in Kiamba District, Sarangani Province

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Abstract

Developing an entrepreneurial mindset is recognized as crucial in STEM education, where integrating business concepts, project-based learning, mentorship, and technology enhances learners' ability to solve real-world problems and innovate (Strimel et al., 2019; Lerario, 2020). In the Philippines, particularly in STEM education, there remains a limited emphasis on fostering creativity and innovation through formal education, despite calls for teaching strategies that encourage authentic design and practical solutions (Velasco, 2013; Anito and Morales, 2019; Honrado and Calimlim, 2021; DeCoito, 2023). However, in regions like Kiamba, Sarangani Province, research is lacking on how these innovative pedagogical strategies—such as PBL, IBL, and Work Immersion—are experienced and localized, highlighting the need for qualitative studies exploring their impact on entrepreneurial mindset development within the local STEM context. This qualitative study explored the innovative pedagogical practices used to foster entrepreneurial thinking in STEM strand education within Kiamba, Sarangani Province. Guided by Social Cognitive Theory, Constructivist Theory, Innovation Diffusion Theory, and Entrepreneurial Value Creation Theory, the research focused on understanding how educators integrate entrepreneurship into STEM, the challenges they face, and the strategies they employ. Ten senior high school STEM teachers participated in semi-structured interviews, revealing that practices such as Project-Based Learning, Inquiry-Based Learning, Design Thinking, and Experiential Learning are instrumental in promoting creativity, problem-solving, and innovation. Despite their effectiveness, challenges such as limited resources, rigid curricula, and insufficient teacher training hinder full implementation. Teachers adapt by localizing content, employing blended learning, and fostering collaboration to meet learners' needs. Findings also emphasized the need for stronger institutional support, curriculum flexibility, and community partnerships. This study highlights the importance of contextualizing entrepreneurial education within the STEM strand to better equip learners with the mindset and skills needed in today's dynamic world. The insights generated can guide policymakers, educators, and school leaders in developing more inclusive and effective educational strategies that align with local realities while cultivating innovation and economic resilience through integrated STEM and entrepreneurship education.

Keywords: *pedagogical practices, entrepreneurial mindset, STEM education, integrated learning, localized material, innovative pedagogy, educational challenges*

Introduction

The pressing need to equip learners with not only technical proficiency but also entrepreneurial thinking has emerged as a key strategy in achieving economic competitiveness and innovation. Strimel et al. (2019) emphasized that while students often develop novel ideas during high school, they lack formal avenues to transform these into viable investments. Lerario (2020) further highlighted that globally, entrepreneurship education in STEM relies on strategies like business course integration, project-based learning, and partnerships with industries to bridge theory and real-world application.

In the Philippines, Velasco (2013), Strimel et al. (2019), Anito and Morales (2019), Honrado and Calimlim (2021), and DeCoito (2023) revealed that entrepreneurial education is often startup-centered, with insufficient focus on creativity and innovation, prompting a need for more integrative classroom practices. However, despite this growing emphasis, Kiamba in Sarangani Province has seen limited qualitative exploration into how such pedagogies are applied locally. The Department of Education (2023) has supported interdisciplinary integration across subjects, but how this plays out in entrepreneurship within STEM remains unclear.

Ribeiro et al. (2023) argued that entrepreneurship nurtures enterprising citizens capable of driving societal change. Hynes et al. (2023) and Liston and O'Sullivan (2023) advocated for STEM education that fosters creativity and a broader understanding of economic and ethical contexts. Dyantyi and Faleni (2023) pointed out that although entrepreneurship is being included in various programs, its delivery and outcome measurement remain inconsistent, especially in scientific disciplines like chemistry. El Atmani et al. (2023) added that teaching innovation in entrepreneurship needs support from mentors, tailored programs, and private sector engagement.

Strimel et al. (2019) reinforced that entrepreneurial mindsets are essential in navigating today's uncertain, competitive world. Fawaida et al. (2023) demonstrated how students integrated traditional and modern technologies in business through STEM-oriented entrepreneurial activities. Meanwhile, Beard (2014) and Nye (2012) showcased international educator-entrepreneurs whose work emphasized innovative learning models accessible to global learners.

National scientists like Davide, Alcala, Cruz, Tecson-Mendoza, and Del Mundo illustrated the Philippine context of science-driven entrepreneurship, blending research, community service, and enterprise (Ramon Magsaysay Awards, 2023; Marfal, 2023; Department

of Science and Technology, 2024; National Academy of Science and Technology, 2024; Bellis, 2019). Their work exemplifies how scientific inquiry can translate into transformative educational and social innovations.

Digital formative assessment, as discussed by Capocci and Burton (2023), and Anastasopoulou et al. (2024), offers educators tools to personalize learning and evaluate progress in entrepreneurial STEM subjects, yet also raises concerns around equity and data privacy. Eltanahy et al. (2020) and Bosman and Shirey (2023) supported experiential models like E-STEM and bioengineering to foster interdisciplinary learning and entrepreneurial skill-building. Dacumos (2023) and Zavalevskyi et al. (2023) confirmed that PBL and blended learning enhance engagement and real-world readiness.

Ammar et al. (2024) showed that personalized teaching approaches in STEM promote innovation despite teacher readiness and resource gaps. Buang et al. (2009, as cited by Sufirman and Siew, 2023) developed the Science Entrepreneurial Thinking (SET) model that links scientific observation to marketable ideas. Marin et al. (2023) highlighted the importance of integrating entrepreneurial marketing into STEM education for problem-solving.

Sickel (2023) and Douglass (2023) stressed the role of design thinking and interdisciplinary collaboration in developing entrepreneurial mindsets, while Rahmaniar (2020), Asigigan and Samur (2021), and Tuong et al. (2023) emphasized that integrating entrepreneurship into STEM improves students' readiness for the evolving workforce. Lee and Ke (2018), Bybee (2013), and Konrad et al. (2021) advocated for inquiry and project-based learning to nurture entrepreneurial thinking.

Aggarwal and Dhir (2019) explained that blending STEM with entrepreneurship equips learners with problem-solving and adaptability skills. Smith and Johnson (2021) added that such integration increases motivation and understanding. Bernardus et al. (2023) and Wardana et al. (2020) showed that experiential learning and self-efficacy play critical roles in mindset development.

Cahyani et al. (2022) and Sun et al. (2023) explored how mindset and motivation mediate entrepreneurial readiness, while Handayati et al. (2020) focused on vocational students' entrepreneurial intentions. Holzner and Halberstadt (2022) and Le et al. (2021) investigated contextual challenges in STEM education, and Wang et al. (2021) emphasized creativity's role in mindset growth.

Rodriguez and Lieber (2020), Secundo et al. (2020), Saadat et al. (2021), and Wibowo et al. (2022) offered insights into best practices and cultural considerations in entrepreneurship education. Le et al. (2021) linked entrepreneurial mindset to career adaptability, reinforcing the long-term value of early integration.

Despite growing global and national recognition, local studies remain scarce—particularly in Kiamba—on how innovative pedagogical practices foster entrepreneurial thinking within STEM. This study addresses that gap, guided by the Social Cognitive Theory (Bandura, 1986), Constructivist Theory (Piaget, 1970), Innovation Diffusion Theory (Rogers, 1962), and Entrepreneurial Value Creation Theory (Mishra and Zachary, 2015). These frameworks collectively support a comprehensive exploration of the strategies, challenges, and innovations that shape integrated entrepreneurial STEM education in the Kiamba context.

