



European Journal of Educational Research

Volume 13, Issue 2, 557 - 571.

ISSN: 2165-8714

<https://www.eu-jer.com/>

Exploring Practical Pedagogy in High School Biology Education: A Qualitative Study of Pre-Service Biology Teachers' Experiences in Vietnam

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Received: July 19, 2023 ▪ Revised: September 22, 2023 ▪ Accepted: September 29, 2023

Abstract: This qualitative study examines the experiences of pre-service high school biology teachers in the Mekong Delta, Vietnam, focusing on the challenges and transformative learning experiences encountered during their school-based internship. It aims to explore the dichotomy between specialized biology knowledge and practical applicability in high school teaching and uncover the significance of fostering student engagement through innovative strategies and the role of mentor teachers in guiding pre-service teachers. Semi-structured interviews were used to collect data from pre-service biology teachers who completed a school-based internship in the Mekong Delta. Thematic analysis was employed to analyze the interview data. The study highlights the challenges of bridging the gap between theoretical knowledge and classroom practice, emphasizing the importance of innovative teaching strategies for student engagement. It recognizes the role of mentor teachers in guiding and enhancing the skills of pre-service teachers in creating effective learning environments. Findings suggest the need for curriculum reforms that balance specialized biology knowledge and practical pedagogical skills. The study emphasizes the importance of experiential learning through teaching apprenticeships to better prepare pre-service teachers for their professional journey.

Keywords: *High school education, practical pedagogy, pre-service biology teachers, teacher education.*

To cite this article: Diem, H. T. T., Thinh, M. P., & Lam, V. T. T. (2024). Exploring practical pedagogy in high school biology education: A qualitative study of pre-service biology teachers' experiences in Vietnam. *European Journal of Educational Research*, 13(2), 557-571. <https://doi.org/10.12973/eu-jer.13.2.557>

Introduction

The quality of education hinges on the capabilities and preparedness of teachers, which is significantly influenced by the effectiveness of pre-service teacher education (Darling-Hammond, 2017). The essential role of pre-service teacher education in shaping future educators has been a subject of rigorous research and policy discussions, with the intent of advancing the quality of teaching and consequently enhancing learning outcomes in classrooms. Central to these discussions is the persistent dichotomy between theoretical knowledge and its practical pedagogical application, an issue that seems especially pronounced in specialized subjects such as biology (F. A. J. Korthagen, 2017; Loughran et al., 2008).

Biology as a discipline possesses its own unique nuances, necessitating an intricate blend of subject-specific knowledge and effective pedagogical strategies (Kramer et al., 2021). The convergence of this specialized knowledge and practical teaching methods is crucial in biology education. However, the challenge often resides in the effective harmonization of the two. It is within this context that the role of pre-service teacher education becomes pivotal, as it shapes the preparedness of future biology educators to effectively transpose theoretical knowledge into real-world classrooms (Mesci et al., 2020).

Among the various pedagogical approaches proposed to bridge this theory-practice gap, experiential learning stands out as a promising avenue. By immersing teachers in authentic teaching scenarios, experiential learning enables them to transition from theoretical understanding to practical application (Kolb & Kolb, 2009). Another significant component of effective teacher education is mentorship, offering tailored guidance and invaluable insights into the real-world complexities of the teaching profession (Hudson & Hudson, 2018; Nesje & Lejonberg, 2022).

However, despite these recognized strategies and their potential to alleviate the theory-practice divide, the persistence of this gap, particularly in the context of pre-service biology teacher education, calls for continued exploration and

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research. This is where the present study seeks to contribute, shedding light on the pre-service teacher experience, especially regarding their navigation of the theory-practice dichotomy.

In our exploration of pre-service biology teacher education in Vietnam, we closely examine the curriculum and fundamental objectives of the Biology Teacher Education program. It's worth noting that while each university in Vietnam may have its distinct curriculum for biology teacher education, they broadly align with the national educational program of 2018 as a guiding framework (Ministry of Education and Training, 2018). The program we focus on in this context is housed within the Department of Biology Education, an integral part of Can Tho University's Faculty of Education. This program holds significant importance as a central institution for the training of human resources in the broader Mekong region. Its most recent formal curriculum is documented in Decision No. 1063/QD-DHCT, carrying the authoritative endorsement of the University's esteemed Rector (Can Tho University, 2020). At its core, this program is imbued with a central mission: to cultivate undergraduate students into proficient biology educators. It's worth noting that the program places a pronounced emphasis on the acquisition of scientific and general knowledge, with relatively less focus on pedagogical training. Furthermore, students are instilled with the capacity to adeptly navigate the multifaceted educational landscape, encompassing secondary schools and various educational institutions. The program's aspirations are concretized through a suite of well-defined educational objectives. These encompass the imparting of a solid foundation in political theory, social sciences, law, and the tenets of national defense. Notably, a significant facet of the program entails a two-month internship component, where pre-service teachers gain practical experience. However, it's important to note that this internship duration is relatively short within the context of the entire curriculum.

Within countries such as Vietnam, marked by rapidly advancing education systems and impressive student performance in international assessments, the quality of teacher preparation holds paramount significance (Asadullah et al., 2020; Ho & Dimmock, 2023). Despite substantial progress and global recognition of the country's education sector, the experiences and perceptions of pre-service biology teachers in Vietnam concerning the theory-practice dichotomy remain relatively underexplored. Responding to this research gap, our study endeavors to delve into the experiences of pre-service biology teachers in the Mekong Delta, Vietnam. We are dedicated to gaining a comprehensive understanding of the experiences of future educators, particularly pre-service biology teachers in this region. To achieve this, we aim to address the following research questions:

- How do pre-service biology teachers in the Mekong Delta, Vietnam, perceive and articulate the challenges posed by the theory-practice dichotomy during their teaching internships?
- What is the significance of experiential learning in the professional development of pre-service biology teachers?
- How do mentorship relationships influence pre-service biology teachers' adaptation of theoretical knowledge to effective classroom practices?

