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Pre-Service Science Teacher Training Needs at the College of Basic Education in Kuwait: A Comprehensive Literature Review

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Abstract

This research paper, "Pre-Service Science Teacher Training Needs at the College of Basic Education in Kuwait: A Comprehensive Literature Review," systematically examines the essential components for effectively preparing future science educators in Kuwait. The study highlights the critical role of well-prepared teachers in fostering student success and a scientifically literate populace, crucial for navigating 21st-century complexities. It delves into theoretical foundations, including Bandura's Social Learning Theory, Piaget and Vygotsky's Constructivist Learning Theory, and contemporary Professional Competence Development theories, emphasising social interaction, active knowledge construction, and continuous professional growth.

The paper defines training needs as the gap between existing and required competencies, categorising them into cognitive, psychomotor, and affective domains. It stresses the importance of systematic identification through task, individual, and organisational analyses. A rigorous systematic literature review of the Kuwaiti context reveals significant gaps in Pedagogical Content Knowledge (PCK), insufficient practical skills (e.g., laboratory instruction, classroom management), enhanced inquiry-based learning and scientific creativity training, and challenges in technology integration. The review also identifies institutional and policy factors influencing these training needs, such as limited resources and national priorities. The paper concludes with a call for comprehensive curriculum reform, enhanced practical experiences, strengthened mentorship, and responsive policy adjustments to improve pre-service science teacher training at Kuwait's College of Basic Education.

1. Introduction chapter

In an increasingly complex world, education's quality hinges fundamentally on its teachers' preparedness. Beyond mere transmitters of knowledge, **educators are the foundational architects of future societies**, shaping the minds that will lead in various capacities. As Darling-Hammond (2017) asserts, effective teaching is a primary driver of student success, unequivocally underscoring the imperative for robust pre-service teacher preparation programmes. This essay will explore the specific **training needs of pre-service science teachers** at the College of Basic Education (CBE) in Kuwait by reviewing relevant literature and illustrating the critical components necessary for their adequate preparation.

Adequate teacher preparation is paramount for ensuring high-quality education. It equips future educators with **content knowledge and pedagogical strategies** for managing diverse classroom situations (World Bank, 2018). This structured training fosters greater confidence and competence in teaching practices, enhancing student performance and a more educated populace (Darling-Hammond, 2017).

Science education holds a unique and critical place within this broader curriculum, nurturing the **critical thinking and problem-solving abilities** vital for navigating the complexities of the modern world. The 21st century's challenges—from environmental issues to rapid technological advancements—demand a scientifically literate populace (National Research Council, 2012). However, science education often contends with challenges such as resource limitations, outdated curricula, and insufficient teacher preparation. While frameworks like the Next Generation Science Standards (NGSS Lead States, 2013) advocate for integrative, inquiry-based learning, their successful implementation depends entirely on equipping science teachers with the necessary skills.

Understanding training needs is central to adequate teacher preparation, involving the identification of gaps between current teacher capabilities and the skills required for effective teaching (Roberson, 2018). For science teachers, this means developing content mastery and **pedagogical skills to engage students in scientific inquiry**. This is particularly relevant in Kuwait's education system, where the College of Basic Education plays a vital role in training educators. Al-Rubaie (2022) describes the CBE as an institution that prepares teachers for Kuwaiti schools.

While the CBE's curriculum incorporates relevant pedagogy, a review suggests gaps, particularly in practical skills like laboratory instruction and technology integration (Al-Enezi, 2022). Furthermore, persistent feelings of ineffectiveness and lack of preparedness among science teachers, often stemming from insufficient training in pedagogical content knowledge (Lederman & Abell, 2014), highlight the need for tailored training.

1.1 Research Problem

Despite the acknowledged importance of comprehensive teacher preparation and the specific challenges science education faces in Kuwait, a significant gap exists in the current literature. There is a notable **absence of comprehensive studies specifically addressing the training needs of pre-service science student teachers at the College of Basic Education in Kuwait**. This lack of focused empirical research limits the effectiveness of current teacher training programmes and undermines future science educators' potential success. This critical knowledge gap, demanding urgent attention, is precisely what this literature review seeks to address. As research underscores that neglecting the specific needs of teachers-in-training can result in ill-prepared professionals (Darling-Hammond, 2006), filling this void is essential for improving educational outcomes in Kuwait.

1.2 Objectives of the Review

The primary objectives of this literature review are as follows:

1. To **identify the key training needs of pre-service science student teachers**, this review examines existing literature to delineate the specific educational and professional skills necessary for pre-service science teachers in Kuwait.
2. To **analyse the factors influencing these needs**: This objective involves closely considering the various sociocultural, institutional, and pedagogical elements that shape the training requirements of student teachers. Understanding these factors is crucial for effective curriculum design and pedagogy.
3. To **synthesise best practices and recommendations** for improving training programmes: Drawing from diverse contexts and best practices in teacher education globally, this review aims to generate actionable recommendations for enhancing teacher training programmes tailored to the needs of science student teachers at the CBE.

1.3 Significance of the Review

This literature review's significance extends across various sectors, impacting universities, educational policymakers, and researchers.

1. **For universities and teacher preparation institutions**: Findings from this review can assist higher education institutions in designing effective training programmes that adequately address the identified needs of pre-service science teachers. A targeted approach can improve overall educational outcomes and graduates' preparedness for future roles.
2. **For educational policymakers**: This literature review provides evidence-based insights that can inform policy decisions on teacher education in Kuwait. Policymakers require robust data to make informed choices about resource allocation, curriculum development, and educational reform.
3. **For researchers**: By identifying gaps in existing research and suggesting future directions, this review may facilitate further studies that explore pre-service teacher training needs, thereby enriching the scholarly conversation surrounding teacher education in the Kuwaiti context.

1.4 Structure of the Review

The subsequent sections of this literature review will be structured as follows:

1. **Literature Review Methodology**: This section will outline the methods used to gather and analyse existing pre-service teacher training needs research.
2. **Key Training Needs of Pre-Service Science Teachers**: This part will identify and discuss the specific training needs outlined in the literature, including theoretical knowledge, pedagogical skills, and practical classroom management techniques.
3. **Factors Influencing Training Needs**: Here, the review will delve into various factors—such as cultural, institutional, and pedagogical contexts—that contribute to the training needs of science student teachers at the CBE.
4. **Best Practices and Recommendations**: This section will synthesise best practices from global contexts, providing actionable recommendations tailored to the Kuwaiti educational landscape and the specific needs of pre-service science teachers.

5. **Conclusion**: The final section will summarise the key findings and implications of the review, reaffirming the importance of addressing the training needs of future educators.

In conclusion, this literature review addresses the pressing issue of the training needs of pre-service science teachers at the College of Basic Education in Kuwait. The review will provide insights critical for improving teacher preparation programmes, influencing educational policymaking, and guiding future research initiatives by filling the existing knowledge gap. The practical training of science educators is paramount for enhancing the quality of education in Kuwait, ensuring that future generations benefit from a well-rounded and comprehensive learning experience.

2. Theoretical and Conceptual Framework

The quality of education largely hinges on the capability of teachers, making practical teacher training essential for developing competent educators. The College of Basic Education in Kuwait faces unique challenges and opportunities, necessitating a critical analysis of teacher preparation theories. This chapter explores the theoretical framework pertinent to pre-service science teacher training needs, encompassing Bandura's Social Learning Theory, Piaget and Vygotsky's Constructivist Learning Theory, and contemporary theories of professional competence development. Furthermore, it integrates findings from recent studies on pre-service science teacher training in Kuwait, providing a comprehensive conceptualisation of the challenges and needs within this specific context.

2.1 Foundational Learning Theories in Teacher Education

Effective teacher preparation programs are deeply rooted in established learning theories that inform pedagogical approaches and foster skill development.

