BINDURA UNIVERSITY OF SCIENCE EDUCATION
FACULTY OF SCIENCE EDUCATION
DEPARTMENT OF CURRICULUM AND EDUCATIONAL MANAGEMENT STUDIES

THE INFUSION OF ENTREPRENEURIAL SKILLS INTO SCIENCE LEARNING ACTIVITIES IN HHOHHO REGION'S HIGH SCHOOLS

BY

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A RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS OF THE MASTER OF SCIENCE EDUCATION DEGREE IN MEASUREMENT, ASSESSMENT AND EVALUATION

JULY 2025

APPROVAL FORM

The undersigned certify that they have read and recommend to Bindura University of Science Education for acceptance, a research project entitled: ***The infusion of entrepreneurial skills into science learning activities in Hhohho Region's high schools***. Submitted by Pazvakavambwa Tabetha Nyarai (B233047A) in partial fulfilment of the requirements for the Master of Science Education degree in Measurement, Assessment and Evaluation.

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DECLARATION

I, Pazvakavambwa Tabetha Nyarai, hereby declare that, except for references to other people's work which have been duly acknowledged, this dissertation is a result of my study and has neither in part nor in whole been presented in the education programme.

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This research work was undertaken under the supervision of Dr. P. Chikuvadze

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DEDICATION

I dedicate this dissertation to my mother, Miriam, who played a pivotal role in spiritual and moral support. I also dedicate this project to my son, Patrick, for encouraging me to be resilient, and to my siblings, Marjorie and Chenai, for their unwavering support throughout this journey.

ACKNOWLEDGEMENTS

I would like to thank the Almighty God for the gift of life, His love and compassion, grace and wisdom he gave me and made me to successfully complete this study. I am also grateful for the love, unwavering support and encouragement of my parents, sisters and son. Sincere gratitude to my supervisor for the unwavering, tirelessly dedicated efforts to bring out the best of me throughout this study. He guided me with his wise counsel, and brought sterling support until this document was completed. Without his guidance, it would have been difficult for me to accomplish this task alone. I also acknowledge the Director at the Ministry of Education and Training, Eswatini, for affording me the permission and support in carrying out this study in high schools in the Hhohho Region.

ABSTRACT

This study explored the infusion of entrepreneurial skills into high school science learning within Eswatini's Hhohho Region. The study was grounded in a pragmatist paradigm and mixed-methods approach. It utilized semi-structured questionnaires, interviews, and literature method for data collection. Stratified random sampling procedure was used to select 30 respondents (science teachers) who participated in data collection. Quantitative data were analysed using descriptive statistics (frequencies and percentages), whereas qualitative data underwent thematic analysis. In this study ethical issues were at the centre of data collection, analysis and interpretation. The results revealed a strong awareness among the selected respondents of the value of entrepreneurial skill development; however, systemic challenges like curriculum overload, insufficient resources, and lack of specialized training hinder effective infusion. However, teachers reported leveraging innovative pedagogical methods, including inquiry-based and project-based learning, to facilitate entrepreneurship-oriented instruction in science learning activities. It further advocated for strategic policy reform and sustained professional development initiatives to empower science teachers. In conclusion entrepreneurial skills are to a larger extent infused into science learning in Eswatini's Hhohho Region, with teachers employing innovative instructional methods, despite systemic challenges that limit full infusion. Hence, the need to emphasize strengthening science teacher capacity and nurturing collaborative, interdisciplinary learning environments. This study contributes to ongoing discourse on Science, Technology, Engineering and Mathematics reforms and positions entrepreneurial skills as a fundamental dimension of science learning in Eswatini high schools.

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CHAPTER 1
THE PROBLEM AND ITS CONTEXT

1.1 Introduction

In this chapter, the problem was put into its context through the articulation of the following aspects: background of study, statement of the problem, research objectives and questions that underpinned the study, assumptions of the study, the significance of study, delimitation of the study and limitations of the study. The chapter concluded with these sections; definitions of key terms, chapters layout for the thesis and the chapter's summary.

1.2 Background to the study

Competency-Based Education (CBE) has gained significant attention in recent years as a promising approach to improving learner learning outcomes (Rhoney et al., 2024). This educational framework focuses on the mastery of specific skills and knowledge, rather than traditional measures such as grades or seat time (Wyne, Zhang & Farahani, 2021). It has been acknowledged by different scholars (Collins, 2025; Curry & Docherty, 2017; Muge & Waiganjo, 2025) that, the CBE is instrumental in helping learners to increase the mastery of 21st century knowledge, skills, and values in problem solving. It is against this background that entrepreneurial skills have increasingly emerged as a cornerstone of 21st-century global learning imperatives, driven by their potential to stimulate economic development, and foster innovation (Branca et al., 2025; McCarthy-Ketteldas, Du Toit, & van Tonder, 2024). Davis (2023) underscores the critical need for educational systems to bridge science learning with entrepreneurial thinking across all levels of instruction, thereby nurturing learners who are both scientifically literate and economically empowered.

Despite global recognition of entrepreneurship as an essential pillar within CBE, science learning in Eswatini remains predominantly discipline-specific, with limited cross-curricular linkages that facilitate interdisciplinary integration (Darwin, 2023; Ministry of Education and Training, 2018; Rusike, Chikuvadze & Zuva, 2024). This fragmented approach constrains learners from making meaningful connections between scientific inquiry and real-world entrepreneurial problem-solving. Moreover, existing educational policies in Eswatini offer minimal guidance or support

for embedding entrepreneurial skills within mainstream science teaching and learning, restricting such efforts primarily to CBE frameworks (Mpofu & Nyoni, 2022). Infusing entrepreneurial skills into science learning has the potential to transform learners' cognitive and affective orientations by enhancing their entrepreneurial self-efficacy, creativity, and intention to pursue entrepreneurial ventures (Passarelli & Bongiorno, 2025).

As such, a more deliberate and systemic infusion of entrepreneurial skills into science learning could play a pivotal role in cultivating innovation-driven graduates equipped to address complex socio-economic challenges (Mtibaa, 2025). Building on this imperative, it is essential to recognize the transformative potential of entrepreneurship skills not merely as an economic lever, but as a pedagogical innovation that nurtures 21st-century skills (Adeoye, Prastikawati & Abimbowo, 2024). These include critical thinking, adaptability, collaboration, and problem-solving within the context of scientific learning. By embedding entrepreneurial pedagogy into science teaching and learning, learners are positioned to engage in inquiry-driven, real-world projects that transcend traditional content delivery (Lesnefsky, 2025). This nurtures a mindset that embraces experimentation, resilience, and opportunity recognition. This approach aligns with constructivist learning theories, which emphasize active, learner-centred experiences that mirror authentic professional and societal challenges (Al Abri, Al Aamri, & Elhaj, 2024). In the Eswatini context, reimagining science learning through this lens could empower learners to become not only consumers of knowledge (S'lungile, & Makoelle, 2022). This also result in creators of value capable of applying scientific knowledge innovatively to develop sustainable, locally relevant solutions.

Despite increasing advocacy for entrepreneurial skills as a catalyst for economic resilience and innovation, recent scholarship (Dlamini, 2022; Dlamini-Nxumalo, Kunene & Charamba, 2025; Motsamai & Alers, 2022). reveals a persistent gap in how such education is conceptualized and implemented particularly in science learning. Rather than infusing entrepreneurial skills within disciplinary frameworks, entrepreneurship education is often treated as a discrete, standalone subject, thereby missing valuable opportunities for interdisciplinary learning (Núñez-Canal et al., 2023). The inherently complex and multidimensional nature of entrepreneurial skills pose challenges for science teachers, who may lack the pedagogical tools and frameworks to

effectively connect entrepreneurial thinking with scientific inquiry and problem-solving (Linton & Xu, 2021).

Furthermore, global policy bodies, such as the European Union (2018), emphasize the importance of equipping learners with entrepreneurial skills including innovation, resilience, and risk management. However, the current science learning in many contexts remain rigidly outcomes-based, prioritizing content mastery over the development of transferable, future-oriented skills (Karampelas, 2022). A particularly underexplored dimension of this challenge is the limited professional development and pedagogical support available to science teachers to facilitate such infusion. Consequently, there is a critical need for empirical research that investigates not only the feasibility and relevance of infusing entrepreneurial skills within science learning. It is against this background that this study sought to address this gap by gaining insights into how the infusion of entrepreneurial skills into science learning can enhance both pedagogical practice and learner outcomes.

1.3 Statement of the problem

Despite the strategic emphasis placed on learner-centred, learning through Eswatini's CBE framework which seeks to cultivate relevant knowledge, skills, and values for lifelong learning and economic participation there remains a critical gap in the effective integration of entrepreneurial skills within science learning. Although education policy and national development discourse (Cyprian et al., 2025; Ministry of Education and Training, 2018; Dlamini, 2018) acknowledge entrepreneurship as a vital skill for navigating real-world challenges and contributing to a diversified economy, science learning have yet to dependably embody this directive in practical and pedagogical terms. The disjunction between policy intent and classroom practice raises pertinent questions about the extent to which entrepreneurial thinking, creativity, innovation, and opportunity recognition are on purpose infused into science learning activities. Without a clear operationalization of entrepreneurial skills within science learning, learners risk missing out on indispensable skills that could sanction them beyond academic content knowledge. This under-utilization not only undermines the transformative potential of CBE but also impedes the creation of agile, economically empowered products who are equipped to respond to local and global challenges. Therefore, this study sought to discourse the

disconnect by establishing the extent to which entrepreneurial skills are infused into science learning.

1.4 Research objectives

This study was guided by the following sub-objectives:

1. To establish science teachers' conceptualisation of entrepreneurial skills in the context of science learning.
2. To identify strategies used to prepare teachers to infuse entrepreneurial skills into science learning.
3. To assess how teachers were infusing entrepreneurial skills into science learning activities.
4. To identify challenges faced when infusing entrepreneurial skills into science learning activities.
5. To design a model that advances the infusion of entrepreneurial skills into science learning activities.

1.5 Research questions

The study was guided by the following questions:

1. What is the teachers' conceptualisation of entrepreneurial skills in the context of science learning?
2. What strategies were used to prepare teachers to infuse entrepreneurial skills into science learning activities?
3. How were the teachers infusing entrepreneurial skills into science learning activities?
4. What challenges were encountered by the teachers when infusing entrepreneurial skills into science learning activities?
5. How can a model that advances the infusion of entrepreneurial skills into science learning be designed?

1.6 Assumptions of the study

The research study is based on several key assumptions. First, it assumes that science teachers possess some level of experience or exposure to the infusion of entrepreneurial skills into instructional practices, even if such infuse is not widespread or well established. Second, the study posits that science teachers have a robust understanding of the relationship between entrepreneurial skills and science learning, recognizing their interconnectedness in areas like value creation and problem-solving.

Additionally, it is assumed that science teachers are generally open to change and innovation, showing a willingness to incorporate new approaches, including the infusion of entrepreneurial skills into learning activities and adapt to interdisciplinary methods. The study further assumes that science teachers view the infusion of entrepreneurial skills into science learning as aligned with the broader educational priorities and goals.

Moreover, it is assumed that science teachers have access to the necessary resources, professional development opportunities, and administrative support to effectively infuse entrepreneurial skills into their learning activities. Lastly, the study posits that science teachers' views regarding the integration of entrepreneurial concepts into the science learning will lead to measurable and sustained positive outcomes for learners. Thus, it improves their academic performance and career readiness. It is also assumed that these insights are expected to influence curriculum development and policy reform.

1.7 Significance of the study

The results of the study benefit the following:

1.7.1 Policymakers

Insights gained from assessing the teachers' experiences can guide policymakers in developing effective educational policies that support the integration of entrepreneurial skills into high school science learning. The new policy can lead to a more cohesive curriculum design that aligns with the global educational trends and labour market demands.

1.7.2 Curriculum developers

Curriculum developers ensure that the integrated science curriculum remains relevant to global expectations, addressing contemporary educational needs of the 21st century, which emphasise skills such as critical thinking, problem-solving, innovation and entrepreneurial mindset.

1.7.3 Science teachers

Teachers play a crucial role in the integration of entrepreneurial skills into learning activities. Their contributions to the insights of this study significantly influence shifts in curriculum development, measurement, assessment and evaluation. This in turn transforms the science learning landscape in promoting elements of CBE and interdisciplinary approach. Science learning involving entrepreneurial skills gives learners an added advantage in acquisition of competencies such as risk taking, creativity and critical thinking. These skills enable students to form viable science related businesses and create job opportunities for others. The science teachers' intentions to infuse entrepreneurial skills into learning activities are worthwhile experience, especially in demonstrating the feasibility and desirability of science-based entrepreneurial careers.

1.7.4 Bindura University of Science Education

The university will utilise the findings to better prepare pre-service science teachers for adopting interdisciplinary approaches to infusing entrepreneurial skills into their teaching practices. Additionally, the university can facilitate in-service professional development programmes to promote lifelong learning for all science teachers.

1.7.5 Researcher

The researcher will contribute valuable insights to the growing body of knowledge in this field. The study also allowed the researcher to adopt effective methodologies and skills for integrating entrepreneurial concepts into science learning.

1.8 Delimitation of the study

This study was geographically confined to the Hhohho Region, one of the four administrative regions of the Kingdom of Eswatini. The region consists of nine (9) high schools, forming the sampling frame for the research. The study deliberately targeted only high school science teachers who were actively facilitating science learning activities. Other potential stakeholders in the learning ecosystem such as learners, school administrators, and members of the science inspectorate were intentionally excluded from the scope of the study. The selection of science teachers as the sole respondents was guided by the study's primary aim to explore their lived experiences in infusing entrepreneurial skills within the context of science learning. This delimitation acknowledges that science teachers are key agents in curriculum delivery, and their insights provide a focused lens through which the infusion of entrepreneurial skills into science learning can be meaningfully examined. Consequently, results from this study may not be generalized to other regions or educational stakeholders, as the contextual and professional experiences of science teachers in the Hhohho Region form the unique basis of analysis and interpretation.