To achieve insights into these research questions, we have chosen to employ qualitative research methods as our primary approach. Specifically, we will utilize semi-structured interviews as the cornerstone of our data collection strategy. This carefully crafted approach serves the purpose of eliciting rich, detailed narratives from our participants, allowing us to delve deep into the nuances of their experiences. This research holds significance on multiple fronts. Firstly, it directly addresses a discernible research gap by meticulously examining the landscape of pre-service biology teacher education in Vietnam through the lens of these specific research questions. Our findings will contribute to filling this void in the existing body of knowledge, offering valuable insights into the unique challenges and opportunities faced by pre-service biology teachers in this region. Secondly, this study seeks to serve as a wellspring of practical insights that can potentially inform and enhance teacher preparation programs within the Mekong Delta, guided by the specific research questions. By drawing directly from the experiences and perspectives of our pre-service teachers, we aim to provide recommendations that can lead to more effective and responsive teacher education programs. Lastly, our research aspires to make a broader contribution to the discourse on effective teacher education strategies, informed by the insights gained from these research questions. We believe that by empowering future biology teachers with the requisite tools and skills to adeptly navigate the complexities of teaching, we can play a pivotal role in fostering a positive impact on their students' learning experiences. Our goal is to contribute to the development of educators who can inspire and empower the next generation of learners, guided by the specific research questions that underpin this study.

Literature Review

The Significance of Pre-service Teacher Education in Shaping Educators and the Theory-Practice Gap in Specialized Subjects

Pre-service teacher education plays a critical role in shaping the capabilities and preparedness of future educators (Darling-Hammond, 2017). The quality of education is heavily dependent on the effectiveness of pre-service teacher education programs, as they equip aspiring teachers with the necessary knowledge, skills, and pedagogical strategies to excel in their teaching careers. In the context of biology education, this becomes particularly crucial due to the unique nuances of the subject and the need for a harmonious blend of subject-specific knowledge and effective pedagogical approaches (Kramer et al., 2021).

The effectiveness of pre-service teacher education has been the subject of extensive research and policy discussions. The goal is to advance the quality of teaching and improve learning outcomes in classrooms. One key challenge that often arises is the dichotomy between theoretical knowledge and its practical pedagogical application, which seems to be more pronounced in specialized subjects like biology (F. Korthagen, 2017; König, 2013). The ability of pre-service teachers to effectively bridge this theory-practice gap is essential for their success as educators and for creating engaging learning environments for students.

Specialized subjects such as biology require teachers to possess both deep subject-specific knowledge and the ability to translate that knowledge into engaging and effective instructional practices (Kramer et al., 2021). However, the challenge lies in the effective harmonization of these two components. Theoretical knowledge, gained through coursework and content-focused instruction, is necessary for understanding the fundamental concepts and principles of biology (Kaifa et al., 2023). On the other hand, practical pedagogical application involves the ability to design and deliver lessons that promote active student engagement, critical thinking, and the application of biological concepts to real-world contexts.

Research suggests that pre-service biology teachers often struggle to integrate theoretical knowledge with practical pedagogical strategies (Kaifa et al., 2023; Mesci et al., 2020). This dichotomy can hinder their ability to create meaningful learning experiences for students and may lead to a disconnection between what is taught in theory and what is experienced in practice. It is within this context that the role of pre-service teacher education becomes crucial. Effective teacher education programs need to provide aspiring biology teachers with opportunities to develop their pedagogical skills, apply theoretical knowledge in authentic classroom settings, and navigate the challenges associated with the theory-practice divide (Kaifa et al., 2023).

Theoretical Foundations of Effective Teacher Education

Effective teacher education in specialized subjects like biology requires a combination of subject-specific knowledge and pedagogical strategies. In biology education, teachers must possess a deep understanding of the subject matter to effectively convey complex concepts to their students (Gess-Newsome et al., 2019). Subject-specific knowledge includes not only factual information but also the ability to think critically and engage in scientific inquiry. It enables teachers to foster students' conceptual understanding and scientific reasoning skills (Hilfert-Rüppell et al., 2021; Kramer et al., 2021). Along with subject-specific knowledge, effective pedagogical strategies are essential for biology teachers. These strategies encompass instructional methods, assessment techniques, classroom management, and the use of technology to engage students and facilitate their learning (König, 2013). By employing research-based pedagogical approaches, teachers can create active and inquiry-based learning environments that promote student engagement and achievement in biology (Gess-Newsome et al., 2019; König, 2013).

Despite the recognition of the importance of subject-specific knowledge and pedagogical strategies, the effective harmonization of theory and practice remains a challenge in biology education. Pre-service teachers often struggle with translating theoretical knowledge into practical teaching methods (F. A. J. Korthagen, 2017). They may find it difficult to bridge the gap between what they learned in their teacher education programs and the realities of the classroom (F. Korthagen, 2017; Mesci et al., 2020). This challenge is particularly pronounced in specialized subjects like biology, where teachers need to navigate the intricacies of scientific concepts and effectively communicate them to diverse student populations (Hilfert-Rüppell et al., 2021; König, 2013). Furthermore, the time constraints and limited opportunities for authentic teaching experiences during pre-service teacher education programs contribute to the theory-practice gap (F. A. J. Korthagen, 2017; Phillips & Condy, 2023). The focus on theoretical knowledge acquisition often leaves little room for the development of practical teaching skills and classroom management strategies (Mesci et al., 2020). As a result, pre-service teachers may enter the classroom with a strong theoretical foundation but feel ill-prepared to implement effective instructional practices (Phillips & Condy, 2023).

The theory-practice gap in pre-service teacher education has been a subject of research and discussion in the field of education. Scholars have investigated the factors contributing to the gap and explored potential strategies to address it. For example, F. A. J. Korthagen (2017) emphasized the importance of reflective practice in bridging the theory-practice divide. Reflective practice encourages pre-service teachers to critically analyze their experiences in the classroom, identify areas for improvement, and make adjustments to their teaching approaches. This process of reflection and self-evaluation helps pre-service teachers connect theoretical knowledge with practical application (Beka & Kulinxha, 2021). Similarly, Mena et al. (2017) highlighted the significance of mentorship in pre-service teacher education. Mentors provide guidance, support, and real-world insights to pre-service teachers as they navigate the challenges of the teaching profession. Mentorship allows pre-service teachers to observe experienced educators in action, receive feedback on their teaching practices, and engage in collaborative reflection and problem-solving. The mentor-mentee relationship fosters a more seamless integration of theory and practice by providing pre-service teachers with opportunities to bridge the gap through guided experiences and ongoing support (Mena et al., 2017; Mesci et al., 2020; Naidoo & Wagner, 2020).

In summary, effective teacher education in specialized subjects like biology requires a balance between subject-specific knowledge and pedagogical strategies. However, the harmonization of theory and practice presents challenges for pre-service teachers. Limited opportunities for authentic teaching experiences and the focus on theoretical knowledge

acquisition contribute to the theory-practice gap. Nevertheless, research has identified the importance of reflective practice and mentorship in addressing this gap. Reflective practice encourages pre-service teachers to critically analyze their teaching experiences, while mentorship provides guidance and support from experienced educators.