2.1.1 Social Learning Theory (Bandura)

Albert Bandura's Social Learning Theory posits that learning occurs within a social context and that individuals learn from one another via observation, imitation, and modelling (Bandura, 1977). This theory underscores the importance of social interaction and suggests that pre-service teacher training programs can significantly benefit from incorporating collaborative learning experiences.

In training future science teachers, a strong focus on mentorship and peer observation can foster an environment where trainees learn effective teaching strategies by observing experienced educators (Lofthouse, 2018). For example, a pre-service programme might incorporate opportunities for student teachers to conduct teaching demonstrations while observing their peers and instructors, leading to constructive feedback and fostering a culture of shared learning (Lave & Wenger, 1991).

Research indicates that teacher efficacy—a teacher's belief in their capacity to affect student outcomes—increases when pre-service teachers engage in an interactive learning community (Tschannen-Moran & Woolfolk Hoy, 2001). Their ability to observe and model behaviours demonstrated by their mentors can enhance self-efficacy, ultimately improving their classroom management and teaching methodologies. Thus, integrating Bandura's principles into training programs could cultivate more confident and effective science educators.

2.1.2 Constructivist Learning Theory (Piaget, Vygotsky)

Constructivist Learning Theory, articulated by Jean Piaget and Lev Vygotsky, posits that knowledge is constructed through interactions with the environment and social interactions (Piaget, 1970; Vygotsky, 1978). This theoretical perspective is particularly influential in the design of teacher training programmes, emphasising the need for active, student-centred pedagogical approaches.

In science education, constructivism suggests that pre-service teachers should be trained to create environments where students actively engage with scientific concepts rather than passively receiving information (Driver, 2012). For instance, training programmes might emphasise inquiry-based learning techniques, encouraging students to formulate questions, conduct experiments, and draw conclusions through their investigations. This aligns with Vygotsky's emphasis on the social aspect of learning, where collaborative activities enable learners to construct knowledge collectively (Vygotsky, 1978).

Moreover, recognising the implications of Piaget's stages of cognitive development could lead to tailored training that accounts for varying levels of student understanding, thus enabling pre-service teachers to adapt their methods to suit diverse learner needs. This alignment between teacher training and constructivist principles could significantly enhance the readiness of new science teachers, equipping them with the tools to facilitate meaningful learning experiences in their future classrooms.

2.2 Theories of Professional Competence Development for Teachers

In addition to the foundational theories of learning, contemporary theories of professional competence development highlight the importance of ongoing professional development opportunities in cultivating effective teaching practices. The Competence-Based Approach advocates for training that equips educators with the necessary skills and knowledge to perform their roles effectively (Mulder, 2017). This approach aligns well with the needs of pre-service science teachers, as it emphasises the integration of theoretical knowledge and practical application.

Professional competence can be broken down into several domains, including pedagogical knowledge (knowledge about teaching methods and strategies), content knowledge (deep understanding of the subject matter), and pedagogical content knowledge (PCK) (knowledge of how to teach specific subject matter effectively) (Shulman,1986). In the context of science teacher training, this implies a firm grasp of scientific concepts and an understanding of how to teach these concepts to students effectively. The synthesis of these knowledge domains is crucial for preparing teachers who can navigate the complexities of teaching in diverse classrooms.

Furthermore, reflective practice is essential to professional competence development (Schön, 1983). Encouraging pre-service teachers to reflect on their teaching practice and experiences as learners can lead to a deeper understanding of their pedagogical choices and their effects on student learning. Training programmes at the College of Basic Education should incorporate structured opportunities for reflection, enabling future science educators to evolve their instructional strategies based on their classroom experiences continually.

Understanding these theoretical and conceptual frameworks that underpin pre-service science teacher training is vital for addressing the specific training needs at the College of Basic Education in Kuwait. Applying Bandura's Social Learning Theory, Piaget and Vygotsky's Constructivist Learning Theory, and modern competence development theories presents a comprehensive approach to shaping effective training programmes.

By leveraging social interaction, constructivist practices, and competency-focused training, the College can significantly enhance the quality of science education through capable and confident teachers. Pre-service teacher training must evolve with the educational landscape, and embracing these theoretical frameworks will better prepare future educators to meet the challenges of the 21st-century classroom. As the demands on teachers continue to grow, the reliance on these theoretical insights will be paramount in ensuring that science educators can inspire and equip their students with the knowledge and skills needed today.

2.3 The Concept of Training Needs

A clear understanding of "training needs" is essential for effectively designing and implementing teacher training programs.

2.3.1 Definitions of Training Needs

Training needs are the gap between existing and required competencies to perform a particular task satisfactorily. Various scholars have proposed different definitions:

1. According to Kura, S. M., & Kaur, S. (2021), training needs are the discrepancies identified between current and desired performance (Kura, S. M., & Kaur, S., 2021). This definition underscores the importance of performance as a metric for evaluating training needs.
2. Romiszowski (2016) describes training needs as the specific skills, knowledge, and behaviours an individual must acquire to perform a job (Romiszowski, 2016) effectively. This definition broadens the scope of training needs to encapsulate knowledge, skills, and behaviours.

3. A Training Needs Analysis (TNA) is a systematic process to identify what training is needed, for whom, and within the specific organisational context. It aims to determine expected learning outcomes, guide the design and delivery of training programs, and uncover organisational factors that may impact training effectiveness. This process also recognises that adult learners are more motivated when training content is relevant to their job demands, thereby acknowledging their specific professional aspirations and contexts (Salas et al., 2012).

These definitions converge on the idea that training needs must be systematically identified to ensure educational programs are rooted in institutional demands and individual shortcomings.

2.3.2 Types of Training Needs

Understanding the types of training needs is essential to developing an effective training programme. Training needs are generally categorised into three principal types: cognitive, psychomotor (skill-based), and affective (attitudinal).

1. **Cognitive Needs:** Cognitive training needs refer to the knowledge required for teaching. This encompasses understanding scientific concepts and theories, and the means to communicate these effectively. For instance, pre-service science teachers must have a firm grasp of fundamental scientific principles and current developments in science education.
2. **Psychomotor (Skill-Based) Needs** involve the physical ability and skill aspect of teaching. For science educators, implementing practical laboratory techniques or using technology to enhance learning falls under this category. Moreover, psychomotor training is crucial for teachers to perform demonstrations or manage experiments safely and effectively (Learn, 2000).
3. **Affective (Attitudinal) Needs:** This category includes the emotional and ethical dimensions concerning training needs. It encapsulates the attitudes towards teaching and learning, which include empathy, enthusiasm, passion for the subject, and commitment to students' success. Developing a positive disposition towards teaching science is paramount for educators in creating an engaging learning environment.

These three training needs indicate varied dimensions that must be addressed during the pre-service training of science teachers, thus preparing them to meet the challenges posed in contemporary education.

2.4 The Process of Identifying Training Needs

Identifying training needs is a structured process critical to ensuring effective educational and professional development. This identification process typically involves three levels of analysis: task analysis, individual analysis, and organisational analysis.

2.4.1 Task Analysis

Task analysis thoroughly examines job requirements and the competencies needed to perform them effectively. In the context of pre-service science teacher training, this may include analysing specific teaching tasks, such as lesson planning, classroom management, and assessment techniques. One efficient method for conducting task analysis is observation and interviews with experienced educators (Goldman & Pea, 2007). Insights from this analysis lead to developing or enhancing training content that aligns closely with the demands of modern teaching environments.

For instance, a study by Alhendal, Marshman, and Grootenboer (2016) indicates that science educators in Kuwait need specific training in inquiry-based learning approaches to help students develop critical thinking skills. Identifying such needs underscores the importance of tailored training initiatives.

2.4.2 Individual Analysis

Individual analysis focuses on assessing the capabilities and competencies of specific individuals within the pre-service training programme. It determines the knowledge gaps and requisite skills needed for each pre-service teacher, thus enabling a more personalised approach to training. Various assessment methods, such as surveys, self-assessments, and competency tests, can measure individual capabilities (Knowles et al., 2012).