1.9 Limitations of the study

According to Miles (2017), the limitations of the study refer to the constraints that the researcher cannot control with regard to the methodology. The possible weakness of the methodology of the study can be determined by the limitations. The study is limited to various factors that can affect reliability and validity of the research results. The science teachers' willingness to answer the semi-questionnaires or respond to interview questions was influenced by their state of minds and the policies that guide the science learning. Cultural norms and values may influence teachers' insights concerning the infusion of entrepreneurship skills into science learning. Therefore, using both quantitative and qualitative methods of data collection was expected to increase the results' reliability and validity.

1.10 Definition of terms

The following terms are defined within educational context;

1.10.1 Entrepreneurial skills

This is defined as the capacity, willingness or opportunity provided to students to organise a business opportunity white considering associated risks (Akpan & Uko,2019). Wei et al. (2023) note that the term can be defined in various ways depending on the context. Ahmad (2013), describes entrepreneurship education as a process involving identification of business opportunities and insights, knowledge, confidence and skills to harness new opportunities. Wei et al. (2023) argue that entrepreneurial skills enhance innovative and entrepreneurial skills, leading to the comprehensive acquisition of knowledge and skills which are crucial for job creation.

1.10.2 Infusion

It involves combining, coordinating or blending two or more subjects or disciplines in order to create a more comprehensive and interconnected learning experience (Prestwich, 2012). Astaduryan and Danelova (2023) defined it as the synchronised display of information from different subject areas, creating conditions for their combination into a single, cohesive understanding. In contrast, infusion refers to the introduction of specific content or concepts into a subject area, weaving these concepts into another domain (Oborah, 2022).

1.10.3 Science learning

Science teaching and learning is the process of helping learners explore and understand the natural world through observation, inquiry, and problem-solving (Alberida, 2020). It encourages curiosity, critical thinking, and the application of scientific knowledge, skills and values to everyday life.

1.11 Chapters layout

The study will be laid out into five chapters. Chapter 1 outlines the problem and its context as follows: introduction of the chapter highlighting the components; background of the study, statement of problem, research objectives, research questions, assumptions of the study,

significance of the study, delimitation of the study, limitations of the study and definitions of terms. Chapter 2 highlights the gaps in literature, thereby justifying the need for this study. In addition, it articulates the theoretical basis guiding this study. Chapter 3 outlines the road map to guide the data collection, analysis and interpretation. Chapter 4 reflects on the results of the study (data analysis and interpretation). Chapter 5 gives an account of the research study in terms of the summary of the results, proposed model, conclusion, recommendations and areas for further studies.

1.12 Chapter summary

The chapter introduced the problem and its setting. The background of the study was also outlined to articulate the gaps that the study seeks to fill. The statement of the problem was described, pointing out the problems that the research seeks to find possible solutions. Research questions, objectives, assumptions and significance of the study were also outlined. Key terms were defined in the context of education. The delimitations and limitations were presented. The following chapter will give related literature from various scholars in order to bring out the gaps that this research study intends to fill.

CHAPTER 2
REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter presents related literature relevant to this study. The first section presents theoretical framework that inform the study, the conceptualisation of entrepreneurial skills, strategies used to prepare teachers for the infusion of entrepreneurial skills into learning activities, methodological approaches to the infusion of entrepreneurial skills into learning activities and challenges faced when infusing entrepreneurial skills into learning activities.

2.2 Theoretical framework

The theoretical framework provides the epistemological foundation that structures this inquiry, delineating its assumptions and orienting its interpretive lens. This study, situated at the nexus of experiential and transformative pedagogies, draws on Experiential learning theory and Transformative learning theory to gain insight into how the infusion of entrepreneurship skills into learning was grounded in active engagement and critical reflection.

2.2.1 Experiential learning theory

Experiential Learning Theory (ELT), proposed by David Kolb (1984), views learning as a dynamic and cyclical process grounded in direct experience. The model consists of four stage: Concrete Experience, Reflective Observation, Abstract Conceptualization, and Active Experimentation through which learners continuously construct and reconstruct knowledge (Bell & Bell, 2020). This approach contrasts with traditional didactic methods by emphasizing the learner's role as an active participant in making meaning from experiences (Bartle, 2015). ELT is particularly suited to educational contexts that value reflection, adaptability, and learner agency, offering a framework that can integrate theory with practice in authentic settings (Besar & Norainna, 2018).

In curriculum design or programme evaluation, especially within teacher education or postgraduate research, ELT promotes a holistic learning environment where learners are encouraged to engage emotionally, reflect critically, conceptualize abstractly, and apply

practically (Kolb & Kolb, 2012). This fluid movement between doing, thinking, and applying fosters deeper learning outcomes and supports lifelong learning skills. For educators seeking to cultivate transformative practices such as integrating urban narratives or multimodal expression into pedagogy ELT (Kang & Kim, 2024). This provides a scaffolding that values diversity in learning styles and encourages co-construction of knowledge across social, cultural, and disciplinary boundaries.

ELT offers a robust foundation for research exploring the infusion of entrepreneurship skills into learning (Jiang, 2022). In such a study, ELT can be used to design interventions where educators and learners engage in real-world entrepreneurial tasks such as opportunity identification, business model development, or community-based problem-solving followed by structured reflection and conceptualization (Huang, 2024). For instance, a research design might involve pre-service teachers participating in a series of entrepreneurship workshops that follow Kolb's learning cycle, enabling them to experience entrepreneurial thinking first-hand and then apply those insights in classroom simulations or curriculum planning (Reyes-Torres, 2025). The study could assess how this experiential approach influences respondents' entrepreneurial self-efficacy, pedagogical adaptability, and capacity to foster entrepreneurial mindsets in learners. By aligning ELT with entrepreneurship education, the research not only evaluates skill acquisition but also examines how experiential processes reshape teaching philosophies and instructional practices (Bell & Bell, 2020). This approach is particularly relevant in contexts like Eswatini, where fostering innovation and self-reliance through education is a national priority.

2.2.2 Transformative learning theory

This Transformative Learning Theory (TLT) was developed by Jack Mezirow with emphasis on how learners revise their frames of reference through critical reflection (Mezirow, 2018). This is so especially when confronted with disorienting dilemmas experiences that challenge their existing assumptions. In the context of infusing entrepreneurial skills into learning, transformative learning can help educators and learners shift from traditional, content-driven instruction to more innovative, opportunity-oriented mindsets (Benamar, 2016).

TLT can be a powerful lens for examining how teachers and learners internalize entrepreneurship not just as a set of skills, but as a shift in mindset and identity (Kőnig, 2024). In a study focused on infusing entrepreneurial skills into learning, TLT would frame the process as one where participants confront and critically reflect on their assumptions about education, risk, innovation, and economic agency. For example, teachers might initially view entrepreneurship as incompatible with traditional pedagogy (Bethge, 2018). Through structured experiences like designing a community-based enterprise or facilitating learner-led ventures they encounter "disorienting dilemmas" that challenge these assumptions, prompting reflection and potential transformation in their teaching philosophy. By applying TLT, in this study it illuminated how entrepreneurial skills becomes a catalyst for broader pedagogical transformation especially in contexts where innovation and self-reliance are critical to systemic reform (Manfreda et al., 2024).

Infusing ELT and TLT provides a dynamic conceptual foundation for a study on infusing entrepreneurial skills into learning. ELT contributes a practical, process-oriented structure where learners engage in concrete entrepreneurial experiences such as designing a start-up prototype, participating in innovation sprints, or simulating enterprise scenarios. These experiences are followed by structured reflection and conceptual reframing, allowing learners to experiment actively with new strategies in educational settings. This cycle cultivates entrepreneurial competencies through doing and thinking, while ensuring that knowledge acquisition is grounded in authentic, real-world contexts.

Complementing this, TLT deepens the inquiry by illuminating how such engagement can catalyse profound shifts in educators' and learners' assumptions, beliefs, and professional identities. Through disorienting dilemmas like navigating risk, failure, or ambiguity in entrepreneurial initiatives participants are prompted to reflect critically on conventional pedagogical norms and economic worldviews (Aguilar, 2025). The outcome is not merely improved entrepreneurial skills acquisition, but a reimagining of teaching itself as a transformative practice (Blanchard, 2020).

ELT underscores the iterative interplay of experience, reflection, conceptualization, and experimentation in fostering applied competencies, while TLT elucidates the cognitive and affective transformations that occur as learners confront and reconstruct underlying assumptions (Kearney et al., 2018). Together, these theories offer a cohesive lens to explore the development of entrepreneurial agency and the reconfiguration of pedagogical identity, thereby framing science teaching and learning as both a praxis-oriented and meaning-making endeavour. This synergy positions learning activities as both a site of experiential action and philosophical inquiry, aligning with broader CBE's goals on innovation, self-reliance, and socio-economic responsiveness.

2.3 The conceptualisation of entrepreneurial skills

The concept of entrepreneurial skills is multifaceted and lacks a definitive definition, as it can be interpreted in various contexts. It is linked to the development of skills such as risk-taking, creative thinking, innovation, and problem-solving (Shuaibu et al., 2021). Other contexts emphasize identifying market gaps and addressing societal needs, while some focus on the production of goods and services (Cyril, 2012). These skills are crucial for driving economic growth and job creation, ultimately facilitating the establishment of successful business ventures (Mitaksh, 2023).

Muhammad (2018) further highlights that infusing entrepreneurial skills into science learning offers students a valuable experience, empowering them to proactively tackle everyday challenges. This infusion helps learners develop qualities that align with creativity (problem-solving, reflection, innovation), a positive mindset (confidence, optimism), and intention (risk-taking, resilience, hard work). Davis (2023) describes entrepreneurship as both a mindset and a life skill, emphasizing that scientific knowledge can be applied to solve problems and generate innovative solutions. Through entrepreneurial skills, learners can engage in creative and critical thinking to enhance the value of scientific products, fostering character traits that support successful business ventures.

Entrepreneurial skills provide a proactive way to address the demands of the 21st century, facilitating successful business ventures (Mishra et al., 2023). However, the current secondary education curriculum in Eswatini fails to meet global standards necessary for preparing learners

for future employment (Mabuza, Mpofu & Makumane, 2025). This highlights the urgent need for curriculum reform to equip learners with the skills needed for the modern workforce and to support job creation (Dillon, 2024, Angel-Urdinola, 2024). Therefore, science learning activities should focus on incorporating methods that promote entrepreneurial skills, rather than relying on rote memorization of basic scientific concepts, which do not enhance problem-solving or creativity (Kola, Abdulrahman & Azeez, 2019).

2.4 Strategies used to prepare teachers to infuse entrepreneurial skills into learning

Entrepreneurship significantly influences individuals' overall well-being. However, many teachers currently in the field have not received adequate preparation to understand and infuse entrepreneurial skills into learning (Ntsanwisi & Simelane-Mnisi, 2025). It is essential for teachers to develop the right attitude and mindset for successfully infusing entrepreneurial skills (Akintola, Adebayo & Odutayo, 2025). Manase (2024) highlights the importance of providing support to teachers through training programmes, such as workshops and professional development initiatives. Additionally, collaborating with colleagues and observing successful entrepreneurs in the community can further enhance teachers' knowledge and skills (García-Martínez et al., 2021; Diaz-Gonzalez & Dentchev, 2022).

2.4.1 Professional development programmes

The primary purpose of professional development programmes is to enhance the practical aspects of learning (Koa, Lin & Chien, 2018). These programmes are essential for equipping teachers with the necessary skills and knowledge related to entrepreneurial skills. They may include workshops, seminars, or training sessions focused on pedagogical strategies for infusing these concepts into science learning (Ahadi et al., 2021). The concepts may include the skills of planning a business, innovation or market analysis. Approaches such as problem-based learning can promote entrepreneurial thinking (Omoniyi & Gamede, 2022). In Eswatini, periodic in-service workshops for science teachers could serve as a valuable starting point for equipping teachers with the right attitudes, knowledge, and preparedness to incorporate entrepreneurial skills into the science learning (Dlamini, 2022).

2.4.2 Collaboration and observation

Science teachers can collaborate with colleagues and business owners to enhance their knowledge and skills in infusing entrepreneurial skills into their learning (De Cotio & Briona, 2023). This approach fosters teachers' self-efficacy in the infusion of entrepreneurial skills into learning (Amit, Mahmood & Som, 2024). When teachers collaborate with successful entrepreneurs who have effectively utilized scientific knowledge, they gain valuable skills that can aid in infusing entrepreneurial skills into learning activities (Nwosu et al., 2022). Observation is a key method that demonstrates how learning can take place within social contexts (Duong, Tran & St-Jean, 2024). When teachers share their personal experiences related to entrepreneurial skills, it increases their motivation to incorporate entrepreneurial concepts into learning activities (Wraae, Brush & Nikou, 2020).

2.5 Instructional methods used to infuse entrepreneurial skills into science learning

Teachers are often perceived to have limited knowledge and focus regarding the pedagogical instructional methods for effectively infusing entrepreneurial skills into science learning. The instructional methods should promote the infusion of these skills than to engage methods used when entrepreneurship is taught as a separate subject (Crişan et al., 2024). Kaandorp et al. (2020); Igwe et al. (2022) highlighted the importance of involving external stakeholders, enhancing learners' understanding of entrepreneurial skills through practical activities outside classroom.