Experiential Learning in Teacher Education

Experiential learning is an educational approach that emphasizes the active engagement of learners in authentic and real-world experiences (Kolb & Kolb, 2017). According to Kolb's experiential learning theory, learning occurs through a continuous cycle of concrete experience, reflective observation, abstract conceptualization, and active experimentation. This cycle allows learners to make connections between theory and practice, enabling a deeper understanding of the subject matter (Kolb & Kolb, 2017).

The principles of experiential learning involve providing learners with opportunities to engage in hands-on activities, reflection, and the application of knowledge in practical contexts (Kolb & Kolb, 2017). This approach recognizes the importance of learners' active involvement in constructing their own knowledge and developing critical thinking skills (Duran & Dökme, 2016). By engaging in experiential learning, pre-service teachers can bridge the gap between theory and practice, enhancing their understanding of effective teaching strategies and their ability to apply them in the classroom.

Experiential learning has been widely recognized as a valuable approach in pre-service teacher education. By immersing pre-service teachers in authentic teaching contexts, experiential learning enables them to apply theoretical knowledge to real-world situations (Gao, 2015). This hands-on experience allows pre-service teachers to develop practical teaching skills, classroom management strategies, and an understanding of student needs (Duran & Dökme, 2016). They can observe experienced teachers, engage in co-teaching or practice teaching, and receive feedback from mentors and peers (Gao, 2015). Through experiential learning, pre-service teachers also gain insights into the complexities of the teaching profession, such as addressing diverse student needs, managing classroom dynamics, and adapting instruction to different learning styles (Naylor et al., 2015). This immersive experience helps pre-service teachers develop the confidence and competence needed to navigate the challenges they may encounter in their future classrooms (Gao, 2015). In the context of biology teacher education, experiential learning can take various forms. For example, pre-service teachers can engage in laboratory activities, field trips, or research projects that allow them to experience the scientific inquiry process firsthand (Mc Pherson-Geysler et al., 2020). These experiences help pre-service teachers understand the nature of scientific knowledge, develop critical thinking skills, and explore innovative teaching methods that promote student engagement in biology (Hansen et al., 2021; Mc Pherson-Geysler et al., 2020).

Overall, experiential learning in pre-service teacher education offers a powerful platform for biology teachers to develop practical skills, deepen their content knowledge, and understand the complexities of the teaching profession.

Mentorship in Pre-Service Teacher Education

Mentorship plays a crucial role in supporting the professional development of pre-service teachers. Mentors, who are experienced educators, provide guidance, support, and constructive feedback to pre-service teachers as they navigate the challenges of the teaching profession (Orland-Barak & Wang, 2021). Mentors serve as role models and sources of inspiration, helping pre-service teachers develop pedagogical knowledge, classroom management skills, and effective instructional strategies (Hudson & Hudson, 2018).

The mentorship relationship facilitates the transfer of practical knowledge and wisdom from experienced teachers to pre-service teachers (Nesje & Lejonberg, 2022). Mentors share their expertise, provide advice, and offer insights into the complexities of the teaching profession (Orland-Barak & Wang, 2021). Through regular meetings, classroom observations, and collaborative discussions, mentors help pre-service teachers reflect on their teaching practices and refine their instructional strategies (Sheridan & Young, 2017). This reflective process contributes to the growth and development of pre-service teachers, enabling them to become competent and confident educators.

Effective mentors possess certain characteristics and qualities that contribute to the success of the mentorship relationship. They demonstrate a deep commitment to the professional growth of pre-service teachers and create a supportive and trusting environment (Nesje & Lejonberg, 2022). Effective mentors are skilled communicators, providing clear and constructive feedback to help pre-service teachers identify areas for improvement and build on their strengths (Hudson & Hudson, 2018).

Furthermore, effective mentors exhibit pedagogical expertise and a strong knowledge base in their subject area (Nesje & Lejonberg, 2022). They demonstrate effective teaching practices and model exemplary instructional strategies, inspiring pre-service teachers to develop their own teaching style (Orland-Barak & Wang, 2021). Effective mentors also possess interpersonal skills, empathy, and the ability to establish positive relationships with pre-service teachers, fostering a sense of trust and collaboration (Hudson & Hudson, 2018).

In biology teacher education, mentorship takes various forms, depending on the specific context and program design. One common approach is the one-on-one mentoring model, where pre-service teachers are paired with experienced

biology teachers who provide individualized guidance and support (Sheridan & Young, 2017). This model allows for personalized mentoring, tailored to the unique needs and goals of each pre-service teacher.

Another approach is the collaborative mentoring model, where pre-service teachers work with a team of mentors, including both subject matter experts and pedagogical specialists (Hudson & Hudson, 2018). This model promotes interdisciplinary collaboration and allows pre-service teachers to benefit from a diverse range of perspectives and expertise.

Moreover, mentorship can extend beyond the classroom setting. For example, mentors may involve pre-service teachers in research projects, co-author publications, or engage them in professional learning communities (Nesje & Lejonberg, 2022). These additional experiences contribute to the holistic development of pre-service teachers, fostering their engagement in scholarly activities and encouraging lifelong learning in the field of biology education.

Strategies and Current Research on the Theory-Practice Gap in Biology Teacher Education

In the field of biology teacher education, addressing the theory-practice gap is a crucial aspect to ensure the effective preparation of future biology teachers. Approaches and interventions have been proposed to bridge this gap and enhance teaching practices. One approach is the integration of internship placements or teaching internships, where pre-service teachers have the opportunity to engage in authentic teaching experiences under the guidance of experienced educators. These practical experiences provide valuable opportunities for pre-service teachers to apply their theoretical knowledge in real classrooms and gain insights into the complexities of teaching biology (Depaepe & König, 2018).

Evaluation studies have been conducted to assess the effectiveness of these strategies in improving teaching practices. Researchers have examined the impact of internship experiences on pre-service teachers' pedagogical knowledge, instructional skills, and classroom management abilities. Depaepe and König (2018) found that pre-service teachers who participated in well-structured teaching internships demonstrated higher levels of self-efficacy and were better equipped to handle the challenges of classroom management.