For example, in Kuwait, many pre-service educators may lack experience with technology integration in science teaching. Individual assessments can identify these gaps, allowing training programmes to incorporate technology into their curriculum.

2.4.3 Organisational **Analysis**

Organisational analysis critically appraises the institutional learning environment and identifies how it impacts training initiatives. This analysis considers institutional goals, resources, and policies that influence teacher training. Aligning the training programme with the objectives of the College of Basic Education is essential (Phillips, J. & Phillips; P., 2005).

Understanding Kuwait's educational policy—especially the emphasis on STEM (Science, Technology, Engineering, and Mathematics) education—can guide the design of training programmes that resonate with the national educational agenda.

2.5 Local Context: Research on Pre-Service Science Teacher Training in Kuwait

The theoretical frameworks discussed above provide a foundation for understanding teacher development. Still, their application must be contextualised within the specific needs and challenges of pre-service science teachers at Kuwait's College of Basic Education. Several studies have investigated this local context, offering valuable insights into current training needs.

2.5.1 Challenges in Teaching Practice

Alshammari, Eyadat, and Ebrahim (2017) conducted an in-depth analysis of the challenges faced by pre-service teachers during their teaching practice in Kuwait. They identified several critical areas, including limited practical experience, inadequate mentoring, and insufficient understanding of pedagogical theories. Their study highlights a gap between theoretical knowledge and practical application, noting that many pre-service teachers feel unprepared to manage classrooms effectively or apply their understanding of science in engaging ways. This disconnect reflects a broader pedagogical issue where teacher education programmes place more emphasis on theoretical constructs rather than practical skills.

Moreover, the challenges identified in this study resonate with the findings of Alsahou and Alsammari (2019), who explored the beliefs about scientific creativity among pre-service teachers. They posited that many pre-service teachers perceive creativity as an asset in teaching and necessary for fostering student engagement in science. The lack of focus on creative pedagogical strategies during their training exacerbates the challenges faced in real-world teaching scenarios, which graduates of teacher training programmes often cite.

2.5.2 Dimensions of Scientific Creativity

In Yaseen's (2015) investigation into creative thinking in teacher education colleges, the concept of scientific creativity was further elaborated. Yaseen argued that fostering creativity in science education prepares teachers to implement innovative instructional strategies. By equipping pre-service teachers with skills to encourage creative thinking in their students, the educational framework can shift from rote learning towards more engaging, inquiry-based pedagogies. Yaseen's findings suggest a significant need to embed creative thinking frameworks into the curriculum of teacher training programmes.

The notion of creativity aligns with the findings of AlHaddad (2014), who assessed teachers' perceptions regarding the effectiveness of art education preparation programmes in Kuwait. Although his focus was primarily on art education, the implications for creative practices in all educational disciplines, including science, were evident. AlHaddad's work reinforces Yaseen's call for creativity to play a central role in teacher education by highlighting the importance of integrating creative strategies across curricula.

2.5.3 Inquiry-Based Learning and Teacher Preparation

The research conducted by Alhendal, Marshman, and Grootenboer (2016) further elucidates the pedagogical perceptions of Kuwaiti science teachers regarding inquiry-based learning. Their findings suggest that while teachers acknowledge the importance of inquiry as a teaching method, there is a notable divergence between belief and practice. Many pre-service

teachers expressed a desire to implement inquiry learning in their classrooms; however, their ability to do so effectively is hindered by inadequate training. This finding directly supports the need for targeted psychomotor and cognitive training, as identified in Section 2.3.2.

One recurrent theme is the insufficient pedagogical content knowledge (PCK) within the teacher education curriculum, which Khalid AlAjmi, Hendawy Al-Mahdy, and Mohamed Emam (2022) highlighted as a critical element in addressing the needs of science teachers in Kuwait. They argued that adequate teacher preparation must be rooted in a strong PCK framework that enables educators to blend subject matter knowledge with appropriate teaching methodologies. The interplay of science content knowledge and pedagogical strategy is where many pre-service teachers report feeling most ill-equipped, directly tying back to Alshammari et al.'s (2017) identification of gaps in preparation. This emphasises the critical importance of Shulman's PCK concept (Shulman, 1986) within the Kuwaiti context.

2.6 Synthesis of Findings and Conceptual Framework

The studies reviewed collectively point towards a need for comprehensive reform in teacher education programmes that cater specifically to the needs of pre-service science teachers in Kuwait. The recurring themes of inadequate practical experience, a disconnect between theory and practice, and insufficient PCK must be addressed to improve the efficacy of educational outcomes in science instruction. As evidenced by these research findings, addressing these gaps entails a multifaceted approach, integrating creative methodologies, inquiry-based practices, and strengthened pedagogical training within the curriculum. This synthesis forms the conceptual framework for this study, proposing that practical pre-service science teacher training in Kuwait requires:

- **Integration of Social Learning Principles:** Emphasising mentorship, peer observation, and collaborative learning to enhance teacher efficacy and practical skills (Bandura, 1977; Lofthouse, 2018; Tschannen-Moran & Woolfolk Hoy, 2001).
- **Emphasis on Constructivist Pedagogy:** Training teachers to facilitate active, student-centred learning environments, including inquiry-based approaches, to enable students to construct knowledge (Piaget, 1970; Vygotsky, 1978; Driver, 2012).
- **Development of Professional Competence:** Focusing on pedagogical knowledge, strong content knowledge, and robust pedagogical content knowledge (PCK) through structured professional development and reflective practice (Shulman, 1986; Schön, 1983; Mulder, 2017).
- **Systematic Training Needs Analysis:** Utilising task, individual, and organisational analysis to identify specific cognitive, psychomotor, and affective gaps in pre-service teachers' competencies, tailored to the Kuwaiti educational landscape (Kura & Kaur, 2021; Romiszowski, 2016; Salas et al., 2012; Phillips & Phillips, 2005).
- **Addressing Local Challenges:** Directly confronting issues identified in Kuwaiti research, such as limited practical experience, insufficient mentoring, challenges with classroom management, lack of focus on scientific creativity, and insufficient PCK (Alshammari et al., 2017; Alsahou & Alsammari, 2019; Yaseen, 2015; AlHaddad, 2014; Alhendal et al., 2016; AlAjmi et al., 2022).

Furthermore, fostering an environment where pre-service teachers can explore and apply innovative strategies in real classroom settings must become a priority within teacher training institutions. This might include implementing robust mentorship programmes, hands-on workshops, and collaborative teaching experiences that enhance their confidence and competence in delivering effective science education.

Figure 1: The interplay between Social Learning Theory and Constructivism is critical

2.7 Conclusion

This chapter laid the groundwork for understanding the critical components of practical pre-service science teacher training at Kuwait's College of Basic Education. We have established a robust theoretical framework by thoroughly examining Bandura's Social Learning Theory, Piaget and Vygotsky's Constructivist Learning Theory, and contemporary theories of professional competence development. These theories collectively emphasise the importance of social interaction, active knowledge construction, and continuous professional growth in shaping competent educators.

Furthermore, a detailed exploration of training needs—their definitions, types (cognitive, psychomotor, affective), and the systematic identification process (task, individual, and organisational analysis)—highlights the necessity of a data-driven approach to program design. Recognising the gaps between current and desired competencies, understanding the specific knowledge, skills, and attitudes required for effective science teaching, and aligning training initiatives with institutional and national educational goals are paramount.

Integrating these theoretical insights with specific findings from research conducted within the Kuwaiti context provides a comprehensive understanding of the challenges and opportunities. By leveraging social interaction, constructivist practices, competency-focused training, and directly addressing local needs identified in research, the College of Basic Education can develop and implement pre-service programs that truly equip future science teachers with the confidence and pedagogical prowess required to excel in the 21st-century classroom and inspire the next generation of scientific minds. As the subsequent chapter outlines, this theoretical grounding will inform the methodology for investigating current pre-service science teacher training needs in Kuwait.