Research Questions

This study aimed to explore how innovative pedagogical practices shaped the development of entrepreneurial thinking within STEM strand education in Kiamba, Sarangani Province. Specifically, it aimed to answer the following:

1. What are the current pedagogical practices employed to stimulate entrepreneurial thinking in STEM strand learners of the schools in Kiamba, Sarangani Province?
2. What are the key challenges and barriers faced by teachers and learners in implementing innovative pedagogy for integrated learning and entrepreneurship skills in the STEM strand?
3. What innovative pedagogical practices can be adopted to enhance integrated learning and foster entrepreneurial thinking among learners in the STEM strand?
4. How do teachers adapt their pedagogical practices to address the unique needs and contexts of learners in promoting entrepreneurial thinking and integrated learning within STEM education in Kiamba?
5. What support mechanisms do teachers identify as essential for effectively implementing innovative pedagogical practices aimed at stimulating entrepreneurial thinking and integrated learning within STEM schools in Kiamba?

Methodology

Research Design

This study employed a qualitative research design anchored in Creswell's (2013) principles. The goal was to explore how innovative pedagogical practices are being utilized to foster entrepreneurial mindsets among STEM learners in Kiamba, Sarangani Province. This approach was chosen for its suitability in providing a comprehensive and nuanced understanding of participants' lived experiences, beliefs, and practices, without the imposition of pre-existing theoretical frameworks. The goal was to allow meaning to emerge organically from the data, grounded in participants' own words and contexts.

In alignment with Creswell's emphasis on purposeful sampling, the study intentionally selected information-rich participants—STEM educators from various schools in the district—based on their direct involvement in curriculum delivery and innovation. These

participants were identified as capable of offering deep insights into the realities of pedagogical integration, local constraints, and contextual adaptations. The qualitative design enabled the researcher to gather complex, detailed descriptions that would not be accessible through quantitative means, thereby offering a more authentic account of educational practices that influence entrepreneurial thinking within STEM learning environments.

Respondents

The participants of this study were ten (10) senior high school teachers from various schools within the Kiamba District, Sarangani Province. These teachers were purposively selected based on specific criteria aligned with the objectives of the study. All respondents were actively involved in implementing innovative pedagogical practices that integrate STEM (Science, Technology, Engineering, and Mathematics) education with entrepreneurship concepts. Their selection was guided by their teaching experience in STEM-related subjects, participation in entrepreneurship education initiatives, and their willingness to provide in-depth insights into their practices.

Purposive sampling was employed to ensure that the respondents possessed relevant expertise and experiences critical to exploring how entrepreneurial mindsets are fostered in STEM education. Their participation allowed for a rich exploration of the strategies, challenges, and contextual factors influencing the implementation of integrated learning in the municipality of Kiamba. The sample size was deemed sufficient for a qualitative study, as it enabled the researcher to gather comprehensive narratives that could inform a deeper understanding of the realities of STEM and entrepreneurship education in this local setting.

Instrument

The researcher conducted a thorough validation process for the semi-structured questionnaire to ensure its reliability and relevance to the study's objectives. This process involved five expert validators with diverse qualifications, including a doctoral degree holder, two master's degree holders, a master teacher, and a school principal, who collectively provided comprehensive feedback from both academic and practical educational perspectives. The validation instrument used was adapted from Robles (2019), Development and Validation of Educational Video Tutorial for 21st Century Secondary Learners, which assesses questionnaires based on ten key criteria: appropriateness of scale, suitability of items, relevance of items, clarity of direction, adequateness of items, organization, objectivity, comprehensiveness, data generation, and attainment of purpose. The questionnaire received a total mean score of 4.60, categorizing it as Very Highly Valid and indicating its capacity to yield unbiased data with a minimal error margin of 0–5%.

The semi-structured questionnaire, adopted and modified from Farhana et al. (2023) and Kubat (2018), was designed to explore multiple facets of integrating entrepreneurial skills into STEM education. Participants were asked to provide their definitions of entrepreneurial skills within the STEM context, describe innovative pedagogical strategies they use to stimulate entrepreneurial thinking, and identify any localized materials or innovations they have developed or observed. They also reflected on the efficacy of these practices and identified challenges faced during implementation. Additional items probed methods of assessing entrepreneurial mindsets, the potential role of STEM education in fostering entrepreneurial competencies, and experiences collaborating with local businesses.

The instrument further sought insights into necessary resources and adaptations for effective integration, the customization of teaching approaches to accommodate diverse learning styles, the use of technology in teaching entrepreneurial skills, and examples of successful student demonstrations of entrepreneurship resulting from these methods. This thorough validation and comprehensive questionnaire design ensured that the data gathered would be both credible and rich in detail, supporting the study's aim to investigate the integration of entrepreneurship within STEM education.

Procedure

To better understand how innovative teaching practices in STEM education help develop an entrepreneurial mindset among students, this study gathered information through semi-structured interviews and Key Informant Interviews (KIIs). These methods were intentionally chosen to give teachers the space to openly share their thoughts, experiences, and challenges, while also allowing the researcher to ask follow-up questions and explore important details more deeply.

Before any interviews were conducted, the researcher made sure to follow ethical research procedures. This included securing formal permission from school heads and education authorities in the Kiamba District. Each participant received a letter of consent explaining the study's purpose, their voluntary involvement, and their right to withdraw at any time. All participants agreed and signed the consent form before taking part in the study.

The actual data gathering started with scheduling interviews with ten teachers who were carefully chosen based on their experience and active involvement in blending entrepreneurship concepts into their STEM teaching. The interviews were conducted face-to-face, depending on each participant's availability and convenience, and typically lasted between 45 minutes to one hour. A set of open-ended guide questions was used to keep the conversation focused while giving enough room for the participants to speak freely. The questions touched on their teaching methods, how they integrated entrepreneurship into STEM lessons, what results they observed in their students, and the difficulties they faced along the way.

In addition to these regular interviews, Key Informant Interviews were also held with teachers who held leadership or curriculum-related roles. These interviews provided a broader perspective on how schools support or implement entrepreneurial education and

how policies and structures influence their teaching practices.

With the participants' permission, all interviews were audio-recorded, and the researcher also took field notes to capture non-verbal cues and the setting's context. Afterward, the recordings were carefully transcribed word-for-word to ensure that no meaningful detail was lost.

The data were then analyzed using Reflexive Thematic Analysis based on Braun and Clarke (2006, 2019). Analysis followed six stages: familiarization, coding, theme generation, theme review, theme definition, and reporting. This method was chosen for its flexibility and alignment with the constructivist paradigm, allowing rich interpretation of patterns and themes grounded in participant experiences.

This in-depth process allowed the study to uncover valuable insights and build a clearer picture of how entrepreneurial thinking is being cultivated through classroom innovation in a local educational setting.