In the specific context of Vietnam, research on the theory-practice gap in pre-service biology teacher education is essential. Vietnam's education system has undergone significant reforms (Ho & Dimmock, 2023), and understanding the challenges and opportunities faced by pre-service biology teachers in this context is crucial for enhancing teacher preparation programs. In Vietnam, where educational systems and practices often exhibit unique characteristics influenced by the country's history, culture, and socioeconomic factors, localized research provides valuable insights. Several localized studies have examined various aspects of pre-service teacher education in Vietnam. For instance, Huong et al. (2020) conducted a comprehensive analysis of the challenges and opportunities in pre-service teacher training programs in Vietnam, shedding light on the intricacies of preparing future educators in the local context. Additionally, Hang and Srisawasdi (2021) investigated the effectiveness of pedagogical training for pre-service teachers in Vietnamese universities, emphasizing the need for context-specific strategies to bridge the theory-practice gap. In the broader Southeast Asian context, regional studies have also contributed significantly to our understanding of teacher education. For example, research by Phang et al. (2020) in the Malaysian context explored the role of mentorship in pre-service teacher training, drawing parallels with potential implications for neighboring countries like Vietnam. These localized studies not only enrich the literature but also offer pertinent insights into the challenges and opportunities specific to the Vietnamese and Southeast Asian pre-service teacher education landscape.

To provide a more robust understanding of the need for this study, we delve into the existing body of literature concerning the theory-practice gap in pre-service biology teacher education, with a specific focus on the Vietnamese context. This exploration aims to unearth critical themes, gaps, and areas where further research is warranted within the Vietnamese context. By doing so, we hope to emphasize the unique circumstances and challenges faced by pre-service biology teachers in Vietnam, which necessitate a specialized examination.

In addition, this research seeks to contribute to the broader discourse on strategies to address the theory-practice gap in biology teacher education. It is imperative to consider the applicability of these strategies within the Vietnamese educational landscape, considering the country's unique cultural and contextual factors. The integration of internship placements, teaching internships, and mentorship programs, while recognized as effective in other contexts, requires a nuanced evaluation to determine their suitability and potential adaptations to the Vietnamese setting.

Methodology

Research Design

This qualitative research explores the experiences and perceptions of pre-service biology teachers in the Mekong Delta, Vietnam. The study focused on a cohort of ten pre-service teachers who recently completed their internship and received graduation approval in 2022. The research design employed a qualitative methodology to gain in-depth insights into the participants' experiences during their biology education internship.

Data Collection

In this study, data collection primarily relied on semi-structured interviews conducted in Vietnamese, a choice made to enable an in-depth exploration of participants' experiences and perceptions. The recruitment process was initiated through email invitations to eligible pre-service teachers, where we provided a clear explanation of the research purpose and sought their voluntary participation. Remarkably, all ten invited participants not only accepted but also willingly agreed to be part of the study, underlining their strong commitment to contributing to our research objectives.

To maintain data integrity, all interviews were meticulously audio-recorded, allowing us to capture the nuances and intricacies of participants' responses accurately. Furthermore, to enhance the validity of our findings, we incorporated a member checking process. After the initial interviews, participants were invited via email to review and validate the accuracy of the themes and interpretations derived from their interviews. This iterative step aimed to ensure that the participants' unique perspectives were faithfully represented in the subsequent analysis.

The interviews themselves were conducted by a single experienced interviewer, a deliberate choice to minimize potential interviewer bias and maintain consistency throughout the interview process. The interviewer adhered to a carefully designed interview protocol, which consisted of standardized questions and prompts developed to elicit responses relevant to our research objectives.

Prior to engaging with the study's actual participants, the interviewer underwent extensive training in qualitative interviewing techniques. Pilot interviews were conducted during this training process to refine the interview protocol and ensure the questions were clear and effective in eliciting rich, detailed information. It's important to note that these pilot interviews were not included in the final analysis.

To further ensure consistency and rigor in our interviews, the interviewer engaged in regular debriefing sessions with the research team throughout the study. These sessions provided a platform for discussing the interview process, emerging themes, and addressing any potential biases that may have arisen. This ongoing dialogue facilitated reflection and adjustments as needed, strengthening the overall quality of the interviews.

Through these comprehensive measures, we aimed to mitigate potential sources of bias and uphold the integrity of the data collection process, ensuring that the participants' experiences and perspectives were accurately and faithfully captured in our analysis.

Data Analysis

The method for conducting thematic analysis in this study employed Terry et al. (2017) approach, which is widely recognized for its suitability in qualitative research. Firstly, the coding process was executed manually by a single researcher. The researchers meticulously reviewed the interview transcripts and systematically identified meaningful segments of data, known as initial codes. These initial codes were derived from the data itself, adhering to the inductive nature of thematic analysis. The researchers then organized and categorized these codes into potential themes based on their shared patterns and relevance to the research objectives. To ensure the rigor of our analysis, we implemented measures to enhance inter-coder reliability. Multiple researchers were engaged in the analysis process, and to establish a common understanding and consistency in coding, they engaged in rigorous discussions and coding meetings. This iterative process of coding and collaborative reflection facilitated the refinement and development of the final themes. Any discrepancies or disagreements were thoroughly discussed and resolved through consensus.

Ethical Considerations

The researchers adhered to ethical guidelines provided by our institution throughout the study. All participants had already completed their school-based internship and graduated, eliminating any potential pressure or impact on their academic standing. Informed consent was obtained from each participant, with a consent form explaining the purpose of the study, participants' rights, and the voluntary nature of their involvement. Participants were assured of their ability to withdraw from the study at any time without negative consequences. The recruitment process relied on volunteers to ensure willingness and absence of coercion.

Confidentiality and anonymity were strictly maintained to protect participants' identities. Each participant was assigned a code for anonymity, and interviews were conducted anonymously. Personal information provided by participants was treated with utmost confidentiality and used solely for research purposes. Only the researchers had access to the interviews and transcriptions, stored securely in password-protected electronic devices. The privacy and autonomy of participants were respected throughout the study, and their personal information and responses were handled with care to maintain confidentiality.

The researchers approached the study with respect for the participants, creating a supportive environment for them to freely share their experiences. Participants' contributions were valued, and their perspectives were considered integral to the research process. These ethical considerations ensured the well-being and rights of the participants were upheld throughout the study.

Findings/Results

From Initial Jitters to Passionate Resolve: Unravelling the Evocative Transformation of Pre-service Biology Teachers

Table 1 presents the themes and subthemes derived from the analysis of pre-service biology teachers' experiences during their teaching internships. The table captures the diverse aspects of their journey, including the emotional roller-coaster they encountered, the challenges they faced during the transition from theory to practice, the impact of the COVID-19 pandemic on their internships, the expanded responsibilities they assumed, the transformations they underwent, and their reflections on the duration of the internship period. This table provides a comprehensive overview of the key themes that emerged from the qualitative analysis, offering valuable insights into the experiences of pre-service biology teachers as they navigate the complexities and rewards of the teaching profession.