3. Methodology of Literature Review Chapter

The need for effective science education is increasingly recognised as a significant determinant of a nation's progression towards a knowledge-based economy. In a globalised world, where technology and information evolve rapidly, countries, including Kuwait, must ensure that future educators are adequately prepared to teach science effectively. This chapter details the methodology in a comprehensive literature review concerning the pre-service science teacher training needs at Kuwait's College of Basic Education (CBE). The review encompasses research design, search strategy and information sources, inclusion and exclusion criteria, data extraction and synthesis methods, and quality appraisal, adhering to rigorous standards to ensure high reliability and validity.

3.1 Research Design: Systematic Review

A **systematic review design** is implemented for this literature review, which is a pivotal choice for several reasons. This approach facilitates an extensive and methodical examination of the existing literature on the specified topic, ensuring the review is exhaustive and unbiased (Liberati et al., 2009). According to Higgins and Green (2011), this approach entails a structured framework that systematically identifies, evaluates, and synthesises all relevant studies contributing to the field of inquiry. This methodology reduces subjective interpretation risk and emphasises consistency across studies (Higgins et al., 2019).

The systematic review design was utilised for this literature review to understand better pre-service science teachers' training needs, particularly at the College of Basic Education in Kuwait. This method is crucial for identifying gaps and challenges within the curriculum and pedagogical approaches. By incorporating quantitative and qualitative studies, this review aims to provide a holistic overview of the factors influencing science teaching efficacy in Kuwaiti education institutions. Various dimensions of teacher training, such as pedagogical content knowledge, teaching strategies, professional development, and challenges faced in teaching science, were identified in the analysis of previous research. By synthesising this diverse range of research, this comprehensive literature review offers valuable insights into the specific requirements of pre-service science teacher training in Kuwait, ultimately aiming to inform policymakers and educators about critical areas for development in teacher training programs.

3.2 Search Strategy and Information Sources

The search strategy employed in this literature review involved meticulous planning and execution to ascertain the inclusion of pertinent studies. This encompasses the databases accessed, the keywords used, and the criteria for inclusion and exclusion of studies.

3.2.1 Databases

The selection of academic databases is crucial for the thoroughness of the literature review. The following databases were utilised:

1. **Scopus**: A comprehensive abstract and citation database of peer-reviewed literature.
2. **Web of Science** provides access to numerous journals across various disciplines, which is paramount for understanding global trends in science education.
3. **ERIC (Education Resources Information** Centre**)**: A key database for education-related research, offering access to journal articles, research reports, conference papers, and other relevant materials.
4. **Google Scholar**: An inclusive search engine that allows access to various academic documents, including theses and reports.
5. **Kuwait University Library Databases**: These databases were particularly beneficial in finding locally relevant studies that may not be available through international databases.

3.2.2 Keywords

The effectiveness of the search depends significantly on the choice of keywords. As such, the following primary search terms and their combinations were employed to maximise the breadth of relevant studies:

- "Pre-service teacher training"
- "Science education"
- "Teacher professional development"
- "Training needs assessment"
- "Kuwait"
- "College of Basic Education"
- "Pedagogical content knowledge"
- "Challenges in science teaching"
- "Science pedagogy"

The combinations of these terms were designed to capture a wide range of studies related to the training needs of future science educators, ensuring that the search was not overly restrictive, while still focused on the specific needs within the Kuwaiti context.

3.3 Inclusion and Exclusion Criteria

Determining inclusion and exclusion criteria was essential to ensure that only the most relevant studies were reviewed and that the literature review remained focused and relevant. The criteria designed for this review were:

Inclusion Criteria:

1. Studies focused on **pre-service science teacher training and education** in Kuwait.
2. Research discussing the **challenges and needs** of pre-service science teachers.
3. **Peer-reviewed articles, theses, and reports**.
4. Publications available in **English or Arabic**.
5. Studies published in the **last 20 years** (from 2005 onwards) have ensured the relevance of data.

Exclusion Criteria:

1. Articles that do not focus explicitly on **science education or training**.
2. Publications not relevant to the **Kuwaiti educational context**.

3. **Non-peer-reviewed literature**, including opinion pieces and editorial content.
4. Studies published **before 2005**.

By applying these criteria, the literature review derived a focused set of studies that provide critical insights into the challenges and needs of pre-service science teachers in Kuwait.

3.4 Data Extraction and Synthesis

Data extraction is pivotal to synthesising findings effectively from the selected literature. For this review, a tailored **data extraction form** was created to capture essential information, including bibliographic details, research method, key findings, and implications for pre-service teacher training. This form ensured consistency and accuracy when collating data from multiple sources.

Thematic analysis was employed to identify recurring themes, patterns, and insights relating to the training needs of pre-service science teachers. Braun and Clarke (2006) illustrate that thematic analysis allows researchers to dissect qualitative data and make sense of complex information. The themes extracted from the literature often revolved around pedagogical content knowledge, teachers' beliefs about their effectiveness, creativity in teaching, and the cultural context influencing science education.

Moreover, **conceptual mapping** aided in schematically representing the interconnections between these themes, thereby clarifying the diverse needs and challenges pre-service science teachers face. This mapping highlighted how various factors, such as institutional support, curriculum design, and professional development opportunities, interrelate within Kuwait's broader context of science education.

3.5 Quality Appraisal

While not mandatory, conducting a **quality appraisal** of the included studies enhances the robustness of the literature review. Critical appraisal tools, such as the **Critical Appraisal Skills Programme (CASP)** and the **Mixed Methods Appraisal Tool (MMAT)**, provide frameworks for assessing the quality of both qualitative and quantitative studies. The review ensures that the findings are credible and reliable by evaluating the selected studies' methodological rigour, validity, and potential biases.

These critical appraisal tools have permitted an informed selection of literature, ensuring that the prevailing challenges in pre-service science teacher training are well understood. For instance, Alshammari et al. (2017) highlight teachers' perceptions of challenges in the teaching process, while Alsahou and Alsammari (2019) delve into beliefs about scientific creativity among educators. Combining these critical insights allows for a nuanced understanding of the multifaceted nature of science teacher training needs.

3.6 Preliminary Findings from the Literature Review

Preliminary findings from the literature indicate several recurring themes regarding the training needs of pre-service science teachers in Kuwait. These themes generally fall into categories related to pedagogical content knowledge, practical classroom experience, and understanding of educational technology. These findings will be discussed in detail in Chapter 4.

3.6.1 Pedagogical Content Knowledge

A significant element identified in the literature is the necessity for enhanced **pedagogical content knowledge (PCK)**among pre-service teachers. Shulman (1986) originally described PCK as the amalgamation of content knowledge and pedagogy, focusing on effectively teaching specific subjects. Several studies highlighted the insufficiencies in this area, noting that many pre-service science teachers lack the skills to translate scientific concepts into accessible learning experiences for students (Fitzgerald et al., 2016; Fraser, 2017).

For instance, a study by Fraser (2017) emphasised the challenges science educators face in implementing pedagogical strategies that effectively engage students in scientific inquiry. Educators have expressed a need for training that would empower them to facilitate student-led investigations and connect scientific concepts to students' everyday experiences.

Access to such pedagogical training is crucial for future educators, especially in regions like Kuwait, where enhancing scientific literacy is paramount.

3.6.2 Practical Classroom Experience

Another critical need identified in the literature is providing **practical classroom experience** during the teacher training process. Several authors, including Al-Rubaie (2022), pointed out that extensive theoretical instruction often does not translate into effective classroom management or instructional strategies when pre-service teachers enter the field. This disconnect indicates a need for enhanced opportunities for pre-service teachers to engage in in-service training or internships that allow them to apply theoretical knowledge in real-world settings, thereby increasing their confidence and effectiveness.