Similarly, Söresen et al. (2022) agreed that entrepreneurial skills can be developed in learners through hands-on and active learning (experiential learning), fostering value creation in venture establishment benefiting society, and contributing to economic growth. While the teaching through entrepreneurship approach is emphasized, traditional methods (learning about entrepreneurial skills) remain a fundamental foundation for imparting theoretical knowledge about entrepreneurship skills (Lackéus, 2015; Makwara et al., 2024; Söresen et al., 2022). In other words, the theoretical approach lays a foundation for the development of the practical approaches to learning. In the context of this study, some methodological approaches such as experiential learning, Project-Based Learning and Problem-Based Learning (PBL) are further interrogated. All these approaches are learner-centred. Characteristics of these non-traditional methods include action-based, creative-based and innovative approaches. Learners are actively

involved in the learning process while teachers play the role of being mentors or facilitators (Olukunbi & Ogunleye, 2020). These approaches are articulated in the following:

2.5.1 Experiential learning

Experiential learning emphasizes that learners learn by doing, with knowledge gained through the transformation of experience (Kolb, 1984). As learners engage in authentic learning experiences, they develop a deeper understanding of concepts, increasing the likelihood of using this knowledge to create science-related business ventures after high school (Kolb & Kolb, 2009; Bartle, 2015). By connecting their beliefs and experiences about entrepreneurial skills to science learning, learners enhance their problem-solving skills (Makwara et al., 2024). This approach promotes knowledge retention and engagement, as active involvement motivates learners to relate their experiences to new material, boosting their confidence and competence (Lackéus, 2015; Makwara et al., 2024). Ultimately, experiential learning can inspire learners to infuse entrepreneurial skills into science learning, contributing to job creation and economic growth in Eswatini.

2.5.2 Problem-Based Learning

PBL emphasizes learner-centred approaches, with teachers facilitating the process. Learners' innovative and problem-solving skills are crucial as they work on projects, receiving guidance from teachers as needed (Olukunbi & Ogunleye, 2020). This method enhances understanding by connecting subject matter to real-world contexts (Thomas et al., 2013). Dewey (2008) argued that learning should be task-driven and hands-on, allowing students to develop science-based entrepreneurial projects to find solutions to real-world problems. Makwara et al. (2024) asserted that utilizing effective teaching methods helps shape learners' entrepreneurial intentions, transforming them into actions by engaging with real-world situations. According to Odundo, Wanjiru and Lilian (2018), PBL approach sets a meaningful platform that addresses identified challenges via creative thinking, and this is facilitated by the approach's adherence to value creation pedagogy. Learners can freely explore and give their point of views as they delve into identifying practical solutions to the problems. Learners are given tasks that encourage innovation and teamwork, thereby enhancing creativity.

The essence PBL lies in its ability to enhance high levels of critical thinking and analytical processes in learners, by placing much emphasis on the use of motivation to acquire knowledge and achieve access (Hutsaloa et al., 2024). Consequently, entrepreneurial skills such as problem-solving work together with critical thinking so that learners achieve success in acquiring science-based solutions, meaning, the infusion of these skills into science learning can be effectively developed (Dovgyi et al, 2019). Besides this approach being time-consuming, there is significant need for learners to explore and resolve identified challenges, using PBL approach that facilitate the use of acquired knowledge to solve problems (Hutsaloa et al., 2024).

2.5.3 Project-Based Learning

Similar this Project-Based Learning bridges theory and practice, with teachers serving as mentors. This approach fosters critical thinking, problem-solving, and innovation as students engage with real-world situations (Pearce et al., 2025). It promotes effective teaching that enhances analytical thinking and collaborative learning (Olukunbi & Ogunleye, 2020). Learners must interact with their environment to improve knowledge retention and skill acquisition (Batbayar, 2022). Project-Based Learning involves applying existing knowledge to solve problems, fostering innovation and preparing learners for self-employment or job creation (Pearce et al., 2025). Through both experiential and Project-Based Learning, learners can effectively develop the entrepreneurial skills necessary for success.

2.6 Challenges faced when infusing entrepreneurial skills into learning

The challenges hindering the effective infusion of entrepreneurial skills into learning include a range of pedagogical strategies that can lead to issues such as a lack of qualified teachers, resource constraints including lack of infrastructure, curriculum limitations, and cultural factors (Maka, 2023; Mbatha & Ndovela, 2024; Mlambo, Mbongwa & Khambule, 2024). Lackéus (2015) also highlights the key challenges, including inadequate learning opportunities such as professional development programmes, time constraints, and insufficient resources. These challenges are interrogated in the following sub-sections.

2.6.1 Entrepreneurship pedagogical knowledge content

Science teachers must understand the principles of entrepreneurial skills before infusing it into learning activities. Limited content knowledge in entrepreneurial skills, due to its divergence from their subject specialization, results in inadequate pedagogical skills (Rogel & Reginalde, 2024). This highlights the need for developing specific content knowledge that connects scientific skills with entrepreneurial skills like problem-solving and critical thinking (Mbatha & Ndovela, 2024; Thomas, 2013). Pedagogical content knowledge is crucial for teachers, enabling them to plan adaptable activities for diverse learner abilities. To enhance this knowledge, teachers should participate in professional development training, supported by local stakeholders such as successful business owners. This collaboration can positively impact learners' entrepreneurial engagement both in learning activities and in the community, leading to effective learning (Mbatha & Ndovela, 2024; Mizzi, 2013).

2.6.2 Inadequate infrastructure, time and resource constraints

Time constraints are a significant challenge, as teachers often prioritize completing science content over infusion of entrepreneurial skills into science learning activities. Additionally, a lack of resources can lead teachers to focus solely on subjects they are comfortable with, resulting in resistance to entrepreneurial skills' infusion into science learning activities (Maka, 2023; Smith et al., 2006). Limited resources significantly affect teachers' perceived ability to integrate entrepreneurship concepts into science learning (May-Varas, 2023). Inadequate infrastructure can be a factor that hinders the development of entrepreneurial skills, since it promotes market development and business growth (Akpan & Clark, 2024). Creating a supporting environment that promotes the acquisition of entrepreneurial skills is needed to done by the government with help from stakeholders (World Economic Forum, 2023).

2.6.3 Professional development programmes, funding and support

Akpan and Uko (2019) noted that infusion of entrepreneurial skills into science learning faces barriers, including insufficient support from parents and administration, lack of funding, inadequate infrastructure, and unqualified teachers. Therefore, it is essential for science teachers to receive adequate training to boost their self-efficacy, while also ensuring that resources, funding, and policies are in place to support effective implementation.

2.7 Chapter summary

Chapter 2 reviews literature on the infusing entrepreneurial skills into science learning, focusing on the theoretical framework that formed the lens through which the issue under investigation was observed. It defines entrepreneurial skills as vital for economic growth and advocates for curriculum reform in Eswatini to prepare students for the workforce. Strategies for enhancing teacher preparedness, such as professional development and collaboration with local entrepreneurs, are discussed. Methodological approaches like experiential, problem-based, and project-based learning are presented as effective integration methods. The chapter also highlights challenges like inadequate teacher training, resource limitations, and insufficient stakeholder support, stressing the need for targeted interventions to enhance the infusion of entrepreneurial skills into science learning.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines the research paradigm, research approach, sample and sampling procedure. In addition, this chapter looks at the following: research instruments, data collection procedure and data analysis, and research integrity. The chapter summary gives an overview of the research methodology.

3.2 Research paradigm

A paradigm is defined as a set of interrelated concepts which provide the background within which we perceive and understand a particular problem (Kumatongo & Muzata, 2021). The paradigm within which we work determines what we look for, how we construe what we observe and how we solve emerging problems (Magrini, 2015). Researchers such as Creswell, (2014); Denzin and Lincoln (2018) define a paradigm as human construction, which deal with first principles or ultimately indicate where the researcher is coming from to construct meaning embedded in data. Therefore, paradigms provide beliefs and dictates, which, for scholars in a particular discipline, influence what should be studied, how it should be studied, and how the results of the study should be interpreted (Gathercole, 2015). It comprises a set of assumptions and perspectives that shape a researcher's worldview and inform their choices of research approach, sampling, instruments, etc. (Alele & Malau-Aduli, 2023). Thus, it provides a set of principles or a blueprint on how researchers would approach their study (Dawadi, Shrestha & Giri, 2021).

It is in this context that this endorsed the pragmatism paradigm to guide data collection, analysis and interpretation. This was chosen based on the assumption of its ability to put forward a situation, analyse and interpret it. Thus, involved the use of both objective and subjective knowledge forms to provide answers to the issue at the centre of the study (Elgeddawy & Abouraia, 2024). Thus, it emphasises on the provision of practical solutions to issue under investigation. This made it suitable for this study as it sought to understand both the measurable

and experiential aspects of the respondents (Creswell & Clark, 2018). In other words, it created the platform for the researcher to gain multiple insights from the respondents in order to effectively provide answers to the main research objective (Elgeddawy & Abouraia, 2024). Thus, it adheres to the view that only factual knowledge gained through the questionnaire (Creswell, 2012).

Crowther and Lancaster (2008) posited that, in pragmatism paradigm the role of the researcher was limited to data collection, analysis and interpretation in both the subjective and objective way. Therefore, pragmatism paradigm depends on both the quantifiable reflection grounded in statistical analysis and the qualitative data generated from the respondents' experiences interrogated through thematic analysis (Kalof et al., 2008). This created the opportunity for the researcher in designing and validating the instruments. In addition, it helps the researcher to generalize the data, thereafter develop a holistic analysis to fully incorporate numerous relevant issues in the study (Kaushik & Walsh, 2019). Hence, the need for researcher to employ both subjective qualitative and objective quantitative approaches to ensure that varied responses to questions contribute to deeper insights (Lim, 2025).

3.3 Research approach

According to Creswell (2014) research approach can be considered to be a plan or procedures that are followed which span the steps from broad assumptions to detailed instruments of data collection, analysis, and interpretation. Thus, it provides a structured framework that guides the researcher in addressing the study's research questions (Smith, 2022). In addition, Naape (2023) notes that this approach outlines the specific steps and procedures for data collection, analysis, and interpretation. Kankam (2019) highlights the significance of selecting an appropriate methodology, emphasizing that the best choice depends on the nature of the research questions or objectives and the type of data to be collected.

Hence, the mixed method approach was used in this study to gain an in-depth understanding of the issue under investigation (Nagpal, Kornerup & Gibson, 2021). Thus, mixed method approach involved the collection of data in numerical and word form for later analysis under the identified variables (Bhawna & Gobind, 2015). Hence, the need to use for the researchers start with research objectives and questions, then collect data with the view to determine whether empirical

evidence to measure the extent of the accomplishment of the needs of the issue under investigation (Mohajan, 2018). This approach was used as a means of avoiding biases intrinsic to single (McCombes & George, 2025). In addition, it was used as a way of compensating specific strengths and weaknesses associated with particular approach.

3.4 Sample and sampling techniques

A population is a group of individuals, objects or items, from which samples are taken for measurement (Kenton, Anderson, & Velasquez, 2025). The Ministry of Education and Training's Hhohho Region is divided into two sub-regions namely: Northern Hhohho and Hhohho with a target population of 158 science teachers who were involved in the infusion of entrepreneurial skills into science teaching and learning activities. It was from this target population that the respondents were selected (Neuman, 1997; Rahman, 2023).

According to Kamuren, Kamara and Ntabo (2017) sampling is defined as seeking of information about a population by observing a part of this population in order to extrapolate the findings to the entire population. It is in this context that Thomas (2022) argues that a researcher has to work with a sample of subjects rather than the full population for data gathering. In the table below the selection of the respondents took in consideration the aspect of representativeness of the sample through making sure that the cluster with more teachers contributes more towards the sample. Hence, the use of stratified random sampling procedure to come up with the respondents (Nguyen et al., 2021) as illustrated in the table below.

Table 3.1: Distribution of selected respondents according to clusters (n= 30)

Cluster(s)	No. of teachers	No. of selected respondents
Northern Sub-Region	60	12
Hhohho Sub-Region	98	18

It is against this background that stratified random sampling procedures was used to come up with the 30 respondents. It was from this target population that the respondents for this study were derived (Narayan, Sinha & Singh, 2023). Thus, the sample in this study was considered as a subset of the target population to which the researcher intended to generalize the study results (Acharya et al., 2013). Thus, the selected sample was considered to be representative since it mirrored the defining attributes of the target population, thereby ensuring the validity and

generalizability of the results. Consequently, the use of a 19% sample size can be acceptable, as it provided adequate coverage to draw reliable conclusions without demanding the inclusion of the entire target population (Ahmed, 2024). For the purposes of data triangulation, purposive sampling technique was used to select 9 respondents (science teachers) who had participated in the completion of the questionnaire. Their inclusion was based on the belief that through their experience in the issue under investigation they can be a rich source of information (Burton et al., 2014).

3.5 Research instruments

Research instruments are techniques used to collect and analyse data in a research study (Collins, 2024). The following instruments were used to ensure that the research questions are adequately addressed:

3.5.1 Semi-structured questionnaire

A questionnaire is a crucial research tool used to evaluate participants' knowledge, attitudes, and practices (Sharma, 2022). It consists of predefined questions aimed at addressing specific research objectives (Cleave, 2023). A semi-structured questionnaire combines both structured and unstructured elements, featuring a mix of open-ended and closed-ended questions (Khan et al., 2024). Open-ended questions allow for diverse responses with minimal researcher involvement, while closed-ended questions provide measurable data (Adeoye-Olatunde & Olenik, 2021).

The researcher opted for a semi-structured format to gather rich data for comprehensive qualitative analysis. This flexible tool enables the collection of both quantitative and qualitative data to address real-world issues and propose practical solutions (Ramanadhan et al., 2021). Respondents have the freedom to answer with minimal constraints or researcher involvement (Ranganathan & Caduff, 2023). The questionnaire was constructed in a semi-structured format, incorporating close-ended and open-ended questions. The structured questions consisted of scales, for instance, Likert Scale gave the respondents an opportunity to select their view-point in terms of ranks such as: strongly agree, agree, disagree or strongly disagree (Sathiyaseelan, 2015).