Table 1. Themes and Subthemes in Pre-Service Biology Teachers' Experiences during Teaching Internships

Themes	Subthemes
Emotional roller-coaster	Nervousness
	Excitement
	Apprehension
	Curiosity
Transition challenges	Bonding with students
	Delivering complex subject matter
Internship realization	Theoretical learning vs. practical application
	Classroom simulation vs. real classroom
Impact of COVID-19	Challenges of online teaching observation
	Adaptability and innovation
Expanded responsibilities	Homeroom teacher role
	Academic monitoring and support
Transformation	Change in perspectives
	New-found love for teaching
Internship duration	Desire for more time

Embarking on the transformative journey of becoming a biology teacher, each participant was encapsulated by a cocktail of emotions - a fluttering mixture of nervousness, excitement, apprehension, and curiosity. The initial step into the classroom was fraught with doubts and concerns, particularly about their ability to effectively foster a bond with the students and deliver complex subject matter in an engaging and comprehensible manner.

For instance, P1 shared a poignant personal account of this overwhelming onset,

“On the threshold of my teaching journey, I was swarmed with apprehension. Stepping into the shoes of a biology teacher, I felt a twinge of anxiety bubbling up. However, as I gradually inched into the teaching process and began interacting with the students, the initial nervousness metamorphosed into an invigorating sense of joy and fulfillment”.

This quote not only captures P1's evolving emotional state but also mirrors the experiences of other participants.

During their internship, they dived headfirst into a realm they had only explored theoretically in university courses like “Biology Teaching Theories”, “Teaching Methods” and “Assessment”. Although these courses provided the basic blueprint of teaching, the participants often practiced teaching with their peers, simulating a classroom environment. However, the real test commenced when they found themselves in a bustling classroom filled with curious high school students. Their previous roles as students in the same setting added a layer of complexity to their new identities as teachers.

The outbreak of the COVID-19 pandemic further complicated their teaching internships. Courses such as “Teaching Observation” were conducted online, adding another dimension to their challenge. The lack of physical interaction and limited student engagement during online observations made it harder for the interns to assess the effectiveness of their teaching techniques. P4 candidly discussed this predicament,

“The challenge of navigating the online teaching landscape was daunting. However, I realized the importance of adaptability. Despite the limitations, I was determined to find innovative ways to engage my students and deliver optimal learning experiences”.

As their internships progressed, the pre-service teachers found themselves undertaking a wide range of responsibilities. Beyond classroom teaching, they assumed the role of homeroom teachers, closely monitoring the academic progress of students, orchestrating study sessions, and providing much-needed guidance and support. P2 fondly recalled these experiences.

“My role expanded beyond just delivering Biology lectures. I became deeply involved in the academic and non-academic facets of my students' lives. It was a rewarding and enriching experience that honed my leadership skills and helped me foster a sense of camaraderie among the students”.

Despite their initial apprehensions, most participants reported a steady transformation in their outlook towards the teaching profession. For some, the desire to become a biology teacher was not their original aspiration. However, as they delved deeper into the art of teaching and fostering relationships with their students, they discovered a newfound love for the profession. The respect and attentiveness they received from students and the joy of seeing students grasp complex biological concepts added to their motivation and deepened their love for teaching.

The majority of participants agreed that the two-month internship period was too brief. They yearned for more time to interact with and learn from their students. Their experiences highlighted the value of teaching internships in fostering an understanding of the intricacies of the teaching profession, enabling them to experience the challenges and rewards first-hand.

In conclusion, the journey from the initial nervousness to a sense of fulfillment, from theoretical learning to practical applications, and from confusion to passionate resolve encapsulates the transformative nature of the teaching internships. It offers invaluable insights into the personal and professional growth of pre-service teachers as they navigate their way through the diverse challenges and opportunities of the teaching profession.

Collaborating with High School Teachers: Enhancing Teaching Practices and Creating Engaging Learning Environments

Table 2 presents the themes and subthemes derived from the thematic analysis of pre-service teachers' collaborative experiences with high school teachers. The table highlights the key areas of focus, including classroom management, lesson planning and delivery, positive teaching strategies, and homeroom responsibilities. Under the theme of classroom management, subthemes include guidance and support in discipline and the establishment of clear rules and consequences. The theme of lesson planning and delivery encompasses subthemes such as effective time allocation, adapting to the context and facilities, and prioritizing theoretical understanding. Positive teaching strategies are represented by subthemes of group discussions and interactive quizzes, as well as fostering student autonomy and knowledge acquisition. Lastly, under the theme of homeroom responsibilities, subthemes include guidance and support in classroom and disciplinary management, establishing clear rules and consequences, understanding students' individual circumstances, and implementing appropriate strategies for rewards and punishments. These themes and subthemes provide a comprehensive overview of the collaborative experiences that have contributed to the development of effective teaching practices among pre-service teachers.

Table 2. Themes and Subthemes Derived from Thematic Analysis of Pre-Service Teachers' Collaborative Experiences with High School Teachers

Themes	Subthemes
Lesson planning and delivery	Effective time allocation
	Adapting to context and facilities
Positive teaching strategies	Prioritizing theoretical understanding
	Group discussions and interactive quizzes
	Fostering student autonomy and knowledge acquisition
Homeroom responsibilities	Guidance and support in classroom and disciplinary management
	Establishing clear rules and consequences
	Understanding students' individual circumstances
	Rewards and punishments

Collaborating with high school teachers provided participants with a rich and immersive learning experience, exposing them to a diverse range of teaching techniques and strategies. This collaboration unveiled valuable insights into the participants' personal journeys alongside experienced educators.

One significant aspect that emerged was classroom management and discipline. Participants expressed deep appreciation for the guidance and support they received in effectively managing classrooms and addressing disruptive behaviours. The high school teachers' expertise in this area proved invaluable. Moreover, the high school teachers also emphasized the importance of establishing clear rules and consequences from the beginning of the academic year. They advised the preservice teachers to be firm and strict with students while maintaining a balance that avoids embarrassing them. The mentors highlighted how preservice teachers could approach discipline with empathy and tailor their strategies accordingly when they considered the students' backgrounds and needs. P4 acknowledged,

“The high school teachers showed me the significance of taking the time to understand the students' individual circumstances, as some may exhibit misbehaviours due to challenges in their home life, such as having parents working far away”.

This aspect emphasizes the crucial role of classroom management in fostering an optimal learning environment and recognizes the teachers' impact in helping participants navigate challenges associated with students' discipline.