Moreover, a study conducted by Alshammari et al. (2017) revealed that many pre-service teachers felt unprepared for classroom challenges upon graduation. Participants noted the absence of continuous support and mentorship from experienced educators during their training. This finding reinforces the importance of structured practical experiences embedded within teacher preparation programs.

3.6.3 Understanding Educational Technology

The increasing role of **educational technology** in modern classrooms cannot be overlooked. Recent literature consistently highlights the pressing need for pre-service science teachers to effectively develop competence in using educational technologies (Hodges et al., 2020). This need is particularly crucial in the wake of the COVID-19 pandemic, which has accelerated technology integration into education. The literature suggests that many pre-service programs do not sufficiently prepare teachers to incorporate technology into their pedagogy, often limiting their effectiveness in engaging digitally native students.

Research, such as that by Al-Enezi (2021), has shown that training should not merely focus on the technical use of devices. Instead, emphasis should be placed on methodologies that integrate technology into pedagogical approaches, allowing pre-service teachers to harness technology in fostering student engagement and facilitating meaningful learning experiences.

This methodology outlines the systematic, rigorous approach adopted in the literature review concerning pre-service science teacher training needs at Kuwait's College of Basic Education. By employing a systematic review design, structured search strategies, careful inclusion and exclusion criteria, comprehensive data extraction and thematic analysis, and quality appraisal, the review aimed to provide an insightful overview of the challenges and needs faced by future science educators in Kuwait. As global educational challenges continue to shape the requirements for practical teacher training, this literature review informs policymakers and educators about the specific needs of science teacher training in Kuwaiti contexts.

4. Literature Review, Analysis, and Discussion Chapter

The ever-evolving landscape of education, particularly within the **science discipline**, critically emphasises the practical training of pre-service teachers. Ensuring these educators are adequately prepared necessitates an examination of their training needs, which span cognitive, psychomotor, and affective domains. This chapter conducts a comprehensive literature review and analysis of the current training needs for pre-service science teachers, drawing upon recent studies to highlight specific gaps, connect them to relevant theoretical frameworks, and provide actionable recommendations for improvement.

4.1 Overview of Reviewed Literature

Research into the preparation of pre-service science teachers offers substantial insights into the multifaceted needs crucial for enhancing their efficacy. Studies consistently examine the cognitive requirements, practical skills, and attitudinal aspects essential for effective science teaching. Scholars like AlAjmi et al. (2022) and Lederman & Abell (2014) identify key areas of deficiency, predominantly focusing on scientific content knowledge and pedagogical content knowledge (PCK). Complementing this, other studies such as Alhendal et al. (2016) and Alshammari et al. (2017) delve into psychomotor (skill-based) needs, including inquiry-based learning, laboratory instruction, and classroom management techniques. Furthermore, the literature addresses affective (attitudinal) needs, emphasising the development of positive dispositions towards teaching science (Alsahou & Alsammari, 2019; Yaseen, 2015; AlHaddad, 2014).

4.2 Identified Training Needs of Pre-Service Science Teachers

The literature reveals distinct training needs across cognitive, psychomotor, and affective domains, directly impacting a pre-service teacher's readiness for the classroom.

4.2.1 Cognitive Needs: Content Knowledge, PCK, and Inquiry-Based Learning

Cognitive needs, particularly associated with scientific content knowledge and pedagogical content knowledge (PCK), form the foundation of effective teaching. AlAjmi et al. (2022) assert that many pre-service science teachers demonstrate significant gaps in fundamental content knowledge. This deficiency hampers their ability to convey concepts effectively and undermines their confidence. Lederman & Abell (2014) further emphasise the importance of PCK, stressing that understanding *how* to teach scientific concepts effectively is as crucial as knowing the concepts themselves.

Furthermore, thoroughly comprehending **inquiry-based learning principles** is instrumental for developing effective teaching strategies. Alhendal et al. (2016) highlight that pre-service science teachers often lack a deep understanding of inquiry-based approaches, which promote critical thinking and deeper understanding of scientific processes among students. Integrating a robust knowledge of scientific content and PCK into pre-service programs is non-negotiable, requiring curricula that impart knowledge and cultivate the necessary pedagogical strategies to teach that knowledge effectively.

4.2.2 Psychomotor (Skill-Based) Needs: Practical Application in the Classroom

Psychomotor needs encompass the practical skills necessary for delivering effective science education. A prevailing deficiency identified by Alshammari et al. (2017) concerns **laboratory instruction**, where pre-service teachers often feel underprepared to conduct experiments and supervise student activities safely and effectively. Inadequate experience in laboratory settings can lead to discomfort and ineffectiveness in teaching practical science, which is vital for concept comprehension.

Moreover, classroom management techniques form another critical psychomotor need. Many pre-service teachers report difficulties maintaining classroom order and ensuring student engagement during activities (Alshammari et al., 2017). This underscores the necessity of equipping future teachers with strategies for effective classroom management, a core component of teaching proficiency.

Technology integration in the science classroom has also emerged as a significant area of concern. Al-Enezi (2021) and Chien et al. (2012) argue that as technology becomes increasingly prevalent, pre-service science teachers must develop the ability to incorporate digital tools effectively into their lessons. This includes utilising simulations, virtual labs, and interactive software to enhance student learning, aligning with the need for practical skills in executing inquiry-based activities (Alhendal et al., 2016). Addressing these psychomotor needs is essential for fostering competent educators who inspire and engage their students.

4.2.3 Affective (Attitudinal) Needs: Cultivating Passion and Empathy

While cognitive and psychomotor skills are critical, affective needs—those relating to attitudes and dispositions—must not be overlooked. Developing positive attitudes towards teaching science is vital for fostering enthusiasm, empathy, and commitment among educators. As highlighted by Alsahou & Alsammari (2019), pre-service teachers who exhibit genuine passion for science are likelier to impart that enthusiasm to their students, significantly enhancing student engagement and interest.

Research by Yaseen (2015) and AlHaddad (2014) further confirms the importance of cultivating positive attitudes. Pre-service teachers can better understand their future roles by fostering empathy and commitment during teacher training. This critical emotional intelligence impacts how they manage classroom dynamics and build rapport with students. Successful teacher training programs must integrate strategies that nurture these positive attitudes, potentially through mentorship, reflective practices, and collaborative work, emphasising empathy and support.

A well-rounded training program that incorporates these cognitive, psychomotor, and affective elements can produce science educators who are knowledgeable, skilled, passionate, and committed to their students' success.

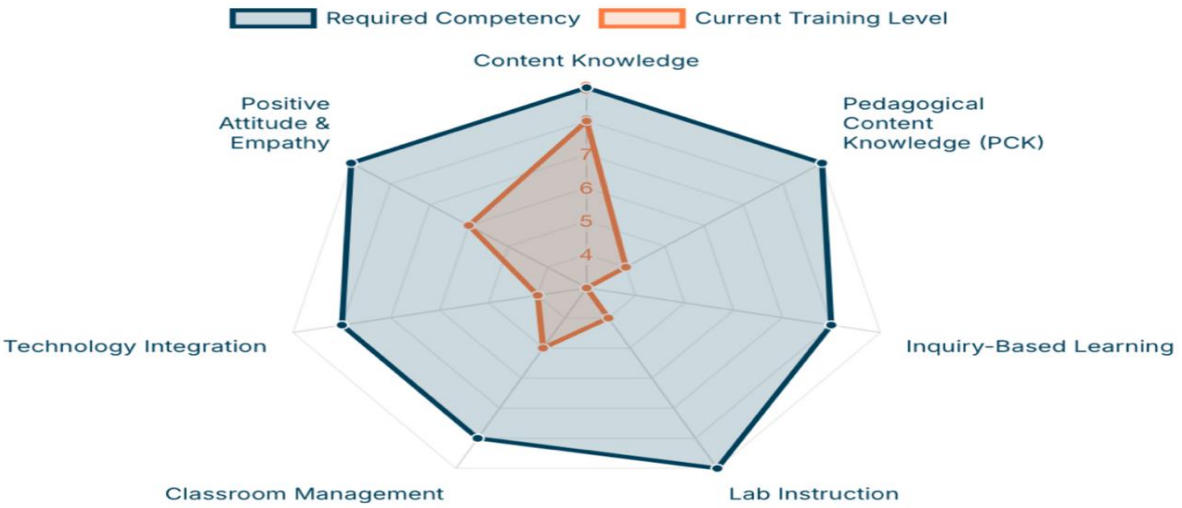

Figure 2: Identified Training Needs of Pre-Service Science Teachers at the College of Basic Education in Kuwait (Comparison of Required Competency vs. Current Training Level)

4.3 Factors Influencing Training Needs in Teacher Education Programs

Several interconnected factors significantly influence the training needs of educators within teacher education programs, particularly in contexts like Kuwait. These influences arise from curriculum design, institutional policies, learner characteristics, and external demands, all of which shape the efficacy and relevance of teacher training efforts.