In this case, the study used semi-structured questionnaires to collect information from the selected respondents. The instruments were divided into the following sections: Section A covered the demographic characteristics of the respondents, Section B conceptualisation of entrepreneurial skills, Section C comprised of the methods used to prepare in infusing entrepreneurial skills into science learning, Section D looked at the instructional strategies used in infusing entrepreneurial skills into science learning, and Section E looked at the challenges that are encountered when infusing entrepreneurial skills into science learning.

3.5.2 Interview

Taherdoost (2021) defines an interview as a method of asking questions to respondents with the aim of gathering both qualitative and quantitative data. An interview is primarily a qualitative research method where an interviewer (researcher) asks the interviewee (respondent) some questions based on the research topic in order to collect in-depth insights (George, 2023). Jain (2021) posited that an interview was an interactive process involving personal exchange of information which can lead to addition of more information to enhance clarity. The researcher selected the interview research instruments because of several benefits that it has. The interview enabled the generation of in-depth, rich data, where the respondents gave their own experiences and thoughts (Demirci, 2023; Knott, 2022).

In addition, the interviews allowed the researcher to explore complexities in human behaviour, their perspectives and what they value in context with the phenomena under study (Jain, 2021; Hecker & Kalpokas, 2023). The interview covered the following themes: background information of the respondents, the conceptualisation of entrepreneurial skills, teacher preparation infusing into science learning, and challenges faced by the teachers in the infusion of entrepreneurial into science learning. The results from the interview sessions combined with those from questionnaire allowed the triangulation of data for the purpose of gaining rich information from the study.

3.5.3 Literature method

Literature method serves as a valuable research instrument in exploring the infusion of entrepreneurial skills into science teaching and learning (Hermann & Bossle, 2020). This offered insights into how such competencies are embedded within Ministry of Education and Training's educational policies, curricular frameworks, and instructional materials. By interrogating these documents such as national curricula, teacher training manuals, lesson plans, and assessment tools, researcher can identify explicit and implicit references to entrepreneurial skills (Starkey, 2020). This instrument also enabled the tracing of pedagogical shifts toward inquiry-based or experiential learning. This instrument articulated the extent to which science learning aligns with broader economic and societal objectives (Wilhelm, Förster & Zimmermann, 2019). Furthermore, literature method complements empirical instruments (semi-structured questionnaire and interview) in enriching the study by revealing systemic intentions, and gaps in the infusion of entrepreneurial skills into science learning.

3.6 Data collection procedure

Hasan (2024) defines data collection as a systematic process of collecting and analysing information to assess whether study objectively and subjectively have been achieved. This step is crucial, as it significantly influences the results of the study (McMillan & Gogia, 2014). Therefore, the researcher acquired a letter from the university in order to obtain a research permit from the Ministry of Education and Training. Thereafter, the researcher had a series of meetings with the heads of the high schools in the region to discuss on how to proceed with the study. This was followed by the researcher sought consent from the selected respondents for their involvement in the study. The researcher made necessary arrangements with the concerned high school heads in order to administer the questionnaire on the selected respondents.

Semi-structured questionnaire schedule was used in order to ensure that similar questions were asked to the selected respondents though they were in different high schools within the two regions. These were distributed both in person and online via Google Forms, allowing respondents ample time to complete them. Thus, a good data collection procedure was crucial to ensure that the reliability estimate is trustworthy. After the administration of the semi-structured questionnaire to the targeted respondents, purposive sampling procedure was used to select 12

respondents to participate in scheduled interviews. These interviews were conducted at times convenient to the respondents so as not to disturb the flow of activities at the selected high schools.

3.7 Data analysis

Data analysis involves a systematic process of inspecting, cleansing, transforming and modelling data to ascertain whether the study has generated new insights (Hosseinzadeh, et at., 2023). Various techniques and approaches were employed to maximise the extraction of data-driven conclusions, which are essential for informed decision-making (Brown, 2014).

3.7.1 Quantitative data analysis

According to Albers (2017) quantitative data analysis is a process of presenting numerical data. Quantitative data in this study used descriptive statistics, hence the process was involved cleaning of data to make sure that the data was correctly identified in order to gain knowledge about the data, lists of data were made to produce descriptive statistics. In this study statistical data was analysed through frequencies and percentages.

3.7.2 Qualitative data analysis

Qualitative data analysis is a process that involves gathering of data, organising it into themes or categories and interpreting it in order to come up with meaningful insights (Bingham, 2023). Raw data collected from respondents is transformed into information that can facilitate decision-making (Korherr, et al., 2022). The analysis of qualitative data is essential to uncover the '*whys'* and '*hows'* that are obtained from exploring human behaviour, experiences and experiences in relation to the research topic (Borg, 2024). One method that can be used to analyse qualitative data is thematic analysis, a theory-driven coding (Alotumi, 2021). Braun et al (2019) emphasised the importance of the researcher to pay attention to every detail in the data so as to extract themes that are representative of the data. In this research study, data was analysed using thematic analysis to identify key themes and characteristics from the collected data. Codes and themes developed from data were interpreted using manual coding methods. The triangulation of the qualitative and quantitative data was done to develop a comprehensive understanding, considering contextual factors that may influence the teachers' perceptions (Hurst, 2023).

3.8 Research integrity

Research integrity encompasses the attributes such as honesty, accountability, rigour, transparency and respect (Kumavat, 2024). These attributes ensure that the research process reflects good practices, thereby fostering trust and confidence throughout the entire research endeavour. Armond, Cobey and Moher (2024) describes research integrity as a process of how research is conducted in an ethical manner, reflecting attributes such as honesty, robustness, and transparency. Research integrity also takes into consideration the adherence to rules and regulations. Maintaining integrity fosters credibility and reliability, essential components of research ethics, including avoiding results fabrication and plagiarism (Lal & Sharma, 2023).

3.8.1 Validity and reliability

Heale and Twycross (2015) define validity as the extent to which concepts used in a quantitative investigation are accurately measured. Validity assesses whether research instruments are well-designed to measure intended constructs. The accuracy of a research instrument determined how valid the instrument is (Middleton, 2019). Valid research instruments yield valuable results that would be generalised to the rest of the population from which the sample of respondents was taken (Ahmed & Ishtiaq, 2021). In order to ensure validity, the researcher had enough participants to represent the targeted population so that there is no sampling bias (Middleton, 2025). Taherdoost (2016) asserted that it is highly essential for researcher to engage experts in the application of content validity of the instruments at the initial stages of the research.

Reliability emphasises the consistency of research instruments, ensuring that repeated measurements produce the same results (Ahmed & Ishtiaq, 2021). Reliability and validity are closely intertwined, as they work together to enhance the quality of research (Middleton, 2025). Taherdoost (2016) argued that reliability alone is insufficient. It must be accompanied by validity. This means that a research instrument must be both reliable and valid to yield trustworthy and valuable results. To ensure this, the semi-structured questionnaire was piloted with a small group of respondents to identify any errors in question wording (Robbers et al., 2023; Holmes, 2023). Pilot testing is crucial for the researcher to determine whether the science teachers understood the demands of the questions. Their feedback enabled the researcher to make adjustments with the view to make instruments comprehensive and clear.

3.8.2 Trustworthiness of the study

To ensure the trustworthiness of this study the researcher made an attempt to ensure credibility of the results through the triangulation of data sources (e.g., interviews, and policy documents) (Lemon, & Hayes, 2020). In addition, member checking to validate interpretation was carried out; and dependability was ensured by maintaining an audit trail and engaging in peer debriefing to support consistent and transparent research processes (Ghafouri & Ofoghi, 2016). Thick, contextual descriptions of the results enabled the researcher to judge their applicability to the context under investigation. Lastly conformability was demonstrated through the documentation of reflexive practices, presenting respondents' voices directly and showing that conclusions are firmly grounded in the data rather than researcher bias (Adler, 2022).

3.8.3 Ethical issues

Bhandari (2024) describes ethical considerations as a set of research guidelines that govern the formulation and implementation of research designs and practices. These guidelines form a code of conduct to ensure that the researchers adhere to ethical principles during data collection. Ethical considerations are essential to uphold integrity, human rights and dignity. The primary goal is to ensure that moral principles, values and standards align with the results and decisions made by the researcher (Khan, 2024).

3.8.3.1 Privacy and confidentiality

Privacy pertains to respondents' willingness to share personal information and their comfort level in doing so (Hecker & Kalpokas, 2025). Confidentiality refers to the researcher's obligation to protect or prevent unauthorized access to data provided by respondents, that is, the willingness to share the information that is obtained from the participants (Neem et al., 2022). To ensure respondent privacy, the researcher ensured that participants' names or their identities are not recorded. In other words, participants were anonymous and they were given codes to identify them. It is important for the researcher to build trust and confidence in the science teachers so that they are free to express themselves during interviews (Dandawate, 2024). For confidentiality, the researcher used codes to identify respondents instead of names when analysing qualitative data (Adarmouch et al., 2020). Protecting the privacy and confidentiality of

participating science teachers by anonymizing responses and securely storing data is imperative. Participants were assured that their personal information remained confidential (Bhandari, 2024).

3.8.3.2 Anonymity

Anonymity refers to the protection of respondents' identities, ensuring that their names are not associated with the collected data (Kang & Hwang, 2023). The researcher ensured that data does not contain identifiable information accessible to unauthorized individuals (Dandawate, 2024). Respondents have the right to anonymity throughout the research process. Researcher should not link participant data to their identities, which is essential for maintaining the integrity and dignity of respondents during the entire research process (Hecker & Kalpokas, 2025).

3.8.3.3 Informed consent

Informed consent is a fundamental aspect of research ethics, meaning that research cannot commence without participants' consent and they are aware of the benefits and consequences of participating in the research (Shah et al., 2024). Researchers provided detailed information on the purpose and expectations of their research to respondents (Manti & Licari, 2018). This transparency allowed participants to understand the research process, ensuring that confidentiality and anonymity are maintained (Hauser et al., 2010). Researchers did not influence respondents' decisions regarding their participation. Informed consent reflected a high level of transparency to ensure that participation is voluntary (Skulmowski, 2025).

3.8.3.4 Researcher bias

Gerhard (2008) stated that minimising bias or systematic errors is crucial for obtaining sound research results. Researcher bias may arise from the researcher's handling of the research design and data analysis (Baldwin et al., 2022). Personal beliefs, preferences, and expectations can influence the interpretation of findings, decisions, and recommendations (Smith & Noble, 2025). Researchers considered the implications of bias to maintain the credibility and accuracy of research findings, adjusting for bias when minimization is not possible. If bias is evident, it should be discussed in the research report to reflect its presence (Gerhard, 2008).

3.9 Chapter summary

This chapter outlined the research paradigm, approach, and sample and sampling procedures. It also detailed the structure of the selected research instruments. The importance of maintaining ethical standards, including anonymity, privacy, and confidentiality, was emphasized, along with the need to avoid researcher bias in respondents' responses. The chapter highlighted the critical step of obtaining informed consent from respondents. Finally, it addressed how research bias can impact the quality of results.

CHAPTER 4

DATA ANALYSIS AND INTERPRETATION

4.1 Introduction

The previous chapter outlined the strategy for data collection, presentation, and analysis. The current chapter focuses on the actual data presentation, analysis, and interpretation of the data collected through interview and semi-structured questionnaire. The results are presented descriptively according to the emerging themes in line the research questions and objectives in chapter 1.

4.2 Characteristics of the respondents

This section focuses on the demographic characteristics of the respondents who formed the sample for the study. The characteristics include the respondents' sex, age range, professional qualifications and teaching experience.

Table 4.1: Demographic characteristics of the selected respondents (n=30)

Attributes		**(n)**	**(%)**
Sex	Females	13	43.3
	Males	17	56.7
Age range	Under 25	0	0
	25-34	6	20
	35-44	11	36.7
	45-54	10	33.3
	Above 55	4	13.3
Academic Qualification	Diploma in Education	8	26.7
	BEd/BScEd	15	50
	MEd/MScEd	6	20
	PhD/DEd	1	3.3
Teaching experience (Years)	Less than 1	0	0
	1-5	2	6.7
	6-10	4	13.3
	Above 10	24	80

In terms of sex, it can be noted that most of the respondents (56.7%) in this study were males, with the remainder (43.3%) being females. This concurs with Chikuvadze and Matswetu (2013); Makhoba, Moodley and Ramchander (2024); Zuma, Hamlall and Dorasamy (2022)'s notion that science-related study areas in education are mostly regarded as 'masculine.' In addition, the results revealed that few respondents (20%) were in age range 25 - 34 years, with 36.7% of the respondents falling in the age range 35 - 44 years, 33.3% of the respondents (33.3%) were in age range 45 - 54 years, and 13.3% of the respondents were in age range above 54 years. The respondents' distribution by age range revealed that they can be considered mature enough to conceptualize issues at the centre of this study. In terms of professional qualifications, few respondents (26.7%) were holders of a Diploma in Education, with half of the respondents (50%) being holders of a BScEd/BEd degree, with few respondents (20%) being holders of MEd/MScEd degrees and 3.3% were holders of a PhD/DEd degree.

In as far as teaching experience was concerned it can be acknowledged that most of the respondents (80%) were above 10 years of experience. This observation makes the researcher believe that due to their length of service in the area under investigation, they have acquired the relevant knowledge, skills and values to enable them to be functional as effective facilitators in the infusion of entrepreneurial skills into science learning. This can be supported by Kind, Park and Chan (2022), who indicated that teaching experience enhances teachers' professional knowledge content, quality of instructional and learners' learning context. The presented data also revealed that the respondents had diversity in terms of age range, professional qualifications and teaching experience, thereby making the sample a rich source of data to be analysed and interpreted to provide answers to research objectives and questions in chapter 1.

4.3 The conceptualisation of entrepreneurial skills in the context of science learning

It is in this context, the results as presented under the theme of conceptualisation of entrepreneurial skills in science learning context. In the table below, analysis and interpretation employed to interrogate data collected from selected respondents.