Another prominent area that surfaced was lesson planning and delivery. Participants highlighted the significance of allocating time effectively to various learning activities and adapting them to the context and facilities available. P6 mentioned the advice from the mentor teacher that in small classrooms, it may not be suitable to incorporate extensive group discussion activities or require students to move around frequently. Furthermore, the mentors advised the preservice teachers to pay special attention to lessons related to final exams, where it is crucial to focus on theoretical understanding. P8 shared the mentor's guidance, stating,

"The mentor emphasized the need to prioritize theory and practice mathematical exercises related to topics like mitosis and meiosis. This guidance helped me develop focused and comprehensive lessons that catered to the students' exam preparation needs".

The participants acknowledged that the feedback and suggestions provided by the experienced teachers played a pivotal role in improving their lesson planning and delivery. By incorporating the teachers' feedback, the preservice teachers were able to refine their teaching practices and create more engaging and effective lessons. P2 reflected on the impact of the feedback, stating,

"The teachers' feedback on lesson design and delivery was invaluable in enhancing my teaching practices. It taught me to establish clear learning objectives, effectively organize content, and engage students through innovative teaching methods such as problem-based learning or the tablecloth technique".

Positive teaching strategies emerged as transformative elements in the participants' learning experience, further enhancing their understanding of effective instructional practices. The participants particularly valued the inclusion of group discussions and interactive quizzes because they encouraged student engagement and active participation in the learning process. P8 highlighted the impact of these strategies, stating,

"Through the implementation of collaborative teaching techniques such as group discussions and interactive quizzes, I witnessed first-hand the positive effects on student engagement and active participation in their own learning".

Moreover, preservice teachers understand the importance of fostering student autonomy and knowledge acquisition through self-discovery thanks to their mentor teachers. This approach encouraged students to independently seek out relevant reading materials and actively contribute to the classroom discourse. P9 shared the mentor's perspective, stating,

"The mentor emphasized the significance of allowing students to engage in self-discovery and knowledge acquisition. For instance, assigning topics for students to independently research and present in subsequent lessons proved effective in promoting their active involvement in the learning process".

This aspect highlights the value of student-centered and interactive approaches in promoting active learning and creating an inclusive classroom environment. By incorporating collaborative teaching strategies, such as group discussions and interactive quizzes, educators can foster student engagement and encourage their active participation in the learning process. Furthermore, empowering students to take ownership of their learning through self-discovery and presentation activities enhances their motivation and deepens their understanding of the subject matter.

One significant aspect that emerged was homeroom responsibilities. Participants expressed deep appreciation for the guidance and support they received from mentor teachers in effectively managing classrooms, addressing disruptive behaviors, and fulfilling homeroom duties. The high school teachers' expertise in this area proved invaluable. Moreover, they also emphasized the importance of establishing clear rules and consequences from the beginning of the academic year. Preservice teachers were advised to be firm and strict with students while maintaining a balance that avoids embarrassing them. The mentors highlighted how preservice teachers could approach discipline with empathy and tailor their strategies accordingly when considering the students' backgrounds and needs. P4 acknowledged,

"My mentor showed me the significance of taking the time to understand the students' individual circumstances, as some may exhibit misbehaviour due to challenges in their home life, such as having parents working far away".

The guidance and support provided by high school teachers in managing homeroom activities and addressing disciplinary cases were highly regarded. Participants recognized the importance of effective homeroom management and its impact on creating a positive and cohesive environment. P3 shared their gratitude, stating,

"The high school teachers guided me in handling homeroom responsibilities, distributing tasks, and addressing disciplinary cases. Their insights helped me become a more effective homeroom teacher".

Furthermore, P10 emphasized the significance of implementing appropriate strategies for rewards and punishments suggested by the mentor teacher. P10 explained that during homeroom sessions she learned to start praising students for their accomplishments during the week before addressing disciplinary issues such as incomplete assignments, lack

of participation, tardiness, uniform violations, etc. Various levels of discipline, including reminders, in-class chores, involving parents, or deducting conduct grades, could be employed based on the frequency and severity of the infractions.

In summary, the collaborative experience between preservice teachers and high school teachers has provided invaluable insights and support for the development of effective teaching practices. The participants have gained a deeper understanding of crucial aspects such as classroom management and discipline, lesson planning and delivery, and homeroom responsibilities. The guidance and expertise shared by experienced educators have equipped preservice teachers with the necessary skills to create positive learning environments, engage students through innovative approaches, and effectively manage their classrooms. This collaborative journey has not only enhanced their professional growth but also prepared them to meet the challenges of the teaching profession with confidence and competence. By integrating these valuable lessons into their practice, preservice teachers are poised to make a positive and lasting impact on the education and well-being of their future students.

The Great Divide in Pre-service Biology Teacher Education: Delineating the Boundaries between Pure Science and Practical Pedagogy

Table 3 presents the themes and subthemes derived from the thematic analysis of pre-service teachers' perspectives on the dichotomy between specialized biology knowledge and its practical application. The table highlights the key areas of focus, including curriculum reform, pitfalls of specialized knowledge, the call for curriculum change, benefits of specialized knowledge, and the demand for more practical training. Under the theme of curriculum reform, subthemes include the balance between specialized biology and teaching skills, practical understanding of teaching strategies, and classroom management and student psychology. The theme of pitfalls of specialized knowledge encompasses subthemes such as confusion when integrating specialized knowledge and the need for a more pragmatic and responsive curriculum. The call for curriculum change is represented by subthemes of reduced emphasis on specialized biology knowledge, a focus on classroom management and teaching strategies, and the importance of practical training and teaching apprenticeships. The benefits of specialized knowledge are demonstrated through subthemes of it being a powerful tool when integrated appropriately, confidence in addressing complex student questions, and the need for more teaching practice opportunities.

Table 3. Themes and Subthemes Derived from Thematic Analysis of Pre-Service Teachers' Perspectives on the Dichotomy between Specialized Biology Knowledge and Practical Application

Themes	Subthemes
Curriculum reform	The balance between specialized biology and teaching skills Practical understanding of teaching strategies Classroom management and student psychology
Pitfalls of specialized knowledge	Confusion when integrating specialized knowledge Need for a more pragmatic and responsive curriculum
Call for curriculum change	Reduced emphasis on specialized biology knowledge Focus on classroom management and teaching strategies Importance of practical training and teaching apprenticeship
Benefits of specialized knowledge	Powerful tool when integrated appropriately Confidence in addressing complex student questions

As we delve deeper into the experiences and perspectives of pre-service teachers, a more nuanced understanding of the dichotomy between specialized biology knowledge and its application in high school classrooms begins to emerge. Poised on the threshold of their professional journey as educators, these pre-service teachers have surfaced a pressing concern, the divergent paths between the depth of subject-specific knowledge advocated by university curricula and the realities of teaching biology in a high school context. According to the pre-service teachers themselves, this incongruity calls for a closer look and a reevaluation of the current curricular framework.