4.3.1 Curricular Gaps and Program Design: Bridging Theory and Practice

As Alshammari et al. (2017) highlighted, a significant concern within teacher education is the disconnect between theoretical constructs and practical application. Many programs overemphasise content knowledge at the expense of pedagogical training. Teacher candidates are often exposed to theoretical frameworks that, while essential, do not translate effectively into practical classroom strategies. For instance, a prospective teacher may excel in educational psychology but struggle to translate theories into engaging lessons. This gap leaves teachers unprepared for the complexities of real-world teaching environments.

The crucial balance between content knowledge and pedagogical skills ensures that effective educators understand their subject matter and possess the skills to access that knowledge. Alshammari et al. (2017) underscore this issue, demonstrating how programs that neglect practical competencies compromise the quality of education pre-service teachers can provide.

4.3.2 Institutional and Policy Factors: Responding to National Priorities

The context of teacher training is profoundly shaped by institutional goals and policies, particularly within institutions like the College of Basic Education in Kuwait. Al-Rubaie (2022) posits that allocated resources and strategic objectives crucially frame the nature of professional development. Limited resources can lead to inadequate training, resulting in ill-prepared educators.

Furthermore, as Phillips and Phillips (2005) outlined, the overarching Kuwaiti educational policy prioritises specific academic goals, influencing program design. While vital for aligning practices with modern economic demands, the recent notable emphasis on STEM education may inadvertently lead to a neglect of the arts and humanities, potentially creating an

unbalanced educational framework. This shift pressures training programs to produce STEM-proficient educators, potentially sidelining holistic educational strategies.

4.3.3 Learner-Specific Characteristics: Tailoring Professional Development

Pre-service teachers' individual experiences and knowledge bases are crucial in informing their training needs. As Knowles et al. (2012) in adult learning theory posit, educators bring unique perspectives and competencies that can either facilitate or hinder their learning. For instance, a candidate from a robust educational background may require less foundational training than someone with inconsistent prior experiences.

Self-assessment is essential, enabling pre-service teachers to identify their knowledge gaps. Customised training approaches considering individual learner characteristics can significantly enhance the learning experience, fostering a more personalised and effective training environment. This also underscores the importance of flexible curricula that adapt to varying competence levels among students.

4.3.4 External Influences: Adapting to a Dynamic Educational Landscape

As we navigate the 21st century, the demands on educators have evolved dramatically due to technological advancements and changing global educational trends. The World Bank (2018) highlights the necessity for educators to be adept at integrating technology into teaching practices. Digital tools transform education, enhancing engagement and facilitating personalised learning experiences.

However, the rapid pace of technological change can outstrip the capabilities of pre-service teachers and training programs. This creates an urgent need for ongoing professional development that introduces new technologies and encourages critical thinking about their practical use for learning. Teacher training must address not only *how* to use technology but also *how to evaluate its impact* on student learning.

Moreover, global educational trends advocating for collaborative and inclusive teaching strategies are reshaping expectations for teacher competencies. Educators are increasingly expected to employ differentiated instruction, culturally responsive teaching, and student-centred learning. This requires teacher education programs to be agile and forward-thinking, incorporating training in these areas while remaining responsive to local contexts.

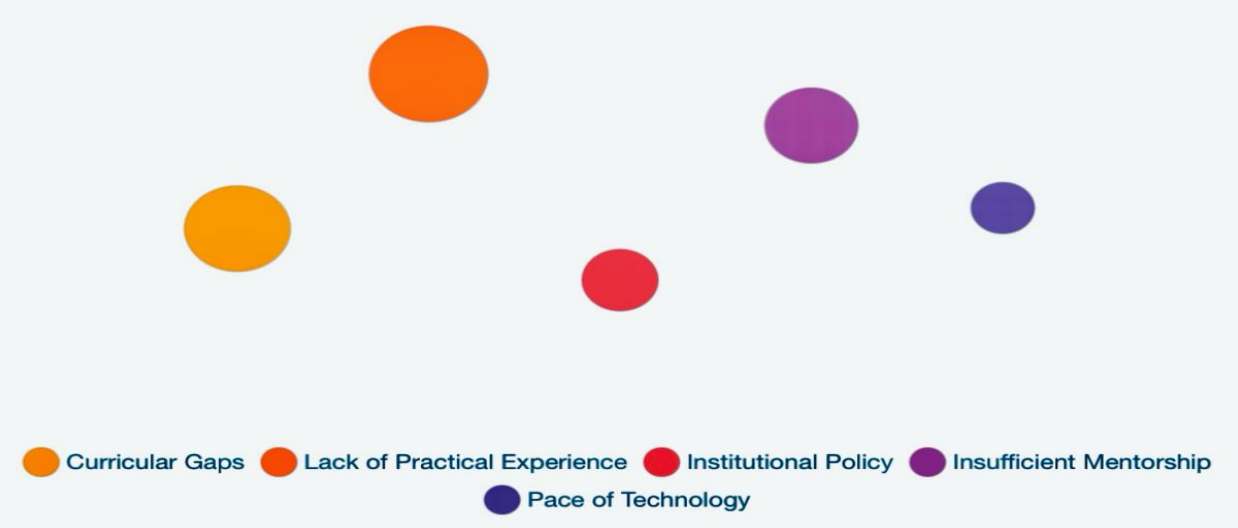

Figure 3 visually represents the key internal and external factors influencing teacher preparedness, with the size of each bubble indicating its relative impact.

4.4 Discussion: Connecting Findings to Theoretical Frameworks

This section connects the identified training needs and influencing factors to prominent educational theories, providing a deeper understanding of the underlying dynamics and suggesting theoretically informed solutions.

4.4.1 Social Learning Theory: Cultivating Skills Through Observation and Mentorship

Albert Bandura's Social Learning Theory posits that people learn within a social context primarily through observation, imitation, and modelling (Bandura, 1977). This theory emphasises the importance of role models, as individuals mimic the behaviours of others, particularly in educational settings. In the context of teacher education in Kuwait, Alhendal et al. (2016) highlight that many teachers struggle with effectively teaching scientific concepts due to a lack of opportunities to observe proficient teaching practices. The absence of experienced educators as role models can hinder the development of pedagogical skills.

The challenges Alshammari et al. (2017) described, such as insufficient mentorship and limited opportunities for peer collaboration among pre-service teachers in Kuwait, resonate strongly with Social Learning Theory. Without the chance to observe and learn from more experienced teachers, they may feel unequipped to engage their students effectively, potentially perpetuating ineffective teaching practices (AlHaddad, 2014).

Structured mentorship programs offer a significant remedy. By pairing inexperienced teachers with seasoned educators, mentorship provides reciprocal observational learning opportunities. Bandura (1977) argues that conducive learning environments foster observation and imitation; thus, structured mentorship in the Kuwaiti educational context could facilitate learning through effective models, allowing pre-service teachers to acquire practical skills, understand classroom dynamics, and enhance their teaching efficacy.