Table 4.2: Conceptualisation of entrepreneurial skills (n=30)

	Strongly Agree		Agree		Strongly Disagree		Disagree	
	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)
The ability to learn to identify scientific problems or community challenges and conceptualise innovative, science-based solutions.	18	60	12	40	0	0	0	0
Encouraging learners to work creatively with limited materials or experimental setups.	16	53.3	14	46.7	0	0	0	0
The capacity to generate, test, and refine original ideas or hypotheses through experimental processes.	17	56.7	11	36.7	0	0	2	6.7
Willingness to engage with uncertain outcomes in experiments, embracing mistakes as learning opportunities.	11	36.7	19	63.3	0	0	0	0
Skills in presenting scientific ideas clearly and persuasively to different audiences, including peers, teachers, and stakeholders.	16	53.3	14	46.7	0	0	0	0
Working effectively in laboratory groups or project-based learning scenarios to co-create science-driven solutions.	19	63.3	11	36.7	0	0	0	0
Applying science concepts to real-world problems in ways that generate value.	23	76.7	6	20	1	3.3	0	0

It can be seen from Table 4.2 above that there is a consensus among most respondents on the conceptualisation of entrepreneurial skills in the context of science learning. Notably, 60% of respondents strongly agreed with the view that entrepreneurial skills involve the ability to identify scientific problems or challenges in communities and innovate science-based solutions. Additionally, 56.7% strongly agreed with use of entrepreneurial skills as involving experimental processes to test hypotheses generated from these problem settings, while 63.3% supported the utilisation of Project-Based Learning activities to address these issues and develop science-based solutions. This aligns with the sentiments expressed by one respondent who stated:

I think it's (conceptualisation of entrepreneurial skills) about problem solving. Because just like in a business, you have to solve a problem in order to be able to make money. It involves being creative […] you have to be innovative [...] being able to do critical things (Interviewee 1)

This contribution highlights that respondents recognize entrepreneurial skills as involving hands-on experiences in generating new solutions to identified problems. This concurs with Pathan et al. (2024), asserting that activities that engage learners enhance their creative ideas through hands-on learning. This support the development of their creativeness and critical thinking skills. In a similar context, another respondent noted that:

Related to teaching, I think it is about innovation, improvisation, and it is in the schools, in teaching and learning of science (Interviewee 2)

The above contribution revealed that, entrepreneurial skills such as innovation play a critical role, as learners improvise and utilize their acquired knowledge to solve real-world challenges with limited resources. This concurs with Zenk et al. (2022); Gojny-Zbierowska and Zbierowski (2021) who emphasized that improvisation is vital for generating new solutions without prior planning and this can lead to responsible innovation. Further to the above contribution, it is revealed that a most of respondents (76.7%) agreed that applying science concepts to real-world problems enhances value creation in social, environmental, and economic sectors of a community. This is echoed in another respondent's view, who acknowledged that:

I would express entrepreneurial skills in science education as the ability to innovate, solve real-world problems, as well as thinking critically. It's something which involves teaching learners to apply scientific knowledge in ways that lead to development of products, services or solutions with any economic or social impact (Interview 7)

Further illustrating this point, another respondent remarked:

[...] applying scientific knowledge in real-life situations such as using understanding of concepts in chemistry can lead to the development of solutions, […] like making soap as a product of a chemical reaction that can be sold to generate income (Interviewee 5)

These contributions reveal that conceptualising entrepreneurial skills involves solving problems by incorporating scientific knowledge to generate innovative ideas and creativity. This view aligns with Kaya-Capocci et al. (2022), who posit that the use of entrepreneurial skills enhances the creation and establishment of new social, economic, and cultural environments, promoting the development of new products and services. However, a few respondents (6.7%) disagreed with the view that the capacity to generate, test, and refine original ideas or hypotheses through

experimental processes can be conceptualised as an entrepreneurial skill. In support one respondent highlighted that:

But in science teaching and learning in high school, I am not sure the context is very clear. We hardly teach business in science (Interviewee 3)

Thus, some of the respondents had difficulties in conceptualising entrepreneurial skills in the context of science learning. In contrast, another respondent emphasized the importance of critical thinking for future problem-solving:

To think critically helps them (students) in the future when they are outside in the world as they solve problems (Interview 1)

This sentiment was echoed by another respondent who noted:

[...] having graduates equipped with problem-solving skills and resilience to tackle real-life challenges (Interviewee 2)

In support of the above contribution, 63.3% were in agreement with the notion that entrepreneurial skills involve willingness to take risks amidst uncertainties, fostering critical thinking and creativity. This concurs with Cyril and Orji (2023), who emphasized that the need for entrepreneurs to possess a positive interest, patience, and the ability to manage risks. In support one respondent stated that:

We can integrate entrepreneurial skills into science learning since it prepares learners for the future by fostering creativity, critical thinking, and independence. It also equips them to turn scientific ideas into practical ventures, promoting both job creation and innovation (Interviewee 4)

In addition, a respondent indicated that:

Infusing entrepreneurial skills in science learning could be important to merge science learning skills with business knowledge that could help develop in learners, other skills to start small enterprises or income-generating projects (Interviewee 3)

The above contributions demonstrate the extent to which the respondents conceptualised entrepreneurial skills in the context of enhancing the link between scientific knowledge and business-related ventures. This is corroborated by most of the respondents (76.7%) who were agreement to the view that that entrepreneurial skills entails the application of scientific knowledge in solving real-world socio-economic issues. In support Goli and Babu (2024) assert that today's world expects learners to be creative, critical thinkers and adaptive to existing problems and proffer solutions. In the same vein Putri, Abdurrahaman, and Herlina (2025)

highlighted that in science learning entrepreneurial skills nurture creativity, innovation, critical thinking etc., in learners. In recognition of the importance of infusing entrepreneurial skills in science learning, one respondent echoed that:

Because basically, I have been looking at enhancing 21st century skills. It is preparing learners for ever-changing global economies. So, there is a need to consider a curriculum that enables fostering of these skills (Interviewee 4)

Additionally, one respondent stressed that:

To make all this a reality, there's an urgent need to rewrite many science textbooks so that they align with new technologies and emerging trends in the modern scientific and digital world (Interviewee 1)

From these contributions, the respondents highlighted the importance of linking science learning to skills essential to the 21st-century socio-economic advancement. This concurs with Al Ali (2024) who postulated that 21st century skills and STEM learning have a symbiotic relationship. Hence, science learning should focus on developing skills like critical thinking, creativity, and innovation to promote lifelong learning mindset (Nyamboga, 2024). In support, Hanafi et al. (2024); Suleiman et al. (2024) postulated that science learning can be made meaningful through the infusion of more holistic, and future-oriented instructional approaches like Problem-Based Learning, experiential learning to promote interdisciplinary learning, entrepreneurial thinking and lifelong learning mindset. This aligns with Pathan et al. (2024), who affirmed that as teachers impart scientific knowledge, they concurrently nurture entrepreneurial skills in learners. The above discussions show that respondents to a larger extent had a clear conceptualisation of entrepreneurial skills in the context of science learning.

4.4 Teacher preparation strategies for the infusion entrepreneurial skills

In this section, the strategies that used to support to teachers as they infuse entrepreneurial skills into science learning are interrogated. Table 4.3 shows opinions advanced by the selected respondents and these were analysed and interpreted.

Table 4.3: Strategies used to prepare teachers for the infusion of entrepreneurial skills (n=30)

	Strongly Agree		Agree		Strongly Disagree		Disagree	
	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)
Professional development workshops	16	53.3	12	40	2	6.7	0	0
Curriculum co-design	13	43.3	10	33.3	2	6.7	5	16.7
Use of case studies and real-world problems	11	36.7	13	43.3	0	0	6	20
Collaborative learning and peer mentoring	14	46.7	13	43.3	0	0	3	10
Digital tools and experiential learning	17	56.7	11	36.7	0	0	2	6.7
Policy and institutional support	9	30	16	53.3	3	10	2	6.7
Assessment reforms	13	43.3	12	40	3	10	2	6.7

4.4.1 Professional development workshops

From the above Table 4.3, it showed that slightly above half of the respondents (53.3%) were strongly in agreement with the opinion that professional development workshops were one of the effective strategies that can be employed to enhance teacher preparedness in infusing entrepreneurial skills in science learning. This concurs with Tan and Teo (2025); Kolho (2024), who emphasized the importance of science teachers' participation in professional development programmes as a way of increasing their knowledge to infuse entrepreneurial skills into science learning. On the other hand, a few respondents (6.7%) strongly disagreed with the earlier on mentioned notion. This was supported by one of the respondents who indicated that:

Professional development workshops are, sadly, not usually taken seriously by some teachers. So, it'll be largely an ineffective strategy to prepare teachers to impart entrepreneurial skills to learners (Interviewee 9).

This sentiment was echoed by other respondents who acknowledged that:

I think here in Eswatini, there is a gap in that regard [.....] most of us have not received formal training in entrepreneurship that is focused on science (Interviewee 3)

In addition, a respondent highlighted that:

A lot remains that needs to be done in terms of human training, specifically focusing on integrating entrepreneurial thinking into science education. Teachers need to be trained so that they are informed, enabling them to pass on the knowledge to their learners (Interviewee 4)

From the respondents' standpoint, it can be highlighted that professional development in the context of infusing entrepreneurial skills into science learning has not been adequately addressed, indicating gaps in teacher capacity development. In the contrast Bilgin and Inaltekin (2022) highlighted the need to expose teachers to experience real-world entrepreneurial experiences through professional capacity development programmes so as to enhance their pedagogical content knowledge. Therefore, it is essential for teachers to be empowered through professional development workshops.

4.4.2 Curriculum co-design

From the results indicated that slightly below half of the respondents (43.3%) strongly agreed with the opinion that curriculum co-designing was considered as one of the strategies that can be used to prepare teachers for effective infusion of entrepreneurial skills into science learning. However, it is significant to noted few respondents (6.7%) strongly disagreed with the advanced opinion in Table 4.3. This contribution was supported by one of the respondents who indicated that:

They (teachers) haven't known any of such Curriculum planners, have to include that one, that shortage of knowledge there is a gap in that regard (Interviewee 3)

Another respondent suggested that:

Teachers should be included in curriculum design. There are the people that are on the playground of implementation concepts in the classroom. I feel the inclusion of teachers in the designing of the science-based entrepreneurship curriculum could change the trajectory of science education, gearing towards skills acquisition and an interdisciplinary approach to learning (Interviewee 9)

The above contributions revealed that the teachers were to a lesser extent involved in curriculum co-design activities. However, in principle the respondents acknowledged that the participation of teachers in curriculum development as a transformative step towards the infusion of entrepreneurial skills into science learning. This concurs with Higgins and Calvert (2024), who considered curriculum development as an iterative process, which requires the conceptualisation of teachers' and learners' wants and needs. In addition, Cyril and Orji (2023) indicated that teachers play a pivotal role in infusing knowledge content related to entrepreneurial skills into science learning to augment sustainable development.

4.4.3 Use of case studies and real-world problems

The results presented in Table 4.3 highlighted that 43.3% of the respondents strongly agreed to the relevance of using case studies and real-world problems in preparing teachers for the infusion of entrepreneurial skills into science learning. On the hand, a few respondents (20%) were in disagreement with view. In support of this, one respondent echoed that:

I wouldn't say personally because I am not privy to a lot of the things that are happening here. All I am usually interested in is just my teaching (Interviewee 4)

Another respondent acknowledged that:

I'm not sure. But most of the time, when we go for workshops, most of which discuss subject specific problems then trying to infuse skills such as problem-solving. I don't know if it's part of the entrepreneurial skills, but they do try to infuse some of these skills that we aren't familiar with (Interviewee 1)

The above contributions to a larger extent indicate the limited use of case studies and real-world problems in the infusion of entrepreneurial skills into science learning. In support, Botha and Obeng-Koranteng (2024); Makwara et al. (2024) indicated that case studies and real-world experiences were an essential aspect for effective infusion of entrepreneurial skills into science learning. These nurture critical thinking and creativity which teachers need in formulating entrepreneurial skills-based science learning (Siew & Arifin, 2025).

4.4.4 Collaborative learning and peer mentoring

The results from the table highlighted that 46.7% of the respondents were strongly in agreement with the use of collaborative learning and peer mentoring in preparing teachers for the infusion of entrepreneurial skills into science learning. A few of the respondents (10%) were in disagreement with the above opinion. In support of those who disagreed with the opinion, one of the respondents revealed that:

Not that I have heard of. Most of the collaboration that is done aims at achieving syllabus objectives, coordinating the teaching to maximise learner outcomes in the academics (Interviewee 3)

From another angle, a respondent acknowledged the importance of collaborative learning and peer mentoring through advancing the following:

Teachers need targeted training focused on science-based entrepreneurial skills, so that they are able to collaborate and do peer mentoring which encourages sharing of information and strategies to use when implementing the integration (Interviewee 6)

The results presented revealed divergence when it comes to the respondents' opinions towards the role of collaborative learning and peer mentoring in preparing teachers for the infusion of entrepreneurial skills into science learning. In line with these results Gracia-Zomeño et al. (2025) advanced that limited collaboration can diminish effective nurturing the infusion of entrepreneurial skills into science learning. In support Slimp (2022) highlighted that the relevance of teacher collaboration through sharing pedagogical strategies to ensure an effective infusion of entrepreneurial skills into science learning activities.

4.4.5 Digital tools and experiential learning

The Table 4.3 above shows that the slightly more than half of the respondents (56.7%) were strongly in agreement with the notion that use of digital tools and experiential learning can be one of the effective strategies to prepare teachers for the infusion of entrepreneurial skills into learning activities. In support one of the respondents mentioned that:

A lot of what we do is actually based on our own initiative, experience or adapting from other relevant resources such as the internet, social media platforms […] see how best we can infuse these skills in our science lessons (Interviewee 7)

The above results concur with Fitrianto and Saif (2024) who asserted that virtual reality, that combines the use of digital tools and experiential learning has the potential can enhance engagement and understanding. This is made possible through the involvement of hands-on learning, which is interactive in nature.