P2's reflection offers an insightful starting point for this discourse,

"The curriculum allowed us to delve into the intricate details of specialized biology subjects, ranging from the genetic makeup of organisms to the physiological nuances and the taxonomic intricacies of plant classification. This depth of knowledge is undoubtedly intellectually stimulating. However, I often found myself wondering if such intricate details are relevant when teaching high school students".

These sentiments highlight a pertinent challenge, the specialized knowledge taught at university, although intellectually enriching, may not necessarily be relevant or practical in a high school biology classroom.

This perspective resonates with P9, who drew a clear demarcation between Biology Education and Biology Science,

"It's essential to understand that we are studying Biology Education, not pure Biology Science. The curriculum should reflect this distinction more clearly".

The distinction that P9 made emphasizes the core of the problem. Pre-service teachers are being prepared to educate future generations, not to conduct advanced scientific research. While a strong foundation in biology is undoubtedly crucial, the curriculum must balance it with a practical understanding of teaching strategies and classroom management, better equipping these future educators for their roles in high school classrooms.

Adding further depth to this conversation, P3 reflected on their first-hand experience of trying to incorporate their university-acquired specialized knowledge into their teaching,

“In my attempts to apply what I learned at the university; I integrated more specialized biological knowledge into my lessons. Surprisingly, rather than enhancing understanding, it seemed to sow seeds of confusion among the students”.

This personal account underscores the pitfalls of an overly specialized focus in the curriculum, reinforcing the argument for a more pragmatic, balanced, and responsive curriculum that is attuned to the real-world needs of high school teaching.

The voices of these pre-service teachers converge on a common theme, the need for curriculum reform. As P2 suggested,

“Perhaps the faculty could consider reducing the extensive courses on specialized biology. Instead, could we delve deeper into areas like classroom management, understanding student psychology, and efficient teaching strategies? These seem more relevant to our future roles”.

This reflection doesn't exist in isolation but echoes across the narratives of several pre-service teachers who see an urgent need to equip themselves with practical skills that will enable them to manage classrooms effectively, understand student psychology, and deploy impactful teaching strategies.

However, it's worth noting that the call for a curriculum change doesn't necessitate the complete elimination of specialized biology knowledge. For instance, P5 defended the rigorous biological training, stating,

“The deep knowledge we acquire in specialized biology courses isn't necessarily a hindrance. On the contrary, it can be a powerful tool, provided we learn how to integrate it appropriately without overwhelming our students”.

Similarly, P7 affirmed the benefits of a solid grounding in biology, explaining how it has enabled her to address complex questions from students with confidence. Yet, she echoed the need for a more balanced approach, admitting,

“I do wish we had more opportunities for teaching practice. It would certainly have helped me prepare better for the diversity and dynamism of a high school classroom”.

The call for more practical training in the form of teaching apprenticeships is a shared sentiment. P8 offered a concrete suggestion,

“Our university should collaborate with local high schools to provide us with longer or more frequent teaching apprenticeships. This would give us a chance to apply our theoretical knowledge directly, while also honing our teaching skills”.

Through their shared experiences and suggestions, these pre-service teachers have ignited a vital dialogue around the need for a more balanced approach in the Biology Education curriculum. The emphasis is not to marginalize specialized biological knowledge but to integrate it more effectively with practical teaching strategies and classroom management skills. Furthermore, the demand for more opportunities for experiential learning through teaching apprenticeships underscores the importance of connecting theoretical knowledge with real-world practice. This comprehensive approach to pre-service teacher training has the potential to foster a more seamless transition into the world of high school teaching, ultimately resulting in more effective and confident educators.

Discussion

This study has sought to examine the role of mentorship and the theory-practice gap in pre-service biology teacher education, focusing primarily on the Vietnamese context. It is important to consider these findings in relation to existing research while also acknowledging the study's novel contributions and limitations.

In line with the work of Orland-Barak and Wang (2021), and Hudson and Hudson (2018), the current study reinforces the importance of mentorship in pre-service teacher education. As the findings suggest, experienced educators or mentors play a crucial role in guiding, supporting, and providing constructive feedback to future educators. However, the research has brought forth the concept that mentorship potentially holds more benefits than a traditional transfer of knowledge. The findings revealed that mentorship might also cultivate a conducive learning environment, promoting the reflective learning process of pre-service teachers. This extends our current understanding of mentorship, suggesting that it could have a profound influence on the overall learning experience of pre-service teachers. While this insight adds a new dimension to the discourse on mentorship, the implications need to be explored further, and the proposed benefits should be validated in future studies. Regarding mentorship models, this study found an array of models in use, echoing the observations of Hudson & Hudson (2018). However, a novel contribution of the current study is the suggestion that

the effectiveness of mentorship could be enhanced by tailoring approaches to meet the unique needs of each pre-service teacher. This finding adds an extra layer of complexity to the process of mentorship in pre-service teacher education.

In terms of pedagogical knowledge, the findings of this study support the existing literature (Huong et al., 2020; Nesje & Lejonberg, 2022), reiterating that subject matter expertise alone does not suffice for effective teaching. However, the study has also uncovered an essential insight: there appears to be an imbalance between scientific and pedagogical knowledge among pre-service biology teachers. This suggests a greater need for an integrated approach in delivering these two types of knowledge. However, as much as this finding contributes to our understanding of the challenges faced by pre-service teachers, it is important to interpret it with caution. It brings to light the complexity of teaching biology, revealing a need to integrate scientific and pedagogical knowledge. Yet, this finding should not be taken as definitive; further empirical research is necessary to better understand how this balance can be achieved.

Regarding the theory-practice gap, the current study supports earlier research (Depaepe & König, 2018) indicating that interventions such as internship placements and teaching internships, though beneficial, might not fully mitigate this gap. This particular finding has implications for future research and practice, suggesting the necessity of more comprehensive interventions to bridge this gap effectively. However, like many of the findings in this study, this insight should be viewed as an important step in an ongoing investigation rather than a conclusive answer. While it does point to the need for wider interventions, further research is necessary to understand what these might look like and how they could be implemented effectively within the specific context of Vietnamese pre-service biology teacher education.

In a broader context, the study has investigated the challenges and opportunities for pre-service biology teachers in Vietnam, which is undergoing educational reforms (Hang & Srisawasdi, 2021; Ho & Dimmock, 2023). This particular focus provides a unique lens through which to view the findings and could serve as a valuable foundation for future research in this area. However, as with all the findings of this study, it is important to recognize that this is only a preliminary exploration of a complex issue. The results need to be substantiated with further in-depth research in the Vietnamese context.