4.4.2 Constructivist Learning Theory: Fostering Active Learning and Inquiry Constructivist Learning

Theory, strongly connected to the ideas of Jean Piaget and Lev Vygotsky, posits that knowledge is actively constructed through experiences and interactions. This approach underpins inquiry-based and student-centred learning, encouraging exploration and critical thinking (Yaseen, 2015).

Examining pre-service teacher training in Kuwait, a gap between the theoretical understanding of constructivist principles and their practical application becomes evident. AlHaddad (2014) notes that while educators recognise the value of student-centred approaches, they often struggle to implement them due to rigid curricula and a lack of training in facilitating such environments. Furthermore, Alsahou and Alsammari (2019) found varying teacher beliefs about creativity and inquiry-based learning, indicating a need for better alignment between theory and practice.

Piaget's ideas about cognitive development emphasise hands-on learning experiences. If educators are not equipped to design and implement inquiry-based instruction, students may remain passive recipients of knowledge. Vygotsky's emphasis on **social interaction** as fundamental to learning further solidifies the need for structured mentorship; pre-service teachers need experiences that allow them to explore and interact in social contexts, simulating real-classroom dynamics. Enhancing training for pre-service teachers to incorporate constructivist methodologies is paramount, focusing on inquiry-based learning (AlAjmi et al., 2022) to bridge the gap between theoretical knowledge and practical application.

4.5 Professional Competence Development:

Insights from Shulman and Schön: Professional competence among teachers is vital for enhancing educational outcomes. Gaps in Pedagogical Content Knowledge (PCK), pedagogical skills, and reflective practice significantly influence teachers' professional development, aligning with Lee Shulman's knowledge domains and Donald Schön's concept of reflective practice.

4.5.1 Gaps in Professional Competence

- **Pedagogical Content Knowledge (PCK):** Gaps in PCK represent a significant challenge. Alsahou and Alsammari (2019) highlight that teachers struggling with PCK find it challenging to create engaging lesson plans, which can impact classroom dynamics and undermine student learning (Alshammari et al., 2017). This can lead to teaching practices that are either too simplistic or overly complex.
- **Pedagogical Skills:** These are essential for the operational aspects of teaching and require various instructional strategies. Yaseen (2015) indicates that limited pedagogical skills often result in ineffective classroom management and diminished student engagement. Practical pedagogical competencies also encompass the ability to use assessment methods that inform instruction, which is often overlooked in teacher training programs.
- **Reflective Practice:** As Schön (1983) defines, reflective practice is essential for professional growth. Teachers who reflect on their practice identify areas for improvement and adapt strategies. However, many educators do not engage in this vital practice. AlHaddad (2014) notes that teachers who do not engage in reflective practice may become stagnant, using ineffective methods year after year, undermining their growth and failing to meet evolving student needs.

4.5.2 Theoretical Frameworks: Shulman's Knowledge Domains and Schön's Reflection

Shulman (1987) identified PCK as a critical component, positing that effective teaching requires content knowledge and an understanding of *how* to teach it. Gaps in PCK indicate a misalignment with Shulman's framework, hindering effective subject matter conveyance. Furthermore, Shulman's conceptualisation extends to general pedagogical knowledge, including teaching theories, classroom management, and assessment. Alhendal et al. (2016) note that many teachers struggle with these aspects, exacerbating pedagogical skill gaps.

Schön's (1983) theory underscores the significance of **reflection-in-action and reflection-on-action** in professional practice. Practitioners must critically analyse experiences to improve decision-making. The absence of reflection means educators fail to identify shortcomings or acknowledge learning needs. AlAjmi et al. (2022) point out that many teachers in Kuwait may not routinely engage in reflective practices due to a lack of training or support, impacting growth trajectories.

4.5.3 Implications and the Need for Targeted Professional Development

These gaps in PCK, pedagogical skills, and reflective practice create a cyclical pattern inhibiting effective teaching. Inability to integrate pedagogical knowledge with content leads to less informed practices and poor student outcomes. Lack of pedagogical skills results in ineffective engagement and assessment. This can lead to discouragement, making teachers less likely to engage in essential reflective practices.

Moreover, without reflective practice, teachers miss opportunities for continual learning and evolution (Schön, 1983). Alhaddad (2014) reinforces this, arguing that professional development workshops must incorporate reflection as a core component. To address these gaps effectively, **targeted professional development initiatives** must be implemented. These should encompass comprehensive training on integrating PCK and pedagogical skills, fostering environments conducive to reflective practice, and providing ongoing support to equip teachers with adaptive pedagogical methods. This approach, merging Shulman's framework with Schön's reflective practices, can cultivate a culture of continuous improvement.

4.6 Training Needs Analysis (TNA): A Framework for Program Design

Training Needs Analysis (TNA) is a critical tool for educators and administrators to understand and bridge the gap between current competencies and those required for optimal performance. It is a systematic approach to determining necessary training to align training with organisational goals and individual aspirations (Alshammari, Eyadat, & Ebrahim, 2017).

As delineated by Bloom's taxonomy, TNA encompasses the **cognitive, psychomotor, and affective domains** of learning (Alhaddad, 2014). Each domain must be considered, as they collectively contribute to educators' competence and the overall educational framework.

4.6.1 Discrepancy and Required Competencies in TNA

At the heart of TNA is the concept of **discrepancy** – the gap between current and required performance levels. This discrepancy illuminates various **competencies needed** for educators to excel. For example, analysis of cognitive needs may reveal a lack of understanding of specific pedagogical theories or technologies (Khalid AlAjmi et al., 2022). Psychomotor needs may expose insufficient training in implementing practical classroom strategies (Yaseen, 2015). Addressing affective needs can uncover issues related to teacher motivation and engagement (Alsahou & Alsammari, 2019). Identifying discrepancies across these domains allows for targeted interventions to upskill teachers, enhancing their efficacy and leading to increased teacher efficacy and positive student outcomes (Alhaddad, 2014).

4.6.2 The Need for Rigorous Task, Individual, and Organisational Analyses

Challenges in TNA, particularly those documented by Alsahou and Alsammari (2019), highlight the need for an in-depth analysis of educational practice structures. These challenges often stem from a lack of alignment between training programs and classroom realities, necessitating reconsidering how TNA is conducted.

- **Task analysis** is vital, helping educators understand the specific competencies required for varied teaching environments.
- **Individual analysis** delves into personal attributes, experiences, and motivation, directly influencing training effectiveness. Khalid AlAjmi et al. (2022) noted that educators' mindsets significantly impact their willingness to engage in professional development.
- Organisational **analysis** (Alhendal, Marshman, & Grootenboer, 2016) examines the broader institutional framework, including school culture, leadership support, and available resources, which shape the context of TNA.

Mapping cognitive, psychomotor, and affective needs onto the concepts of discrepancy and required competencies provides a clear picture. Cognitive needs relate to intellectual capabilities (Yaseen, 2015), often revealing a lack of familiarity with current educational theories. Psychomotor needs highlight the practical skills for effective teaching methods (Alshammari et al., 2017), requiring hands-on training. Affective needs focus on emotional and motivational aspects (Alsahou & Alsammari, 2019), often overlooked yet crucial for preventing turnover and fostering classroom enthusiasm.

Addressing these challenges requires comprehensive task, individual, and organisational analyses. These enable identification of specific competence areas for development, foster tailored programs that resonate with teachers, and provide insight into how institutional factors impact training success. Alhaddad (2014) argues that educators require ongoing support and resources to implement new skills. Embedding a continuous feedback loop within the TNA process allows institutions to evolve training programs in response to emerging challenges and instructional needs.

4.7 Conclusion

The training needs of pre-service science teachers are diverse and multifaceted, encompassing cognitive, psychomotor, and affective domains. A robust understanding of **scientific content and PCK** is imperative for cognitive needs, while closing gaps in **practical skills** like laboratory instruction, classroom management, and technology integration is essential. Finally, fostering **positive attitudes** towards teaching science empowers pre-service teachers to inspire the next generation.