4.4.6 Policy and institutional support

Slightly above half of the respondents (53.3%) were in agreement with the notion that sound policy and institutional support are crucial in preparing teachers for the infusion of entrepreneurial skills into science learning. In support one of the respondents acknowledge that:

Every academic year begins with staff development workshops within schools where the administration invites external stakeholders. I remember one of them presented on content related to business, entrepreneurship and the like [...] teachers gained some insights on this aspect of entrepreneurial skills etc. (Interviewee 7)

In addition, another respondent echoed that:

I have seen people attending workshops organised by the Ministry [of Education and Training] alongside some NGOs usually focussing on CBE and entrepreneurial skills in Agriculture (Interviewee 4)

The presented results revealed the existence of institutional mechanisms that support teacher preparation in the implementation of a new policy requirement. This concurs with Munasi and Msezane (2024) who highlighted the need for professional support as teachers adapting to the requirements of the infusion of entrepreneurial skills into science learning.

4.4.7 Assessment reforms

Most of the respondents (43.3% strongly agreed and 40% agreed) acknowledged the significance of assessment reforms as one of the many strategies that can be used to prepare teachers for the infusion of entrepreneurial skills into science learning. In support, a respondent noted that:

Tertiary institutions that train science teachers can also start including CBE that aims at enhancing entrepreneurial skills (Interviewee 5)

In addition, one of the respondents indicated that:

Although in science subjects we have some practical assessments based on the subjects, where learners can apply problem solving and critical thinking, such should also be happening when it comes to lessons that integrate entrepreneurial skills. It is therefore important for teachers to be trained in that aspect, to make these assessments worthwhile. Otherwise, what is mostly done is the assessments based on memorisation of content (Interviewee 8)

From the presented results it can be noted that most of the respondents acknowledged that relevance of assessment reforms in preparing teachers for the infusion of entrepreneurial skills into science learning. Thus, adopting those assessment methods, which promote knowledge acquisition and skills development. This concurs with Omoniyi and Gamede (2022), advanced the need to assessment approaches that foster action-based learning. Hence, the need to shift from the traditional assessment methods to those that promote experiential learning. This is crucial in developing the entrepreneurial mindset leading to economic growth and innovation in the 21st century society (Adeyemo, Chukwuemeka & Popoola, 2024).

4.5 Instructional methods used to infuse entrepreneurial skills into science learning

In this section, centres on interrogating respondents' views on the instructional methods employed when infusing entrepreneurial skills into science learning.

Table 4.4: Instructional methods used to infuse entrepreneurial skills (n=30)

	Strongly Agree		Agree		Strongly Disagree		Disagree	
	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)
Project-Based Learning	14	46.7	11	36.7	0	0	3	10
Problem-Based Learning	13	43.3	15	50	0	0	2	6.7
Inquiry-Based Learning	14	46.7	12	40	2	6.7	2	6.7
Role-Playing and Simulation	15	50	11	36.7	0	0	4	13.3

4.5.1 Project-Based Learning

A close look at the results presented in Table 4.4 shows that most of the respondents (46.7% were strongly in agreement and 36.7% were in agreement) acknowledged the significance of project-based learning in facilitating the infusion of entrepreneurial skills into science learning at the selected high schools. In the same stance, one respondent highlighted that:

Instead of just lecturing and giving them all the information, we do try to give them project-based topics, if I may put it like that they learn faster (Interviewee 1)

From the results it can noted that the respondents perceived project-based learning as one of the most valuable instructional methods, which can be employed when infusing entrepreneurial skills into science learning at the selected high schools. This concurs with Chularee et al. (2024), who postulated that project-based learning as an active learning approach, which promotes the creation of a learning environment which fosters the infusion of entrepreneurial skills into learning activities. In support, Adeoye, Abimbowo and Mahmud (2024) highlighted that it nurtures in learners an entrepreneurial mindset as well as equipping them with knowledge relevant in generating viable solutions.

4.5.2 Problem-Based Learning

From the presented statistics in the table above, it can be highlighted that most respondents (43.3% strongly agreed and 50% agreed) were in support of the assertion that PBL fosters the infusion of entrepreneurial skills into science learning. In support, another respondent applauded that:

Exposing learners to situations that need them to solve problems in our community is actually a good thing [….] problem solving by applying scientific knowledge that they learn in class. So, this method can indeed enhance the skills like critical thinking and creativity as well (Interviewee 5)

In addition, one respondent highlighted that:

Problem-based learning can help in making learners work with minimal supervision from their teachers, allowing the learners to explore the real-world problems and find viable solutions […] team work to achieve their goals of coming up with answers to identified community challenges (Interviewee 9)

The results highlighted that PBL was capable of facilitating the infusion entrepreneurial skills into science learning. Thus, it fosters the development of an entrepreneurial mindset (creativity, critical thinking, and risk-taking) in the learners as they participate actively in learning activities that are grounded in the need to solve real-world problems. As learners participate in PBL-related activities, this helps them to be able to self-regulate, and be self-reliant. This aligns with Ito and Okpue (2025), who affirmed that PBL through participation learning activities that geared towards solving scientific problems enhances learners' acquisition of entrepreneurial skills. In support, Chueh and Kao (2024) highlighted that PBL helps learners to be objective, creative, innovative and critical thinkers as they search for possible solutions to real-world problems.

4.5.3 Inquiry-Based Learning

The results in Table 4.4 shows that slightly below half of the respondents (46.7%) were strongly in agreement with the opinion that inquiry-based learning was one of the effective instructional method that can be used to facilitate the infusion of entrepreneurial skills into science learning. In the same vein one of the respondents indicated that:

The methods of teaching which teachers should use would be for those teachers who are knowledgeable in that field could be fieldwork or inquiry-based learning […] only limitation to its success as one of the best methods is limited resources, infrastructure etc. (Interviewee 2)

Another respondent highlighted that:

Inquiry-based learning can benefit the learners in various ways that are beyond academic achievements such as promoting continuous learning together with enhancing the skills such as critical thinking, innovation and creativity. I believe this method is robust and worthwhile to promote application of science concepts in business related ventures (Interviewee 7)

The respondents' contributions indicated the relevance of inquiry-based learning was an as instructional method that can promote the infusion of entrepreneurial skills into science learning. This aligns with Muge and Waiganjo (2025), who stated that learners engaged in inquiry-based learning are exposed to situations that can create a strong foundation for lifelong learning, In support Morris (2025) revealed that inquiry-based learning was essential in creating a lively and interactive environment, thereby promoting learner-centredness. In other words, this promotes critical thinking, creativity and innovation (Nghiem et al., 2025).

4.5.4 Role-playing and simulation

Table 4.4 above indicated that half of the respondents (50%) were strongly in agreed with the opinion that role-playing and simulation was one of the instructional methods that teachers can employ to infusion entrepreneurial skills into science learning. In support to this observation, one respondent stated that:

I believe that exposing learners to real-life scenarios, where they actively engage in identifying societal problems and developing solutions, is a crucial strategy. This approach serves as a platform for fostering critical thinking, creativity, and risk-taking. It allows them to gain a deeper understanding of the problem as they work towards solving it (Interviewee 1).

In the same line, another respondent added that:

[…] creating a business-oriented environment within the school community will also aid in the acquisition of entrepreneurial skills. For example, the science department could partner with the agriculture department to provide scenarios where learners engage hands-on in identifying and solving problems (Interviewee 6)

The presented results are a clear testimony of the importance of using cross-disciplinary instructional methods and scenarios to mimic real-world situations. Therefore, this creates an

appropriate platform to advance the infusion of entrepreneurial skills into science learning. This fosters a risk-free environment, providing resources that help learners to develop an entrepreneurial mindset. This aligns with Katsanakis (2025), who posited that business-oriented simulations promote practical experiential learning through a hands-on approach, enabling learners to navigate real-world situations.

4.6 Challenges encountered when infusing entrepreneurial skills into science learning

This section focuses on challenges faced when infusing entrepreneurial skills into science learning.

Table 4.5: Challenges faced on infusing entrepreneurial skills (n=30)

	Strongly Agree		**Agree**		**Strongly Disagree**		**Disagree**	
	(n)	**(%)**	**(n)**	**(%)**	**(n)**	**(%)**	**(n)**	**(%)**
Curriculum overload	11	36.7	15	50	2	6.7	2	6.7
Limited teacher preparedness	8	26.7	16	53.3	3	10	3	10
Inadequate resources and infrastructure	20	66.7	7	23.3	0	0	3	10
Assessment misalignment	11	36.7	16	53.3	1	3.3	2	6.7
Institutional resistance	8	26.7	17	56.7	3	10	2	6.7
Power dynamics and cross-disciplinary tensions	10	33.3	15	50	2	6.7	3	10
Lack of contextualized models	10	33.3	16	53.3	4	13.3	0	0

4.6.1 Curriculum overload

Half of the respondents (50%) were in agreement with view that curriculum overload was one of the challenges faced when attempting to infuse entrepreneurial skills into science learning. In support to this notion, one respondent acknowledged that:

I feel like one of the challenges we face is that, I would say it's a curriculum or the syllabus constraints, that even though you want to teach and incorporate skills, like the presentation, them just discovering things on their own, we are not able to do that because there's this time constraint that you need to be done with this syllabus topic at this particular time (Interviewee 6)

In the same context of curriculum overload, another respondent echoed that:

[….] a rigid curriculum that does not allow always to accommodate innovation. Teachers may also face time constraints and large class sizes. Making it difficult to implement its own enquiry-based learning (Interviewee 7)

Hence, the respondents acknowledged that curriculum overload was one of the many challenges, which were being faced by teachers when infusing entrepreneurial skills into science learning. This concurs with Ahmed (2024); Chen et al. (2023), who asserted that curriculum overload affects the effective infuse of entrepreneurial skills into learning activities.

4.6.2 Limited teacher preparedness

The results in Table 4.5 indicated that most of the respondents (26.7% strongly agreed and 53.3% agreed) were in support of the opinion that limited teacher preparedness had a negative influence on the infusion of entrepreneurial skills into science learning. In support, one of the respondents acknowledged that:

Higher education institutions that train science teachers can also start including interdisciplinary training that aims at entrepreneurial skills (Interviewee 4)

In the same context, another respondent highlighted that:

[….] teachers need to collaborate with others from other schools in order for them to better prepare themselves, sharing experiences and so forth, so that they effectively infuse the skills (Interviewee 1)

The results showed that limited teacher preparedness can be considered as one of the challenges that affect the effective infusion of entrepreneurial skills into science learning. This concurs with Oladele et al. (2025), who indicated that the need to infuse entrepreneurship skills into teachers' training programmes to equip them with relevant competencies.

4.6.3 Inadequate resources and infrastructure

Results showed that most of the respondents (66.7%) were strongly in agreement with the view that inadequate resources and infrastructure was impacting negatively on the infusion of entrepreneurial skills into science learning. This was supported by one respondent who articulated that:

Another thing that we have is maybe I can say, limited teaching resources. Because for science, most of the learners learn by visual learning. So, resources, we need to have like labs, some schools don't even have labs. Fortunately, we do have labs, but we may find that we don't even have the equipment or the apparatus that is needed for that particular topic that involve entrepreneurial skills (Interviewee 5)

In the same stance, another respondent added that:

The challenges could be insufficient resources, lack of funding and also lack of knowledge in that regard. Yes. They might be willing but the resources are not permitting. So, there is need for re-capitalisation of our schools in that regard (Interviewee 3)

Thus, inadequate resources and infrastructure impede the effective infusion of entrepreneurial skills into science learning. This concurs with Pathan et al. (2023) who highlighted the importance of the having in place adequate resources and infrastructure when infusing entrepreneurial skills into science learning.

4.6.4 Assessment misalignment

Most of the respondents (53.3% strongly agreed and 36.7% agreed) were in agreement with the notion that assessment misalignment can be considered as one of the challenges affecting the infusion of entrepreneurial skills into science learning. With similar opinion, one respondent articulated that:

It's difficult to talk about challenges of something that I am not sure happens. I am a head of department. I visit teachers' classes and check their schemes of work and lesson plans and never do I come across talks nor text about entrepreneurial skills. Maybe they could even find it awkward to be found talking about things not specified in the syllabus/department objectives (Interviewee 3)

The respondents' contributions acknowledged that assessment misalignment can be considered as one of the challenges that can impact negatively on the infusion of entrepreneurial skills into science learning. This concurs Scroccaro, Engzell and Norrman (2025), who highlighted that the use effective assessment strategies can promote the infusion of entrepreneurial skills into science learning. In support a respondent indicated that:

Entrepreneurial skills can be possibly assessed in some instances such as science related or STEM competition expos, where learners are encouraged to carry out some research projects which are judged based on creativity, innovation, value to society and other aspects. I think, these STEM expos can help in assessing the level of learner in that regard of attaining these skills (Interview 8)

Respondents are acknowledging that assessment can be done within the school or even outside as learners will be demonstrating the infusion of entrepreneurial skills into science learning. Thus, these can be infused into learning activities geared towards promoting problem-solving, critical thinking, creativity and innovation. This concurs with Bwembya (2024) who highlighted that

science-based assessments should enhance the nurturing of skills for sustainable development and employability.

4.6.5 Institutional resistance

The results in Table 4.5 indicated that above half of the respondents (56.7%) were in agreement with the notion that institutional resistance can hinder the effective infusion of entrepreneurial skills into science learning. This concurs with one respondent who highlighted that:

Infusing entrepreneurial skills into science faces resistance due to traditional teaching preferences and lack of support for contemporary methods. Interdisciplinary approaches and supportive policies are needed to promote integration across all platforms (Interviewee 4)

The contributions from the semi-structured questionnaire and interview concur with Farid and Rahman (2020), who postulated that lack some knowledge and skills by those in-charge of operations in institutions of learning can affect the infusion of entrepreneurial skills into science learning. This may result in them not fostering a supportive culture especially in linking entrepreneurial skills with science concepts, procedures and activities (Ullah, Ghutai & Tariq, 2025). In addition, Goli and Babu (2024); Nyamboga (2024) indicated the need for the installation of a culture of innovation in science learning.