Ethical Considerations

Ethical clearance was secured from the Mindanao State University–General Santos City Institutional Ethics Review Committee, which issued a Certificate of Exemption. Participants provided informed consent, and anonymity was preserved through KII (Key Informant Interview) codes. All data were securely stored and used strictly for academic purposes.

Results and Discussion

Current Pedagogical Practices that Stimulate Entrepreneurial Thinking in STEM Strand Learners

This section addresses the research question on the current pedagogical practices used to foster entrepreneurial thinking among STEM strand learners in Kiamba, Sarangani Province. It highlights teachers' insights on how classroom strategies and instructional approaches are designed to promote innovation, creativity, and problem-solving aligned with entrepreneurship education.

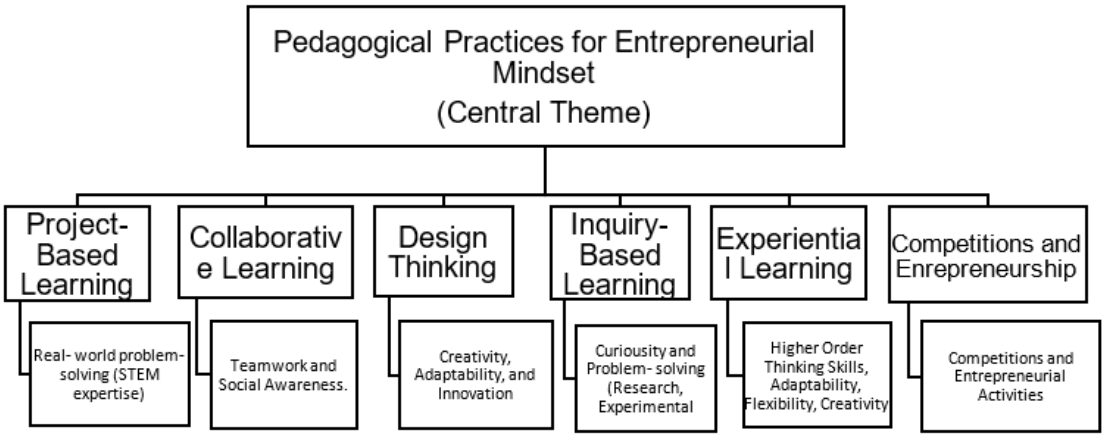

Figure 1. *Pedagogical Practices Employed to Stimulate Entrepreneurial Mindset*

Figure 1 illustrates the six key pedagogical approaches used to cultivate an entrepreneurial mindset in learners. These themes emerged from the analysis as recurring strategies in educational settings: Project-Based Learning, which emphasizes real-world problem-solving and STEM expertise; Collaborative Learning, which fosters teamwork and social awareness; Design Thinking, which promotes creativity, adaptability, and innovation; Inquiry-Based Learning, which nurtures curiosity and problem-solving through research and experimentation; Experiential Learning, which develops higher-order thinking skills, adaptability, flexibility, and creativity; and Competitions and Entrepreneurship, which engage students in entrepreneurial activities. Collectively, these pedagogical practices contribute to shaping learners who are innovative, resilient, and equipped for entrepreneurial challenges.

Theme 1. Project-Based Learning (PBL)

Project-Based Learning (PBL) consistently emerged as the most emphasized strategy in fostering entrepreneurial thinking in STEM education, as it effectively connects classroom concepts to real-world scenarios and engages students in practical, hands-on problem-solving. Teachers highlighted how PBL encourages the application of STEM knowledge in authentic projects—such as science investigatory activities—that cultivate critical thinking, creativity, collaboration, and adaptability, all essential traits of an entrepreneurial mindset. Complementary approaches like collaborative learning, design thinking, and experiential learning also support this goal by promoting soft skills such as leadership and communication. Literature affirms that PBL deepens understanding, improves knowledge retention, and prepares students for real-life challenges (Dacumos, 2023; Zhou, 2023). However, challenges such as complex lesson planning, resource demands, assessment difficulties, and varying student engagement require institutional support and thoughtful implementation. Despite these hurdles, the findings strongly suggest that PBL remains a cornerstone of innovative pedagogy, bridging theory and practice to prepare learners for future entrepreneurial pursuits.

Theme 2. Collaborative Learning

Collaboration plays a pivotal role in STEM education by equipping students with essential 21st-century skills such as teamwork, communication, and problem-solving through structured group tasks (KII 2, KII 5, KII 7). Informants emphasized that collaborative learning not only fosters academic competence but also cultivates social awareness and entrepreneurial thinking by encouraging students to work collectively toward shared goals while maintaining individual accountability. This balance mirrors real-world entrepreneurial environments where cooperation and personal initiative are both crucial. As students engage in socially relevant problem-solving activities, they gain exposure to diverse perspectives, deepening their understanding and empathy. Study supports that such collaborative strategies enhance intrinsic motivation, critical thinking, and classroom inclusivity, contributing to overall student success (Loes, 2022). However, effective implementation requires careful planning, skilled facilitation, and institutional support to address common challenges such as uneven participation, group conflicts, and classroom management issues (Siller and Ahmad, 2024). Thus, prioritizing well-designed collaborative learning models and teacher training is essential to foster socially responsible and entrepreneurially inclined learners.

Theme 3. Design Thinking

Design thinking offers a structured yet flexible approach to STEM education, guiding students through stages of empathizing, defining problems, ideating, prototyping, and testing to develop user-centered and innovative solutions (KII 3; KII 10). This process nurtures key entrepreneurial competencies such as adaptability, creativity, and critical thinking, enabling students to meaningfully address real-world technological and social challenges. Informants emphasized how design thinking empowers learners to continually refine their ideas through feedback and real-user interaction, thereby fostering deeper engagement and iterative learning. This is supported by Bene and MacNeilly (2020), who assert that design thinking promotes collaboration, empathy, and radical idea generation, making it an effective tool for enhancing teamwork and problem-solving in diverse settings. However, challenges remain, particularly in the Philippine education context where class periods are limited to 45 minutes. As Laursen and Haase (2019) point out, the absence of methodological clarity in design thinking may hinder its practical implementation, requiring educators to move beyond general suggestions and adopt more context-specific strategies. Despite these constraints, integrating design thinking into STEM instruction remains a promising pathway for cultivating innovation and entrepreneurial mindsets among learners.

Theme 4. Inquiry-Based Learning

Inquiry-based learning (IBL) is a powerful pedagogical strategy that fosters curiosity, independence, and problem-solving—core elements of entrepreneurial thinking—by encouraging students to actively explore, ask questions, and experiment (KII 3; KII 9). Informants emphasized that this approach helps learners engage deeply with real-world challenges, cultivating insights and adaptability necessary for navigating entrepreneurial environments. Grounded in constructivist theory, IBL positions students as active participants in constructing their own knowledge through hands-on investigation and exploration, thereby enhancing critical thinking and resilience (Gholam, 2019). It also supports differentiated instruction and deeper engagement by allowing students to pursue inquiry paths aligned with their interests. However, despite its potential, IBL faces implementation challenges, particularly when educators lack experience in guiding meaningful inquiry or when assessment tools are unclear, leading to shallow classroom interactions and subjective evaluations (Mao, 2023). Therefore, while IBL holds promise for enriching STEM education with entrepreneurial competencies, its success depends on well-prepared teachers and structured assessment frameworks to ensure authentic and effective learning experiences.