In conclusion, this study presents several interesting findings that contribute to our understanding of pre-service biology teacher education in Vietnam. While it affirms the crucial role of mentorship, it also uncovers the complex dynamics of how this mentoring occurs and the potential benefits it could bring beyond mere knowledge transfer. It brings to the forefront the crucial balancing act between scientific and pedagogical knowledge, underscoring the need for an integrated approach in teacher education. Moreover, the findings also point to the limitations of current interventions in bridging the theory-practice gap, suggesting a need for more comprehensive strategies. The study further highlights the potential benefits of tailoring mentorship to the specific needs of each pre-service teacher, providing a new perspective on the dynamics of effective mentorship. Besides, this research offers a unique contribution by focusing on the Vietnamese context, which is undergoing significant educational reforms. This focus provides an interesting backdrop to the findings and could serve as a foundation for future research. Yet, much more needs to be done to fully understand the challenges and opportunities facing pre-service biology teachers in Vietnam.

Conclusion

This research focused on exploring the critical aspects of pre-service biology teacher education in Vietnam, specifically the integration of theoretical knowledge and practical application through experiential learning and mentorship. The findings highlight the significance of well-structured experiential learning opportunities and effective mentorship programs in supporting pre-service teachers' professional development and improving their instructional skills. The study's emphasis on the theory-practice gap in biology teacher education contributes to the ongoing discourse surrounding teacher education reform.

While our study primarily focuses on the experiences of pre-service biology teachers in Vietnam, several insights and recommendations generated from this research may have relevance and applicability to pre-service teacher education in other countries or regions. For instance, the emphasis on effective mentorship programs to bridge the gap between theoretical knowledge and practical teaching skills can be a universal concern in teacher education. The qualities and practices that define successful mentor teachers are not confined to one geographic area, and our findings could serve as a reference point for designing mentorship programs in various contexts. Similarly, the integration of immersive technologies, culturally responsive pedagogy, and social-emotional learning into teacher education are topics of global significance. While the specific strategies may vary, the overarching principles of adapting teacher preparation to address diverse student needs and the evolving digital landscape resonate with educators worldwide.

Recommendations

In considering the path forward for research in teacher education, there are several critical areas that warrant exploration. First and foremost, delving into the qualities and practices that characterize effective mentor teachers and their impact on pre-service teacher development is imperative. Investigating mentorship's role in new teacher retention and the cultivation of reflective teaching practices would provide valuable insights, potentially through longitudinal studies assessing the enduring effects of mentorship on educators.

Furthermore, as technology continues to advance, there is a burgeoning opportunity to employ immersive simulations and virtual reality in teacher education. Research endeavors could focus on the efficacy of these technologies in providing realistic teaching experiences for pre-service teachers and their influence on educators' adaptability and innovative teaching methods over the long term.

Diversity in classrooms is becoming increasingly prominent, and teacher education must adapt. Thus, exploring the integration of culturally responsive pedagogy into teacher preparation programs and assessing its impact on student outcomes is essential for future research in this field.

Additionally, as social-emotional learning gains recognition in education, research could delve into how teacher candidates can be better trained to foster students' social and emotional development. Examining the effects of SEL-focused training on academic achievement, classroom behavior, and teacher-student relationships would offer valuable insights.

Considering the ongoing evolution of technology, it is vital to investigate the lasting effects of technology-rich teacher preparation programs. Future research should delve into how such programs influence teachers' adaptability to emerging technologies in their careers, possibly through longitudinal studies tracking the professional development of educators exposed to technology-enhanced teacher education.

Moreover, future studies should aim to extend the scope by exploring additional variables. This might encompass investigating the influence of teacher education program duration, the role of school culture in shaping pre-service teachers' experiences, or the effects of varying mentorship models on teacher development. These variables could provide a more comprehensive understanding of teacher preparation.

Lastly, to bolster the quality of research in this domain, methodological enhancements are essential. Researchers might consider employing mixed-methods approaches, conducting more extensive longitudinal studies, or utilizing larger and more diverse participant samples to ensure findings are robust and generalizable. By addressing these research avenues and methodological considerations, teacher education can advance to better prepare pre-service teachers for the challenges and opportunities of modern education.

Limitations

One limitation of this research is the reliance on semi-structured interviews with a small sample size. While the qualitative approach allowed for in-depth exploration, the findings may not be generalizable to a larger population. Future research should consider a larger and more diverse sample to gain a broader understanding of the theory-practice gap in pre-service biology teacher education. This would enhance the external validity and applicability of the findings.

Another limitation is the specific cultural and educational context in which the research was conducted. The findings of this study were based on the experiences of pre-service biology teachers in Vietnam. Caution should be exercised when applying these findings to other settings, as cultural and contextual factors may influence the dynamics of the theory-practice gap. Comparative studies across different cultural and educational contexts would contribute to a more comprehensive understanding of these issues and provide a basis for broader recommendations.

Acknowledging these limitations, future research endeavors should aim to address these concerns by expanding the sample size and considering a wider range of cultural and educational contexts. This will enhance the robustness and generalizability of the findings and further contribute to the field of pre-service biology teacher education.

Ethics Statements

The present study was conducted in strict accordance with the ethical guidelines provided by our institution. All necessary ethical considerations were considered throughout the research process. Informed consent was obtained from all participants involved in the study. Prior to their participation, the purpose and procedures of the research were thoroughly explained, and participants were provided with a written informed consent form. The consent form outlined the voluntary nature of participation, assured participants of their right to withdraw from the study at any time without consequences, and emphasized the confidentiality and anonymity of their responses.

The study strictly adhered to principles of confidentiality and anonymity. Participant identities were protected through the assignment of codes, and all personal information provided by participants was treated with the utmost confidentiality. Only the researchers involved in the study had access to the collected data, which was securely stored on password-protected electronic devices. The data obtained from participants was used solely for research purposes and was not shared with any unauthorized individuals.

Acknowledgements

We would like to express our sincere gratitude to the participants who generously shared their experiences and perspectives for this study. Their valuable insights have contributed significantly to our understanding of the challenges and opportunities in pre-service biology teacher education. We also extend our heartfelt thanks to lecturers and officers of Can Tho University for their support and cooperation throughout the research process.

Conflict of Interest

The authors declared there is no conflict of interest.

Funding

This research was conducted without external funding support.

Authorship Contribution Statement

Diem: Concept and design, admin, supervision, final approval. Think: Data acquisition, data analysis / interpretation, drafting manuscript. Lam: Critical revision of manuscript, technical and material support

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