4.6.6 Power dynamics and cross-disciplinary tensions

Most of the respondents (33.3% strongly agreed and 50% agreed) were in agreement with the view that power dynamics and cross-disciplinary tensions can be considered as one of the challenges that hinder the smooth infusion of entrepreneurial skills into science learning. In support one of the respondents indicated that:

Maybe it needs to start from the top. Maybe it's about curriculum diversification that needs to happen. If it is a curriculum directive then we will embrace it. Ways to reduce resistance must be considered too if the idea is not appealing to them or doesn't come with incentives (Interviewee 3)

In addition, another respondent noted that:

[…] the planners, the powers and the administrators actually need to really re-capacitate our education in that regard. That is, linking science concepts and business. I think our graduates will benefit more and become problem solvers (Interviewee 2)

These contributions highlighted that power dynamics and cross-disciplinary tensions can affect the infusion of entrepreneurial skills into science learning. Thus, the absence collaboration within the departments and across the department can contribute to the ineffective infusion of entrepreneurial skills into science learning. This concurs with Kazakeviciute and Urbone (2016), revealed that the power dynamics and cross-disciplinary tensions can be as result of poor communication within the institution's structure and failure to adapt to the demands of cross-disciplinary learning.

4.6.7 Lack of contextualised models

Table 4.5 shows that most of the respondents (33.3% strongly agreed and 53.3% agreed), were in agreement with the opinion that lack of contextualised models can be considered as one of the challenges encountered when infusing entrepreneurial skills into science learning. In line with this opinion, one responded acknowledged that:

Teachers need direction on how it can be done. It must be clarified about which skills are taught? How are they to be taught? At what levels/grades/forms? How much time is to be allocated in a day or in a week? Teachers would definitely need upskilling on the entrepreneurial skills to infuse. So different levels of professional development would be requisite (Interviewee 3)

In the same vein, another respondent echoed that:

For the smooth integration of entrepreneurial skills into science teaching and learning, I feel there must be some kind of a roadmap, or blueprint in which the science teachers can utilise or manipulate to ensure that these skills, creativity, critical thinking and so forth can be instilled in the learners. This could work well helping teachers achieve the main objective of skills acquisition. I think this roadmap can also assist teachers to come up with appropriate assessments for progress checking the learners on the level of their ability to create, innovate and use scientific knowledge to solve real-world problems (Interviewee 8)

Furthermore, another respondent lamented that:

There is a need for using logical steps into linking science content knowledge with the related entrepreneurial skills such that it will be easier for teachers implemented the infused science base entrepreneurship education curriculum. Other teachers may still fail to link the two (science and entrepreneurial skills), so to minimise that problem, a clear outline of the teaching and learning objectives is needed (Interviewee 7)

The results recognised that the absence contextualised models can pose a challenge to the effective infusion of entrepreneurial skills into science learning. Thus, contextualised models provide teachers with a clear direction on how to infuse entrepreneurial skills, selection of

instructional methods, time allocation time and the concrete steps guiding the infusion into science learning. This concurs with Bidarra and Rusman (2016), who postulated the need to blend science learning activities with other contemporary disciplines. Therefore, lack of contextualised models was seen as a challenge to effective infusion of entrepreneurial skills into science learning.

4.7 Possible strategies used to minimise the effect of the challenges faced

In this section, the possible strategies to minimise challenges that are highlighted in the previous section were interrogated.

Table 4.6: Possible strategies to minimise effect of the challenges faced (n=30)

	Strongly Agree		Agree		Strongly Disagree		Disagree	
	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)
Streamline overloaded science curricula by infusing entrepreneurial skills into existing topics.	17	56.7	11	36.7	0	0	2	6.7
Infusing real-world entrepreneurial ecosystems into workshops, peer mentoring.	21	70	9	30	0	0	0	0
Establish well-equipped science laboratories and innovation.	18	60	12	40	0	0	0	0
Performance-based assessments that evaluate creativity, initiative, and problem-solving.	16	53.3	14	46.7	0	0	0	0

4.7.1 Streamlining overloaded science curriculum

From the statistics presented in Table 4.6, highlighted that slightly more than half of the respondents (56.7%) were strongly in agreement with the view that streamlining of the overloaded science curricula was one of the strategies that can be used to avoid content fatigue while promoting relevance and application. In other words, it creates a firm foundation for the infusion of entrepreneurial skills into science learning. This was supported by one of the respondents who noted that:

The science curriculum needs to be reviewed and include elements that promote the enhancement of entrepreneurial skills, […] looking at each topic in the syllabus and see where learning objectives that foster entrepreneurial skills can be incorporated and how best these skills can be taught using methods like experiential learning, inquiry-based learning, problem-solving etc. (Interviewee 6)

In the same breath, another respondent added that:

Streamlining the science curriculum with entrepreneurial skills competencies would shed light into how teachers go about in their day-to-day planning of appropriate classroom activities that involve hands-on experiences through active learning. In other words, as a science teacher myself, I can be able to create real-life scenarios to make learners engage in critical thinking, creativity, become innovative and solve problems scientifically (Interviewee 8)

From the respondents' contributions advocated for the need to restructure the science learning activities. In other words, it calls for the infusion of entrepreneurial skills into the science curricula. This concurs with Swargiary (2025) who emphasized the need for curricula transformation in order to meet the requirements of the CBE philosophy. In support, Chen et al. (2023); Magasi (2025) highlighted the importance of incorporating active learning instructional methods to ensure effective content delivery by using real-world examples. In addition, Hajis and Othman (2024) advocated for adequate teachers' training such that they can better equipped with relevant pedagogical content knowledge for them to effectively manage the streamlined curricula.

4.7.2 Expose teachers to transformative approaches to learning

The results in Table 4.6 indicated that most of respondents (70%) were strongly in agreement with the assertion that teachers' involvement in workshops, peer mentoring, and exposure to real-world entrepreneurial ecosystems can be one of the strategies to transformative science learning activities. In support to the above observations, one respondent noted that:

To effectively integrate entrepreneurial skills into science education, a multi-pronged approach is essential, interdisciplinary teacher training, and ongoing professional development through workshops and peer mentoring. This ensures teachers are well-equipped to deliver engaging content and foster crucial entrepreneurial skills (Interviewee 5)

Another respondent shared the same sentiments and added that:

[…] Integrating the entrepreneurial skills in science learning can also help in cultivating a supportive environment that encourages innovation and provides opportunities for practical application. This can only be made possible with well-equipped teachers who are knowledgeable of this entrepreneurial content (Interviewee 8)

The results highlighted numerous strategies that can be used exposed teachers to transformative approaches to enhance the infusion of entrepreneurial skills into science learning activities. This concurs with Escudeiro et al. (2025) who postulated the need to empower teachers through pre-service or in-service programmes so as to enhance the quality of instruction during the facilitation of science learning. In other words, this equips the teachers with the relevant knowledge, skills and values to enable to effectively engage and nurture a culture of innovation, creativity and lifelong learning.

4.7.3 Equip science laboratories to promote interactive learning

The presented statistics show that most of the respondents (60%) were strongly in agreement with the need to equip science laboratories so as to enhance the infusion of entrepreneurial skills into science learning. In line with the presented statistics, one respondent acknowledged that:

Science laboratories in schools should have relevant equipment that drive entrepreneurial competencies in line with the 21st century skills. These types of equipment could be those that allow earners to be hands-on in solving problems by constructing prototypes (Interviewee 8)

In the same stance, another respondent further reiterated that:

[…] creating innovative hubs in the science laboratories exposes learners to real-life situations. These hubs can incorporate business elements so as to facilitate interdisciplinary approach to show how scientific applications connect to business-oriented platforms. In that way, it will be easy for learners' entrepreneurial competencies such as creativity, innovation and lifelong learning to be developed (Interviewee 4)

The results concur with Bertemes, Haan, and Hans (2024), who postulated that equipped science laboratories create an environment that fosters high-quality learner engagement. Thus, nurture an active interface that facilitate the sharing of knowledge and skills develop as learner make attempts to solve societal problems.

4.7.4 Use learner-centred approaches in learning

The results in Table 4.6 show that most respondents (53.3% strongly agreed and 46.7% agreed) highlighted that the need to shift from the traditional way of learning to one that is learner-centred. This approach creates a platform that enhances learners' active interaction with the

environment, thereby promoting the infusion of entrepreneurial skills into science learning. In support to this, one respondent articulated that:

To reduce the effect of the challenges that hinder effective integration of entrepreneurial skills, teachers must consider learner centred approaches that empower the learners to own their learning experiences […] methods like project-based, problem-based to encourage them to be hands-on (Interviewee 6)

In addition, another respondent echoed the following sentiments:

To minimize challenges encountered when infusing entrepreneurial skills into learning requires a multifaceted approach that fosters self-reliance, risk-taking, creativity, and innovation. Ultimately equipping learners to positively impact the workforce and their communities (Interviewee 9)

The results advocated for use of learner-centred instructional methods when infusing entrepreneurial skills into science learning. These are seen instructional methods capable of developing learners' creativity, innovativeness, and problem-solving skills. This concurs with Adeoye, Abimbowo and Mahmud (2024); Djajanto (2024) who postulated that teachers need to adopt active learning approaches in order to enhance the infusion of entrepreneurial skills into science learning. In support, Dinama, Kelebemang and Olesitse (2024) highlighted the need for adoption of transformative instructional methods to enhance effective infusion of entrepreneurial skills into the teachers' pedagogical content knowledge.

4.8 Chapter summary

This chapter presented a rigorous analysis and interpretation of the results guided by the initial research objectives, questions and methodological framework. It stated by outlining the analytical approach employed mixed methods and justifies its alignment with the conceptual underpinnings of the study. For quantitative studies, this involves data cleaning, coding, and entry procedures, followed by descriptive statistics and illustrated with tables. In qualitative contexts, data preparation includes transcription, anonymization, and thematic organization leading into a presentation of emergent themes and subthemes grounded in respondent narratives. The chapter then integrated these results with existing literature and theoretical frameworks, offering a contextualized interpretation that highlighted both expected and unanticipated results. Each insight was explicitly linked back to the sub-objectives and questions

with the view to provide an answer to the main objective of the study. In the next chapter the study is summarised, a pedagogical model advanced, conclusion arrived and recommendations highlighted.

CHAPTER 5

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

Chapter five concludes the study by summarizing the research problem, theoretical framework and methodological approach, and by proposing a pedagogical model grounded in the findings and theoretical framework. It presents key conclusion, offers practical recommendations for science teachers and policymakers, and suggests areas for further research. This chapter brings the study to a close while opening pathways for continued scholarly and practical engagement.

5.2 Summary of the dissertation

This dissertation critically examined the integration of entrepreneurial skills into science learning within the selected high schools in the Hhohho Region, underpinned by a theoretical framework comprising experiential learning and transformative learning theories. The study commenced by articulating a clearly defined research problem, foregrounding the persistent curricular and pedagogical barriers that inhibit the effective infusion of entrepreneurial skills into science learning. The significance of the inquiry was established by situating it within broader efforts to promote skills-based education aligned with national development goals and 21st-century learning imperatives. Through a comprehensive literature review, the study synthesized both theoretical constructs and empirical findings, thereby informing the development of a robust conceptual framework to guide the investigation.

Methodologically, the study was anchored in the pragmatist paradigm, which justified the adoption of a mixed methods approach to capture the complexity and contextual nuances of the research problem. Quantitative data were collected and analyzed to reveal statistical trends and generalizable patterns, while qualitative insights illuminated the lived experiences, perceptions, and practices of respondents. The integration of these data sources enabled a holistic understanding of how entrepreneurial skills are currently conceptualized, implemented, and experienced within the science learning activities. The ensuing data analysis unveiled the following salient themes and trends:

- From the results, it was noted that respondents conceptualised entrepreneurial skills as problem-solving, creative, critical thinking, lifelong learning and innovation.
- The respondents highlighted that science teachers were prepared to infused entrepreneurial skills into science learning through teacher capacity development programmes, seminars, workshops, and conferences.
- The results revealed that science teachers were using instructional methods like project-based learning, problem-based learning, inquiry-based learning, experiential learning, etc., to infuse entrepreneurial skills into learning activities.
- The respondents noted that when infusing entrepreneurial skills into science learning, the following challenges were encountered: curriculum overload, limited teacher preparedness, cultural perceptions, lack of contextualised models, inadequate resources and infrastructure, etc.
- Respondents advanced some strategies that can be employed to minimise the impact of the encountered challenges. These are some of the possible strategies: curriculum streamlining, interdisciplinary teacher training, seminars and workshops, use of project-based, inquiry-based instructional methods, etc.

In addition, the above the results prepared the foundation for the formulation of a contextually responsive pedagogical model to guide the methodical infusion of entrepreneurial skills into science learning activities as illustrated in the next section.

5.3 Proposed contextually responsive pedagogical model

This section details the model's design rationale, core components, and anticipated impact, providing a foundation upon which educators and policymakers can innovate toward more relevant and future-ready learning experiences.