Theme 5. Experiential Learning

Experiential learning, as highlighted by informant KII8, empowers STEM students to apply theoretical knowledge in real-world contexts, thereby fostering higher-order thinking skills such as critical thinking, creativity, adaptability, and flexibility—traits essential to entrepreneurial success. This pedagogical approach enhances student engagement by allowing them to take ownership of their learning, develop original solutions, and actively reflect on their experiences (Rodrigues, 2023). Through structured, hands-on activities embedded in authentic scenarios, learners bridge the gap between abstract concepts and practical applications, reinforcing entrepreneurial competencies. When experiential learning integrates both theoretical foundations and real-life practice, it supports a dynamic educational process where students evolve into self-directed problem solvers. However, as Yang et al. (2021) caution, this method is not without its limitations; challenges such as acculturative stress, language barriers, and social pressures—especially in global or diverse learning environments—can hinder student development and diminish the efficacy of experiential approaches. Thus, while experiential learning holds considerable promise in STEM-entrepreneurship education, its successful implementation requires thoughtful adaptation, supportive learning environments, and culturally responsive strategies to fully realize its transformative potential.

Theme 6. Competitions and Entrepreneurship

Integrating competitions and entrepreneurial activities into STEM education significantly enhances creativity, innovation, and adaptability by immersing students in realistic, high-pressure scenarios that demand the practical application of knowledge and skills. As noted by informant KII10, combining design thinking, project-based learning, and entrepreneurship with competitions elevates student engagement and transforms experiential learning into more authentic, motivating experiences. These competitive formats

reinforce critical thinking, teamwork, and solution-oriented mindsets while aligning learning with real-world entrepreneurial demands (Reimer et al., 2020). Moreover, such activities reflect core tenets of Social Cognitive Theory, which underscores the importance of learning through active participation, observation, and interaction within social contexts. Students gain self-efficacy, interpersonal skills, and technical expertise as they collaborate and learn from peers, thereby reinforcing both cognitive and behavioral competencies vital for professional success. However, while competitions can catalyze motivation and performance, Murray (2019) cautions that they may marginalize lower-performing students, provoke stress—particularly among linguistically diverse learners—and shift focus away from collaboration and empathy. To ensure equity and holistic growth, educators must design inclusive, balanced experiences where competitive elements are strategically integrated with reflective, collaborative, and supportive practices. Positioned thoughtfully, competition serves not as the central mechanism but as one of many tools to cultivate entrepreneurial thinking and real-world readiness in diverse STEM classrooms.

Key Challenges and Barriers in Implementing Innovative Pedagogy in STEM Strand

The following discussion addresses the research question: What are the key challenges and barriers faced by teachers and learners in implementing innovative pedagogy for integrated learning and entrepreneurship skills in the STEM strand? The discussion seeks to illuminate the complex realities educators and learners face, providing valuable insights into the gaps that must be addressed to realize meaningful, innovation-driven STEM education.

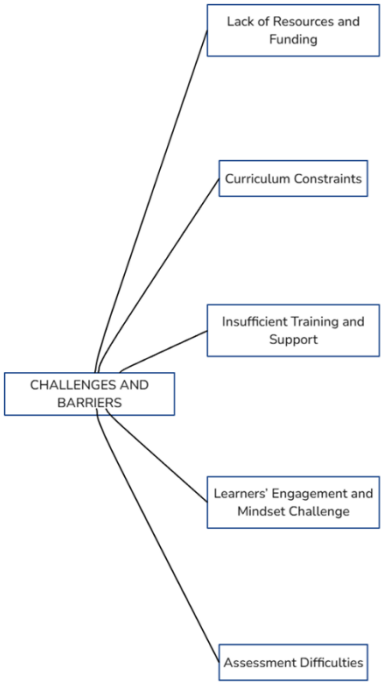

Figure 2. *Key Challenges and Barriers in Implementing Innovative Pedagogy in STEM Strand*

Figure 2 highlights the key challenges and barriers in implementing innovative pedagogy for integrated learning and entrepreneurship skills in the STEM strand. These include lack of resources and funding, which limits access to materials and hinders hands-on learning due to financial constraints. Curriculum constraints such as rigid structures, time limitations, and the difficulty of balancing requirements with flexibility also pose significant issues. Insufficient training and support affects teacher readiness, with limited professional development opportunities and a lack of entrepreneurship expertise. Learners' engagement and mindset challenges emerge from fear of failure, low motivation, and resistance to risk-taking, all of which impact entrepreneurial learning. Assessment difficulties also arise from traditional evaluation methods that are not suited to measuring creativity, innovation, and entrepreneurial thinking.

Theme 1. Lack of Resources and Funding

A major barrier to implementing innovative pedagogy in the STEM strand is the persistent lack of resources and teacher expertise, which significantly limits the integration of entrepreneurial education. Informants emphasized that inadequate access to materials, financial support, and advanced technology hinders hands-on, real-world learning experiences crucial for fostering creativity, problem-solving, and innovation among students (KII2; KII4). Moreover, while teachers may be technically proficient, they often lack the necessary training in entrepreneurship, reducing their ability to mentor students effectively in this domain. This gap not only frustrates teachers' efforts to implement community engagements, trainings, and competitions but also restricts students' exposure to entrepreneurial opportunities, limiting the depth and relevance of their learning. As Sahito and Wassan (2024) highlight, this combination of resource scarcity and insufficient professional development undermines the effectiveness of STEM-based

entrepreneurial education. Although some argue that leveraging local partnerships and targeted teacher training can mitigate these limitations (Sungur Gul et al., 2023), the lack of systemic support continues to challenge consistent implementation. To move beyond theoretical instruction and cultivate practical entrepreneurial competencies, schools must prioritize sustainable collaborations, resource mobilization, and ongoing capacity-building for educators. Without such efforts, students risk being underprepared for the complex, innovation-driven demands of future STEM careers.

Theme 2. Curriculum Constraints

A key barrier to implementing entrepreneurial education in the STEM strand is the rigidity of the curriculum and severe time constraints, which limit opportunities for project-based and experiential learning. Teachers report that the pressure to meet standardized academic requirements often forces them to prioritize content delivery over innovative approaches, thereby restricting the integration of deeper, real-world entrepreneurial concepts (KII8). This structural limitation results in reduced opportunities for students to develop creativity, critical thinking, and problem-solving skills—core competencies essential for entrepreneurship. Learners, likewise, struggle to engage with entrepreneurial tasks due to competing academic priorities and the complex nature of real-world applications, such as navigating business regulations and marketing challenges (Abdullah and Othman, 2021). While some argue that entrepreneurial education can still thrive through time-efficient strategies like short workshops and online platforms (Sheffield and Blackmore, 2018), the systemic rigidity of school schedules and curricula continues to constrain innovation. Addressing this issue requires curriculum reform, interdisciplinary integration, and the adoption of flexible scheduling models to enable more meaningful, hands-on learning within the limited time available.

Theme 3. Insufficient Training and Support

The lack of continuous and targeted professional development for educators significantly hampers the effective integration of entrepreneurial education within the STEM strand. Many teachers feel inadequately prepared to teach advanced entrepreneurial topics such as market research, business modeling, and fundraising, largely due to limited access to specialized training programs (KII3; KII8). Although DepEd provides in-service trainings and SLAC sessions, these often focus on general pedagogical concerns—such as lesson planning and compliance with new national guidelines—while only loosely touching on innovation or entrepreneurial thinking without clear labeling or depth (KII8). Moreover, opportunities for external training are scarce and selective, excluding many educators from gaining exposure to emerging instructional approaches. This aligns with the findings of Rogayan et al. (2021), who emphasize that teachers' limited background in business and entrepreneurship restricts their ability to connect STEM concepts to real-world contexts, thereby weakening student engagement and understanding. Further compounding the issue, short-term and fragmented training models fail to provide the sustained support needed for lasting instructional transformation (Hammond et al., 2017). While some argue that self-directed learning and peer collaboration can bridge this gap (Eroglu and Kaya, 2021), the absence of structured and comprehensive capacity-building programs ultimately limits teachers' ability to inspire creativity and cultivate entrepreneurial mindsets—critical components in preparing learners for innovation-driven careers in STEM.

Theme 4. Learners' Engagement and Mindset Challenge

Learners' hesitation to engage in entrepreneurial learning often stems from fear of failure, low self-confidence, and a strong preference for structured environments that provide clear instructions and minimal ambiguity (KII3). This mindset limits their willingness to take risks or explore open-ended tasks, hindering the development of creativity and innovative thinking essential in entrepreneurship. Henriksen et al. (2021) noted that such psychological barriers reduce students' openness to experimentation and real-world problem-solving. While fear and lack of confidence can be seen as obstacles, Ramer (2022) suggests they may also encourage careful planning and persistence when supported effectively. To foster entrepreneurial mindsets, schools can design gradual, scaffolded activities that frame failure as a learning opportunity, build resilience, and create a supportive space for collaboration and exploration. Through this approach, students can slowly grow more comfortable with uncertainty and begin to develop the skills and attitudes necessary for success in entrepreneurial and STEM-related fields.

Theme 5. Assessment Difficulties

Assessing entrepreneurial skills within the STEM strand remains a major challenge, as traditional evaluation methods fail to adequately measure complex competencies such as creativity, innovation, and problem-solving (KII3). Unlike conventional subjects with definitive right or wrong answers, entrepreneurship involves open-ended thinking and real-world decision-making, which are difficult to capture through written exams or quizzes. Alternative assessments—such as performance tasks, reflective journals, simulations, and project-based outputs—are essential for evaluating students' entrepreneurial mindsets in a more authentic and context-sensitive way. Hua and Dizon (2025) emphasized that STEM education often prioritizes theoretical knowledge, overlooking the importance of assessing entrepreneurial attributes aligned with modern industry demands. Similarly, Belmonte et al. (2022) argue that while traditional assessments fall short, this gap should not be viewed as a systemic flaw but as an opportunity to innovate and diversify assessment practices. Without such reform, students' risk being undervalued and educators may struggle to nurture their full potential. These challenges reflect key principles of Entrepreneurial Value Creation Theory, which asserts that meaningful entrepreneurial learning requires overcoming barriers—including outdated assessment models—in order to foster innovation, adaptability, and real-world value generation in education.

Innovative Pedagogical Practices

The following discussion addresses the research question: What innovative pedagogical practices can be adopted to enhance integrated learning and foster entrepreneurial thinking among students in the STEM strand?

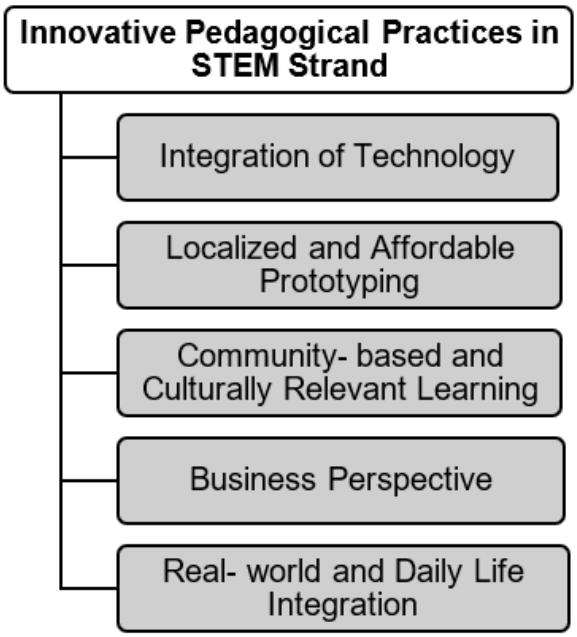

Figure 3. *Innovative Pedagogical Practices that can be adopted to Enhance Integrated Learning and Foster Entrepreneurial Thinking in STEM Strand*

Figure 3 illustrates innovative pedagogical practices designed to enhance integrated learning and entrepreneurial thinking in the STEM strand. These include the integration of technology to support interactive instruction and localized, affordable prototyping to encourage practical creativity. Community-based and culturally relevant learning ensures content is meaningful and inclusive. Emphasizing business perspectives equips students with a broader understanding of economic realities. Real-world and daily life integration fosters deeper engagement and applicability. Collectively, these practices aim to nurture critical thinking, innovation, and adaptability. They provide a foundation for future-ready, entrepreneurial STEM learners.

Theme 1. Integration of Technology

Integrating virtual simulations and QR code-enabled game-based activities into STEM education fosters heightened engagement and deeper understanding through interactive and meaningful learning experiences. Teachers have observed that virtual simulations transform passive instruction into dynamic, participatory environments where students actively explore scientific concepts, making lessons more enjoyable and impactful (KII1). Similarly, QR code-driven games enhance motivation by offering immediate rewards and encouraging extended exploration of subject content (KII4). These strategies not only make learning more accessible but also support differentiated instruction, aligning with students' digital fluency and varied learning preferences (Bhat, 2023). Tene et al. (2024) affirmed the effectiveness of immersive technologies like VR and AR in significantly boosting both academic performance and engagement in STEM, with AR noted as particularly impactful. However, as Rathore and Sonawat (2015) cautioned, the success of such innovations depends on their thoughtful implementation and teacher preparedness, as poorly integrated technology can lead to distraction or disengagement. Thus, while these tools offer promising avenues for enriching STEM education, their full potential can only be realized through adequate institutional support, professional development, and alignment with learner-centered pedagogical goals.

Theme 2. Localized and Affordable Prototyping

Integrating recyclable and locally sourced materials into STEM education enhances innovation, sustainability, and community relevance while making learning more accessible and cost-effective. Teachers who implement prototyping projects using upcycled items—such as coastal waste or recyclable household materials—not only reduce expenses but also foster environmental awareness and practical entrepreneurship among students (KII3; KII6). These strategies allow learners to address real-world problems using familiar, local resources, deepening their critical thinking and creative skills. The positive response from both students and fellow educators reveals the replicability and impact of such approaches in diverse contexts, promoting a culture of innovation grounded in local realities. According to Starkie et al. (2022), embedding sustainability into STEM and STEAM learning strengthens ecological responsibility while nurturing community development and interdisciplinary thinking. However, as Aada (2024) notes, challenges persist in aligning these initiatives with curricula, resource availability, and teacher readiness. Addressing these barriers through

targeted training, community involvement, and curriculum integration is essential to transforming isolated upcycling activities into meaningful, replicable educational models that promote long-term ecological and entrepreneurial thinking.