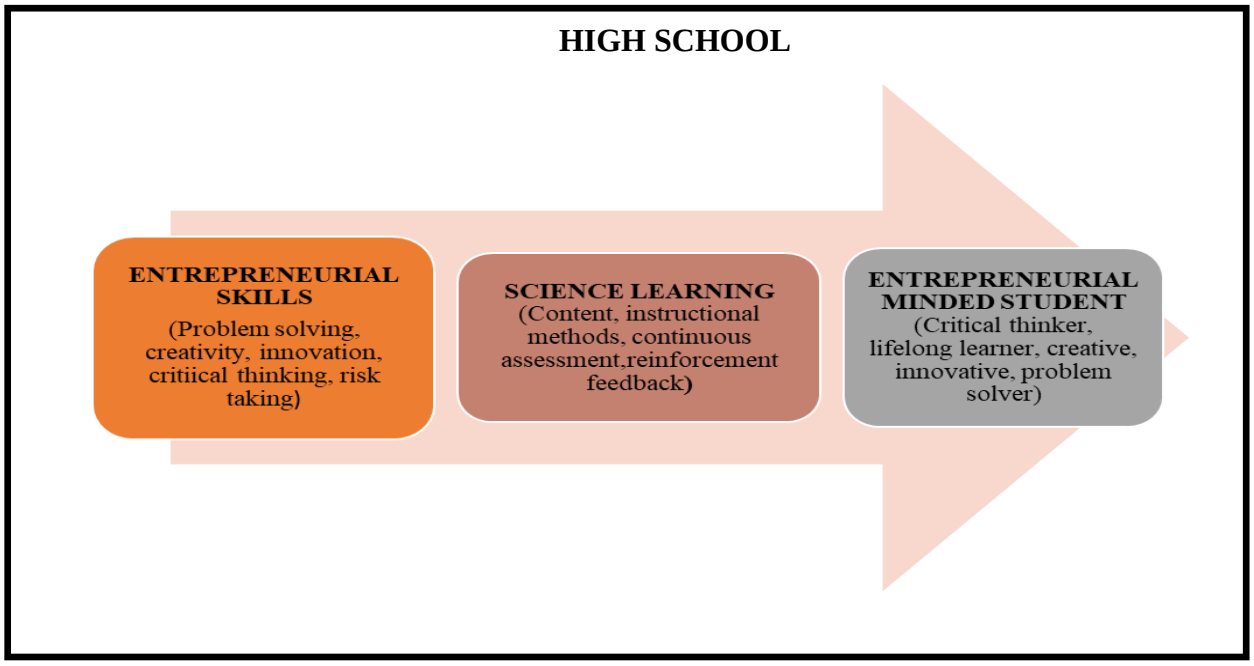

Fig 5.1: Contextually responsive pedagogical model

Grounded in theoretical insights and empirical results, the proposed model is intended to bridge the gap between disciplinary knowledge and practical skills acquisition by aligning science instruction with real-world entrepreneurial competencies. It reflects the socio-educational realities of the Hhohho Region, ensuring cultural relevance, resource sensitivity, and pedagogical adaptability. The model not only responds to the challenges identified in the study but also provides a structured framework through which science education can become a catalyst for innovation, self-reliance, and economic empowerment. In addition, it aspires to reposition science learning activities as a transformative tool for personal empowerment and local economic development. It comprises several interrelated components designed to facilitate the systematic infusion of entrepreneurial skills into science learning activities. At its foundation are core principles drawn from relevant learning and economic theories, ensuring the model is both pedagogically sound and developmentally appropriate. It sets out clear instructional objectives that integrate scientific knowledge with entrepreneurial skills such as innovation, critical thinking, and problem-solving.

The model offers a structured content infusion framework that aligns science topics with entrepreneurial themes, fostering interdisciplinary learning. It advocates for dynamic teaching strategies including inquiry-based and project-based learning that promote learner autonomy and experiential engagement. Teachers are envisioned as facilitators who cultivate entrepreneurial mindsets while adapting instruction to local contexts. Assessment mechanisms are diversified to include both formative and performance-based tools that evaluate scientific understanding alongside entrepreneurial application. The model is also sensitive to contextual realities, emphasizing the use of locally available resources and community partnerships. Finally, it includes mechanisms for continuous monitoring and refinement, ensuring adaptability and responsiveness to evolving educational needs.

5.4 Conclusion

The study revealed that entrepreneurial skills such as problem-solving, creativity, critical thinking, lifelong learning, and innovation are meaningfully infused into science learning. Science teachers were actively engaging in professional development programmes and employing learner-centred instructional methods like project-based and inquiry-based learning to foster these skills. Despite facing challenges like limited resources and rigid curricula, teachers proposed actionable strategies to overcome these challenges. In conclusion it can highlighted that while advancement has been made in the infusion of entrepreneurial skills into science learning, sustained support and structural reforms are necessary to deepen and expand this approach.

5.5 Recommendations

From the results this study advances the following recommendations:

- Professional development workshops: Initiate targeted in-service training programmes to deepen science teachers' understanding of entrepreneurial skills, emphasizing their relevance within scientific contexts.
- Collaborative learning communities: Establish peer-learning platforms where teachers can share best practices and co-design science lessons with embedded entrepreneurial skills.

- Instructional autonomy and innovation: Encourage and support teachers to experiment with learner-centred strategies that promote entrepreneurial thinking e.g., problem-based and project-based learning.
- Policy support and resource allocation: Ensure clear policy guidance and provision of teaching aids and infrastructure to mitigate systemic constraints (e.g., overloaded curricula, large class sizes).
- Pilot and scale the proposed model: Implement the developed contextually responsive pedagogical model through pilot programmes in selected schools, followed by evaluation and iterative refinement.

5.6 Areas for further study

This study advances the need to conduct studies in the following areas:

- The long-term effects of infusing entrepreneurial skills into science learning on learners' career trajectories, entrepreneurial behaviour, and scientific literacy beyond secondary school.

- Test the proposed contextually responsive pedagogical model in varied geographical and socio-economic settings to assess its transferability, scalability, and adaptability beyond the Hhohho Region.

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APPENDICES

Appendix 1: Introductory letter from Bindura University of Science Education

Bindura University of Science Education

BINDURA UNIVERSITY OF SCIENCE AND MATHEMATICS EDUCATION

BINDURA ZIMBABWE

Tel: 0271 – 7531 ext 1038

Fax: 263 – 71 – 7616

BINDURA UNIVERSITY OF SCIENCE EDUCATION

Date: 15 APRIL 2025

TO WHOM IT MAY CONCERN

NAME: **TABETHA NYARAI PAZVAKAVAMBWA** REGISTRATION NUMBER: **B233047A**

PROGRAMME: **MASTER OF SCIENCE EDUCATION DEGREE IN MEASUREMENT AND EVALUATION** PART: **2.1**

This memo serves to confirm that the above is a bona fide student at Bindura University of Science Education in the Faculty of Science Education. The student has to undertake research and thereafter present a Research Thesis in partial fulfillment of a Masters Degree in Science Education programme. The research topic is: **The Infusion of entrepreneurial skills into Science teaching and learning in Hhohho Region's high schools.**

In this regard, the department kindly requests your permission to allow the student to carry out her research in your institutions.

Your co-operation and assistance is greatly appreciated.

Thank you

BINDURA UNIVERSITY OF SCIENCE EDUCATION
ASSISTANT REGISTRAR ADMISSIONS
15 APR 2025
ADMISSIONS
P BAG 1020, BINDURA

Dr. C. MAKUVIRE

ACTING CHAIRPERSON - (CURRRICULUM AND EDUCATIONAL MANAGEMENT STUDIES)

Appendix 2: Approval Letter from the Responsible Authority

KINGDOM OF ESWATINI

MINISTRY OF EDUCATION & TRAINING

01st July, 2025.

Attention:

Hhohho Region High Schools- Principals

Mhlatane High School, Mpofu High School, Piggs Peak Central High, Fundukuwela High School, St Francis High School	**St Marks High School, Endzingeni Nazarene High, Ekudvwaleni High School, Malibeni High School.**

Through
Hhohho Regional Education Office r

Dear Colleague,

RE: REQUEST FOR PERMISSION TO CONDUCT AN EDUCATIONAL RESEARCH STUDY – MS. TABETHA N. PAZVAKAVAMBWA

1. The Ministry of Education and Training has received an application from Ms. Tabetha N. Pazvakavambwa, a student at Bindura University of Science and Mathematics Education, that in order for her to fulfill her academic requirements at the university, she has to (conduct research) and her study or research topic is: "**The infusion of Entrepreneurship Education into High School Science Learning: Teachers' Experiences.**" The researcher will select Five (5) Schools from the above mentioned. The instruments for research will be: semi-structured questionnaire, interview, literature method, data analysis, quantitative data analysis and qualitative data analysis. Details concerning the study are stated in the participants' consent form which will have to be signed by all participants before Ms. Tabetha N. Pazvakavambwa begins her Research Study. Please note that parents will have to consent for all the participants below the age of 18 years participating in this study.

2. The Ministry of Education and Training requests your office to assist Ms. Tabetha N. Pazvakavambwa by allowing her to use the above mentioned schools as her research site. Data collection period is Three months.

Thank you for your collaboration.

DR. THOLAKELE C. MNGOMETULU
DIRECTOR OF EDUCATION

MINISTRY OF EDUCATION & TRAINING
DIRECTORS OFFICE
01 JUL 2025
P.O. BOX 39
MBABANE H100
ESWATINI

Cc: Regional Education Officer(s)
Chief Inspector – Secondary
Principal(s) of the above mentioned Schools
Prof. S. Bhebhe – Supervisor

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Appendix 3: Questionnaire for the selected respondents

I am a final year student enrolling for the Master of Science Education (Measurement, Assessment and Evaluation) degree at Bindura University of Science Education. I am carrying a study on the infusion of entrepreneurial skills into Science teaching and learning in selected high schools.

Instructions

You are requested to kindly answer all questions. Please do not discuss with anyone, but answer all questions honestly and truthfully. Carefully read each question, and where you do not understand, do not hesitate to seek clarity and assistance from the researcher. Please insert a tick in the column that indicate your best choice, and if you decide to change your initial response, insert and 'X' on your obsolete choice, and put a tick on your new choice. For confidentiality purposes, please do not endorse your name, initials or signature in any part of this questionnaire.

Section A: Personal profile

1. Sex [ ] Female [ ] Male
2. What is your age range in years? [ ] Under 25 [ ] 25-34 [ ] 35-44 [ ] 45- 54 [ ] Above 54
3. Highest academic qualification: [ ] Diploma in Education [ ] BEd/BScEd [ ] MEd/MScEd [ ] PhD/DEd
4. Teaching experience in years [ ] Less than 1 [ ] 1-5 [ ] 6-10 [ ] Above 10

Section B

5. To what extent do you agree with the following on the conceptualisation of entrepreneurial skills in the context of Science teaching and learning?

	Strongly Agree	**Agree**	**Strongly Disagree**	**Disagree**
The ability of learners to identify scientific problems or community challenges and conceptualise innovative, science-based solutions.				
Encouraging learners to work creatively with limited materials or experimental setups, fostering adaptability and persistence in scientific inquiry				
The capacity to generate, test, and refine original ideas or hypotheses through experimental processes.				
Willingness to engage with uncertain outcomes in experiments, embracing mistakes as learning opportunities.				
Skills in presenting scientific ideas clearly and persuasively to different audiences, including peers, teachers, and stakeholders.				
Working effectively in laboratory groups or project-based learning scenarios to co-create science-driven solutions.				

Applying science concepts to real-world problems in ways that generate value - social, environmental, or economic.				

Any other comments (if necessary) ……

Section C

6. To what extent do you agree with the opinion that the following are some of the strategies used to prepare and support teachers to infuse entrepreneurial skills into Science teaching and learning?

	Strongly Agree	**Agree**	**Strongly Disagree**	**Disagree**
Professional development workshops				
Curriculum co-design				
Use of case studies and real-world problems				
Collaborative learning and peer mentoring				
Digital tools and experiential learning				
Policy and institutional support				
Assessment reforms				

Any other comments (if necessary) ……

Section D

7. To what extent do you agree with following opinions about the different instructional methods that are used by teachers to infuse entrepreneurial skills into Science teaching and learning?

	Strongly Agree	**Agree**	**Strongly Disagree**	**Disagree**
Project-Based Learning (PBL)				
Problem-Based Learning				
Inquiry-Based Learning				
Role-Playing and Simulation				

Any other comments (if necessary) ……

Section E

8. To what extend do you agree with the following assertions on challenges encountered when infusing entrepreneurial skills into Science teaching and learning?

	Strongly Disagree	**Agree**	**Strongly Disagree**	**Disagree**
Curriculum overload				
Limited teacher preparedness				
Inadequate resources and infrastructure				
Assessment misalignment				
Institutional resistance				
Power dynamics and cross-disciplinary tensions				
Lack of contextualized models				

Any other comments (if necessary) ……..

9. To what extend do you agree with the following assertions on the mitigatory measures that can be used to minimize the effect of the challenges?

	Strongly Disagree	**Agree**	**Strongly Disagree**	**Disagree**
Streamline overloaded science curricula by integrating entrepreneurial competencies into existing topics.				
Infuse real-world entrepreneurial ecosystems into workshops, peer mentoring.				
Establish well-equipped science laboratories and innovation hubs where students can prototype ideas and engage in hands-on learning				
Performance-based assessments that evaluate creativity, initiative, and problem-solving.				

Any other comments (if necessary) ……..

Thank you for your cooperation

Appendix 4: Interview guide for selected respondents

Thank you for accepting the researcher's request. The study focuses on the infusion of entrepreneurial skills into Science teaching and learning in the selected high schools. Most importantly feel free to express your thoughts and answer the questions to the best of your ability and no personal information will be included in the final report.

1. In brief tell me something about yourself.

2. What comes to mind when you hear the term 'entrepreneurial skills' in the context of science teaching and learning?
3. What is the importance of infusing 'entrepreneurial skills' into Science teaching and learning?
4. What professional training has been given to teachers in preparing them to infuse entrepreneurial skills into Science teaching and learning in Eswatini?
5. What instructional methods are used by teachers when infusing entrepreneurial skills into Science teaching and learning?
6. What are some of the challenges that are faced by teachers as they infused entrepreneurial skills into Science teaching and learning?
7. What strategies can be used to reduce the effect of these challenges on the infusion of entrepreneurial skills into Science teaching and learning?
8. Thank you for your participation in this interview