Theme 3. Community-Based and Culturally Relevant Learning

Integrating localized and culturally relevant approaches into STEM education enhances student engagement and deepens understanding by connecting academic content to learners' lived experiences and community realities. Through community-based case studies and projects—such as using coconut husk to create sustainable plywood alternatives—students apply scientific principles to solve real-world problems rooted in local needs, thereby fostering innovation and environmental awareness (KII3; KII7). This contextualized learning makes STEM concepts more relatable and empowers students to see entrepreneurship as a tool for addressing challenges within their surroundings. As Khan and Cohen (2025) emphasize, culturally responsive STEM instruction improves problem-solving, motivation, and inclusivity, particularly for marginalized learners. These practices not only promote civic responsibility and sustainable thinking but also encourage learners to see themselves as active contributors to their communities. However, as Bello et al. (2023) caution, over-reliance on localized content may risk limiting students' exposure to broader scientific principles and global perspectives, underscoring the need for balance between local relevance and academic rigor. Overall, the integration of cultural and community contexts in STEM nurtures a more inclusive, entrepreneurial, and socially transformative educational experience.

Theme 4. Business Perspective

Integrating entrepreneurship into STEM education becomes significantly more impactful when anchored in real-life, community-based contexts that students can directly relate to. Teachers report that using local businesses and neighborhood challenges—such as supply shortages or struggling sari-sari stores—makes entrepreneurial concepts more understandable and relevant for learners (KII9). By framing entrepreneurship through familiar issues, students begin to see their communities as spaces for innovation and opportunity. This is further enhanced through project-based learning, where investigatory outputs like banana peel coffee and cassava flour become potential school trademark products, giving students real exposure to product development and commercialization (KII5). Such initiatives allow learners to apply scientific knowledge while exploring value creation, thus bridging theory and practice. This method fosters critical thinking, creativity, and a genuine entrepreneurial mindset. Kabelele et al. (2023) emphasize that experiential learning in product development equips students with both scientific literacy and business acumen, reinforcing their role as active problem-solvers. However, Ahmad et al. (2022) caution that focusing too heavily on commercial success may compromise scientific curiosity and reduce emphasis on deeper inquiry. Despite this, the integration of entrepreneurship within localized STEM learning not only cultivates student engagement but also positions education as a pathway for personal and community transformation.

Theme 5. Real-World and Daily Life Integration

Integrating real-life and community-based experiences into STEM education significantly enhances the relevance and impact of instruction by grounding abstract concepts in students' lived realities. Teachers reported that using familiar situations—such as electricity issues in remote sitios or challenges faced by small local businesses—helped contextualize STEM topics and naturally introduce entrepreneurship (KII10). This localized approach fosters deeper understanding and encourages students to design practical, sustainable solutions applicable to their communities, such as proposing solar energy projects to local government units. Students become more engaged and reflective when they see the relevance of lessons to their own environment, bridging the gap between theoretical learning and real-world application. Deysolong (2023) supports this approach, emphasizing that blending entrepreneurship with STEM fosters critical thinking, creativity, and real-world problem-solving skills, preparing learners for dynamic societal demands. However, Wasudawan et al. (2024) caution that disparities in resources, logistical challenges, and cultural barriers can hinder implementation and impact student outcomes. Nonetheless, these pedagogical innovations align with Rogers' Innovation Diffusion Theory (1962), which highlights how compatible, observable, and trialable innovations—such as community-integrated STEM projects—can spread effectively within educational systems. Overall, anchoring STEM in local contexts empowers learners to see education not merely as academic training, but as a transformative tool for civic engagement, innovation, and socio-economic development.

Pedagogical Practices to Address Learners' Needs in Promoting Entrepreneurial Thinking

The following discussion addresses the research question: How do teachers adapt their pedagogical practices to address the unique needs and contexts of learners in promoting entrepreneurial thinking and integrated learning within STEM education in Kiamba? The discussion highlights the pivotal role of teacher agency in shaping inclusive and context-driven learning environments that cultivate entrepreneurial thinking in rural STEM education.

Figure 4 presents a thematic flowchart that illustrates a cohesive set of instructional strategies designed to cultivate entrepreneurial thinking within STEM education. It begins with Differentiated Instruction, which underscores the importance of adapting lessons to accommodate diverse learner profiles. This naturally progresses into Project-Based and Experiential Learning, where hands-on tasks and real-world simulations create meaningful engagement. Building on this, Student-Centered Approaches—including learner autonomy, group collaboration, choice, and mentorship—foster personalized and empowering educational experiences. The model then integrates Technology, highlighting the role of blended learning, digital tools, coding, and robotics in fostering innovation and enhancing digital literacy. These strategies converge in the creation of an Inclusive and Stimulating Learning Environment, where role

models, reflection, and constructive feedback sustain student motivation and encourage continuous growth.

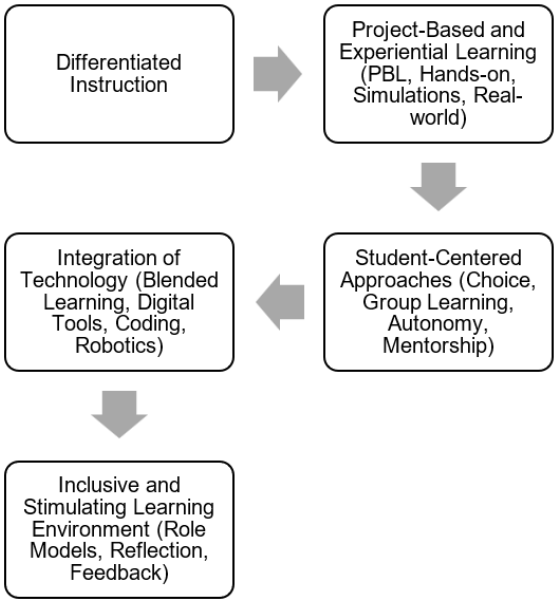

Figure 4. *Pedagogical Practices to Address Learners' Needs in Promoting Entrepreneurial Thinking*

Theme 1. Differentiated Instruction

Differentiated instruction (DI) plays a crucial role in fostering inclusive and responsive STEM education by addressing the diverse learning styles of students—visual, auditory, kinesthetic, and read/write—thereby enhancing engagement, comprehension, and academic performance. Teachers emphasize the importance of tailoring lessons to match students' learning preferences, using tools such as infographics for visual learners, discussions for auditory learners, simulations for kinesthetic learners, and written texts for read/write learners (KII1; KII3). This approach not only increases participation and motivation but also supports the development of essential entrepreneurial traits like creativity, problem-solving, and self-direction. Studies affirm that DI fosters deeper engagement when learners can interact with content in personally meaningful ways (Ali, 2025). Moreover, rotational activities inspired by Gardner's Multiple Intelligences theory enable students to explore varied modalities and discover their strengths, further enhancing confidence and self-efficacy (McCall, 2024; KII9). However, challenges remain, including insufficient teacher training, limited resources, and systemic grouping practices that may hinder inclusivity and reinforce inequities (Schwab and Woltran, 2023). Despite these barriers, differentiated instruction remains a powerful pedagogical strategy for creating learner-centered STEM environments that prepare students for both academic and entrepreneurial success.

Theme 2. Project-Based and Experiential Learning (PBL, Hands-on, Simulations, Real-world)

Project-Based Learning (PBL) stands out as a transformative strategy in STEM education, effectively fostering entrepreneurial thinking by engaging students in real-world, student-driven tasks that bridge theory and practice (KII3). Through hands-on projects, simulations, and case studies, learners apply academic knowledge to authentic community challenges, thereby enhancing creativity, critical thinking, and problem-solving skills (KII5; Tierney et al., 2022). These experiential approaches promote autonomy, accountability, and deeper engagement, enabling students to take ownership of their learning while nurturing resilience and innovation—key traits for future entrepreneurs (Dahal and Bhat, 2023). By situating learning in relevant, lived experiences, PBL boosts motivation and comprehension, allowing students to connect their education to real-life contexts and long-term goals. However, implementation challenges remain, including limited resources, large class sizes, rigid curricula, and the technological demands of designing meaningful projects—all of which can strain teachers' time and confidence (Tawfik et al., 2021). Nonetheless, the consistent integration of PBL has the potential to reshape STEM classrooms into dynamic environments where learners develop not only academic proficiency but also the entrepreneurial mindset and adaptive skills needed to succeed in a complex, rapidly evolving world.

Theme 3. Student-Centered Approaches (Choice, Group Learning, Autonomy, Mentorship)

Promoting student-centered approaches that emphasize autonomy, collaboration, and learner choice significantly contributes to developing entrepreneurial mindsets in STEM education. By allowing students to choose topics, roles, or methods of learning, teachers empower them to take ownership of their educational journey, fostering intrinsic motivation and creative thinking (KII8; Bhardwaj et al., 2025). Group work and peer collaboration provide opportunities for collective problem-solving, effective communication, and teamwork—skills essential for entrepreneurship (KII10; Lu and Smiles, 2022). Flexible grouping strategies and mentorship connections further enrich these experiences, enabling students to engage with diverse peers and gain real-world insights from experienced role models. These practices help students develop resilience, adaptability, leadership, and innovation, ultimately preparing them to navigate

real-life challenges with confidence. However, the shift toward student-centered learning remains difficult for many educators due to the dominance of traditional teaching methods and the lack of sufficient training, highlighting the need for ongoing professional development to support meaningful implementation (Minayeva et al., 2022).

Theme 4. Integration of Technology (Blended Learning, Digital Tools, Coding, Robotics)

Integrating technology into STEM education is essential for fostering entrepreneurial skills and addressing diverse learning needs in today's digital landscape. Blending traditional instruction with digital tools—such as simulations, coding platforms, graphic design software, and robotics kits—makes learning more interactive, engaging, and aligned with real-world applications (KII3; KII7). This blended approach not only enhances technological literacy but also encourages critical thinking, creativity, and collaboration, helping students connect theoretical knowledge with practical entrepreneurial challenges (Karakaş and Hıdıroğlu, 2022; Kastrati and Boçe, 2023). Digital tools provide immersive learning environments where students develop problem-solving abilities, adaptability, and confidence through hands-on and virtual experiences. However, effective implementation faces barriers, including inadequate access to updated technology, unreliable internet, limited professional development, and resistance to change among some educators (Paran et al., 2024). Overcoming these challenges is vital to fully realize the potential of educational technology in building entrepreneurial mindsets and preparing students for success in a rapidly evolving, tech-driven world.

Theme 5. Inclusive and Stimulating Learning Environment (Role Models, Reflection, Feedback)

Creating an inclusive and stimulating classroom environment is vital in nurturing entrepreneurial thinking, as it encourages learners to feel valued, express diverse ideas, and take creative risks with confidence. When educators adapt teaching strategies to accommodate different learning styles and implement reflective practices such as journaling, feedback, and discussions, students gain deeper insights and can meaningfully apply their learning to real-world contexts (KII4; Ahmad et al., 2023). Role models and real-life entrepreneurial success stories further enhance this learning environment by inspiring students through relatable examples, fostering motivation, and helping them view entrepreneurship as a viable and attainable career path (KII3; Nowinski and Haddoud, 2019). Such exposure strengthens entrepreneurial identity, promoting resilience and a proactive mindset. However, barriers like insufficient professional development, inadequate facilities, rigid curricula, and limited support services challenge the implementation of truly inclusive classrooms (Jardinez and Natividad, 2024). Despite these obstacles, fostering an atmosphere of inclusivity, creativity, and support equips students not only with technical competencies but also with the confidence, collaboration, and innovation skills essential for entrepreneurial success.

Support Mechanisms that Teachers Identify as Essential for Effectively Implementing Innovative Pedagogical Practices.

The following discussion addresses the research question: What support mechanisms do teachers identify as essential for effectively implementing innovative pedagogical practices aimed at stimulating entrepreneurial thinking and integrated learning within STEM schools in Kiamba? The discussion underscores the value of institutional support, professional development, access to relevant teaching materials, and collaboration with local stakeholders in enabling teachers to design meaningful learning experiences. These support mechanisms empower educators to foster entrepreneurial mindsets and integrative learning, particularly in resource-limited and rural STEM settings.

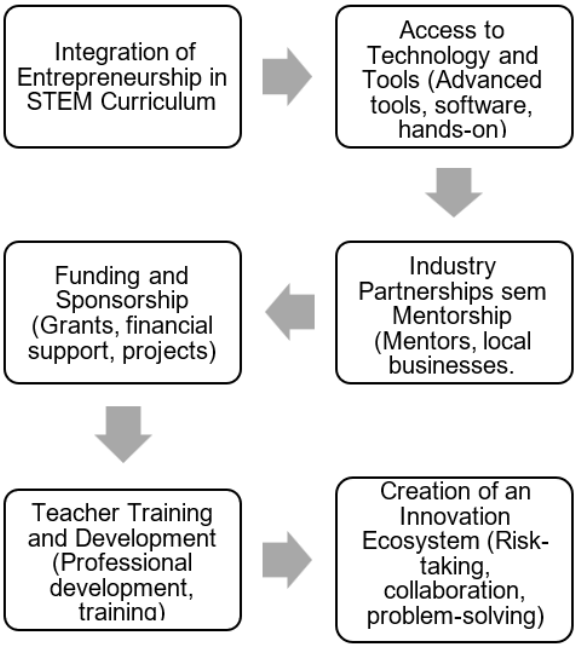

Figure 5. *Support Mechanisms that Teachers Identify as Essential for Effectively Implementing Innovative Pedagogical Practices*

Theme 1. Integration of Entrepreneurship in STEM Curriculum

Integrating entrepreneurship concepts into STEM education is essential for cultivating students' innovation, critical thinking, and business acumen across all levels of learning. Informants emphasized that teachers must be well-equipped and oriented to deliver this integrated approach effectively, recognizing their frontline role in shaping entrepreneurial mindsets (KII2). Yu et al. (2024) supported this by outlining three instructional models—entrepreneurship as an added component, embedded throughout instruction, or centered on project-based learning—all of which foster active engagement and practical application. Key strategies such as performance tasks, hands-on experiments, and recognition of student achievements were highlighted as vital components that link theoretical knowledge with real-world experiences (KII10; Fantinelli et al., 2024). These experiential methods deepen learning, boost student confidence, and enhance career preparedness. To implement this effectively, targeted professional development and well-designed curricular resources are necessary to support educators. When entrepreneurship is embedded in STEM instruction, the classroom transforms into a space for dynamic learning where students are empowered to apply their knowledge creatively and practically, equipping them for future professional and entrepreneurial challenges.

Theme 2. Access to Technology and Tools (Advanced tools, software, hands-on)

Access to advanced technology and tools is crucial for fostering innovation and entrepreneurial thinking in STEM education, as highlighted by informants who stressed the need for modern resources, industry partnerships, and teacher training to develop students' entrepreneurial skills effectively (KII5). This view is supported by Çelik and Baturay (2024), who emphasized that the educational impact of emerging technologies depends on their thoughtful and equitable integration. Merely introducing advanced tools is insufficient without ensuring that all learners can access and meaningfully engage with them. To prepare students for the dynamic demands of STEM industries, schools must provide hands-on experiences using up-to-date software and prototyping tools, coupled with real-world problem scenarios and guidance from trained educators and industry professionals. This integrated approach creates a learner-centered environment that encourages creativity, innovation, and critical thinking. Furthermore, it helps bridge the gap between theoretical knowledge and practical application, ensuring that students are not only academically prepared but also equipped with the skills to thrive in a rapidly evolving technological landscape.

Theme 3. Industry Partnerships and Mentorship (Mentors, local businesses, innovation hubs)

Collaboration with industry professionals and structured mentorship programs play a vital role in bridging the gap between theoretical learning and real-world entrepreneurial applications in STEM education. Informants emphasized that effective stimulation of entrepreneurial thinking begins with mentorship, providing students with guidance, real-world insights, and exposure to expert practices through partnerships with local businesses and innovation hubs (KII6). Esangbedo et al. (2023) support this view, asserting that such collaborations are essential for equipping students with industry-aligned skills and enhancing their adaptability to technological advancements. These partnerships allow students to apply STEM knowledge in authentic contexts, fostering innovation, confidence, and practical problem-solving skills. Moreover, involving industry professionals in curriculum development helps ensure educational programs remain relevant and responsive to evolving market needs. As students gain firsthand experience and mentorship, they develop a more holistic understanding of entrepreneurship, better preparing them to navigate future careers. However, sustaining these initiatives requires institutional commitment, strategic planning, and continued investment in resources to maintain strong, meaningful connections between education and industry.

Theme 4. Funding and Sponsorship (Grants, financial support, projects)

Funding and sponsorship are critical enablers of entrepreneurial education, particularly in facilitating hands-on experimentation and innovative student projects. Informants emphasized that access to financial resources, such as small grants and private sponsorships, allows learners to fully engage in experiential learning, participate in competitions, and access high-quality materials that enrich the learning process (KII9). Cestino et al. (2023) affirmed that financial support is essential for launching and sustaining entrepreneurial initiatives, enabling ideas to develop into viable ventures even with minimal ongoing maintenance. Establishing structured funding programs and forging partnerships with private businesses can ensure learners receive the tools and infrastructure necessary to transform theoretical knowledge into practical applications. Moreover, sustained funding fosters motivation, creativity, and project continuity, while the absence of such support limits students' ability to innovate and grow. Thus, reliable and equitable financial backing not only enhances the depth and quality of entrepreneurial education but also empowers students to develop critical skills that benefit both their personal development and the broader community.

Theme 5. Teacher Training and Development (Professional development, training)

Teacher training and professional development emerged as a vital component in successfully integrating entrepreneurial education within STEM, as educators must be well-equipped with the necessary knowledge, skills, and strategies to deliver innovative, experiential, and entrepreneurship-oriented lessons effectively (KII5). Respondents emphasized that confident, well-prepared teachers are more capable of fostering entrepreneurial mindsets among students. This aligns with Suleiman et al. (2024), who asserted that targeted professional development enhances educators' capacity to design and implement entrepreneurship-focused curricula through simulations, projects, and industry collaboration. These programs also promote teamwork and continuous knowledge exchange among teachers, ensuring they stay updated on effective instructional techniques. Equipping teachers with these competencies supports a

learner-centered environment that cultivates critical thinking, creativity, and real-world problem-solving skills. Furthermore, sustained professional development not only boosts teacher effectiveness but also ensures that students receive relevant, engaging instruction that prepares them for future challenges in both academic and entrepreneurial contexts. Therefore, institutional investment in educator training is essential to maximizing the impact of entrepreneurial STEM education.

Theme 6. Creation of an Innovation Ecosystem (Risk-taking, collaboration, problem-solving)

The establishment of an innovation ecosystem is a foundational component for nurturing entrepreneurial mindsets in STEM education, as it cultivates a holistic environment that supports risk-taking, problem-solving, and collaboration (KII4; KII8). Informants emphasized the need for safe, collaborative spaces where students can experiment without fear of failure, engage with peers, and acquire practical business skills applicable to real-life contexts. Such ecosystems, including innovation hubs and networking platforms, promote a culture of sharing ideas, benchmarking best practices, and fostering continuous improvement.

Keelson et al. (2025) affirm that innovation ecosystems stimulate entrepreneurial growth by integrating mentorship, collaboration, and exposure to role models, which collectively strengthen students' confidence, adaptability, and career-readiness. Within these environments, students are empowered to explore ideas, apply theoretical knowledge to authentic challenges, and develop essential entrepreneurial competencies that align with the demands of modern economies. Ultimately, schools that support such innovation ecosystems not only enrich student learning but also contribute to broader socioeconomic development by producing skilled, confident, and future-ready entrepreneurs.

Conclusions

The implementation of innovative, student-centered pedagogies in Kiamba's STEM education highlights educators' growing readiness to embrace more dynamic and responsive instruction, reflecting a strong potential to sustain and scale entrepreneurial teaching practices if adequate institutional support is provided. However, this progress also reveals systemic gaps—particularly at policy and administrative levels—that could hinder innovation, restrict teacher agency, and slow learner development if left unaddressed. To respond to these challenges, the Department of Education and school leaders must strengthen teachers' existing capacity through continuous professional development and targeted training in learner-centered, entrepreneurial pedagogies. Complementary to this, curriculum developers should consider revising policies to introduce flexible guidelines, updated assessment frameworks, and enhanced support for instructional materials that promote entrepreneurship. Ensuring that entrepreneurial education is contextualized and rooted in learners' local environments and socio-cultural realities can be achieved by encouraging schools to design localized teaching materials and community-relevant projects, supported by adequate tools and training. Establishing a holistic support system—including collaborative networks, sustained investment, and increased teacher autonomy—is critical to institutionalizing these efforts. Partnerships with local government units (LGUs), industries, and NGOs can further amplify these initiatives by co-developing mentorship programs, community-based learning opportunities, and resource-sharing mechanisms that collectively build a thriving innovation ecosystem within STEM education.

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