This chapter underscores the importance of well-rounded and strategically designed teacher education programs by critically analysing these needs through **Social Learning Theory, Constructivist Learning Theory, Shulman's domains of knowledge, Schön's reflective practice, and Training Needs Analysis**. Such programs must bridge theory and practice, adapt to institutional policies and external influences, consider learner-specific characteristics, and implement continuous improvement cycles. By evaluating and revising teacher training curricula according to these comprehensive findings, educational institutions can ensure they meet the evolving needs of teachers and learners in an increasingly complex educational landscape.

5. Key Findings and Recommendations Chapter

This chapter will summarise the most significant findings from the comprehensive literature review presented in the preceding chapters. These findings will then be translated into concrete, actionable recommendations to improve pre-service science teacher training at Kuwait's College of Basic Education (CBE). The recommendations are grounded in the theoretical frameworks and empirical evidence discussed, providing a strategic path forward for enhancing the preparedness of future science educators.

5.1 Synthesis of Key Findings

The comprehensive literature review consistently identified several prominent and interconnected training needs and influencing factors impacting pre-service science teacher preparation at Kuwait's College of Basic Education. What has become clear is a systemic need for more integrated, practical, and contextually relevant training.

Firstly, a critical and persistent gap exists in **pedagogical content knowledge (PCK)** among pre-service science teachers, as highlighted by AlAjmi et al. (2022) and Lederman & Abell (2014). This deficiency significantly impacts their ability to translate complex scientific concepts into accessible and engaging learning experiences for students, thus hindering effective science instruction. Without robust PCK, teachers may possess strong content knowledge but struggle with how to teach it effectively to diverse learners.

Secondly, the review underscored the persistent challenges related to **practical teaching experience**, classroom management, and effective mentoring. Studies such as Alshammari et al. (2017) revealed that pre-service teachers often feel unprepared for classroom realities, particularly in managing student behaviour and conducting laboratory instruction safely and effectively. The limited duration and quality of practical experiences, coupled with insufficient structured mentorship, leave a significant void between theoretical learning and practical application, a gap also evident in the lack of reciprocal observational learning as theorised by Bandura (1977).

Thirdly, there is an emphasised need for greater integration of **inquiry-based learning** and **scientific creativity** into training programs. Alhendal et al. (2016) noted that while teachers recognise the importance of inquiry-based approaches, their ability to implement them effectively is constrained by inadequate training. Similarly, Alsahou & Alsammari (2019) and Yaseen (2015) identified a need to incorporate strategies for fostering scientific creativity, moving away from rote learning towards more innovative and engaging pedagogies. The constructivist learning theories of Piaget and Vygotsky (Piaget, 1970; Vygotsky, 1978) strongly advocate for active, student-centred learning, which requires teachers to be proficient in facilitating such environments.

Finally, **institutional and policy factors** significantly contribute to these identified training needs. As articulated by Al-Rubaie (2022) and Phillips & Phillips (2005), limited resources, misaligned institutional goals, and overarching national educational priorities (such as the emphasis on STEM) can inadvertently create curricular gaps and influence the program design. The disconnect between theoretical frameworks and practical application in curricula, along with the rapid pace of technological advancements and evolving global educational trends, further exacerbates these needs, demanding a more agile and responsive teacher preparation system.

5.2 Recommendations for Improving Training Programmes

Based on the synthesis of these key findings and guided by the theoretical frameworks discussed (Social Learning Theory, Constructivist Learning Theory, Professional Competence Development, and Training Needs Analysis), the following specific, practical, and evidence-based recommendations are proposed for improving pre-service science teacher training at the College of Basic Education.

5.2.1 Curriculum Reform and Pedagogical Integration:

- **Develop Robust PCK Modules:** It is highly recommended that explicit, dedicated modules focusing on **Pedagogical Content Knowledge (PCK)** be developed and implemented. These modules should go beyond general pedagogy to specifically address *how* to teach particular science concepts, integrating content mastery with effective

pedagogical strategies. This direct alignment with Shulman's (1986) framework would ensure pre-service teachers can effectively translate their scientific knowledge into accessible and engaging lessons.

- **Enhance Inquiry-Based Learning Training:** Propose dedicated workshops and courses that focus on designing and facilitating inquiry-based science lessons. Training should emphasise practical strategies for promoting student questioning, experimentation, and critical thinking, addressing the gaps identified by Alhendal et al. (2016). This aligns with constructivist principles, enabling teachers to foster active knowledge construction.
- **Embed Creativity in Pedagogy:** Suggest incorporating specific strategies for fostering scientific creativity directly into teaching methods courses. This includes training pre-service teachers on encouraging innovative thinking, problem-solving, and imaginative engagement with scientific concepts, referencing the insights from Yaseen (2015) and Alsahou & Alsammari (2019).

5.2.2 Strengthening Practical Experience and Mentorship:

- **Expand Supervised Teaching Practicums:** Recommend significantly increasing the duration, diversity, and quality of practical teaching experiences in varied school settings (e.g., different grade levels, student demographics). This would directly address the limited practical experience and feelings of unpreparedness reported by Alshammari et al. (2017), providing more opportunities for real-world application of theory.
- **Implement Structured Mentorship Programs:** Propose formal mentorship initiatives that link pre-service teachers with experienced science educators. These programs should facilitate regular observations, feedback sessions, and collaborative planning, embodying the principles of social learning theory (Bandura, 1977; Lofthouse, 2018). As Lave and Wenger (1991) described, such initiatives would create a legitimate peripheral participation context.
- **Integrate Reflective Practice:** I suggest making mandatory reflective journals, peer observations, and structured feedback sessions a core component of practicums and methods courses. This would encourage pre-service teachers to critically analyse their teaching practices and experiences, promoting continuous professional growth per Schön's (1983) reflective practitioner model and enhancing feedback effectiveness (Hattie & Timperley, 2007).

5.2.3 Leveraging Technology and Resources:

- **Integrate Educational Technology Training:** Recommend specific, hands-on training on effectively using educational technology for science instruction, including virtual lab simulations, data analysis tools, and interactive platforms. This addresses the critical need for digital literacy and pedagogical integration highlighted by Al-Enezi (2021) and Chien et al. (2012), ensuring teachers can leverage modern tools to enhance learning.
- **Develop Resources for Diverse Learners:** Suggest training pre-service teachers on adapting instruction for varying student needs, learning styles, and developmental stages (referencing Piaget's developmental stages). This includes developing and utilising resources that support differentiated instruction and inclusive classroom practices in science.

5.2.4 Policy and Institutional Support:

- **Conduct Regular Training Needs Assessments (TNAs):** We recommend systematic and ongoing TNAS incorporating task, individual, and organisational analysis (Roberson, 2018; Kura & Kaur, 2021). Regular TNAs would ensure that training programs remain relevant, responsive to emerging challenges, and aligned with the competencies required for effective science teaching (Salas et al., 2012).
- **Align with National Educational Priorities:** Ensure that CBE programs align explicitly with Kuwait's STEM education goals and broader national development plans. This alignment, as suggested by Phillips & Phillips (2005) and the National Research Council (2012), would secure institutional support and resources and ensure the relevance of graduates to national educational demands.
- **Foster Collaboration:** I recommend stronger, formal partnerships between the College of Basic Education and local schools. This collaboration should facilitate joint curriculum development, shared professional development opportunities, and extended practical placements, creating a more cohesive and supportive training environment that bridges the theory-practice divide.

If systematically implemented, these recommendations can significantly enhance the quality and relevance of pre-service science teacher training at the College of Basic Education in Kuwait, ultimately leading to more confident, competent, and effective science educators for the nation.

6. Conclusion Chapter

This final chapter provides a concise summary of the entire research paper, reiterates the significance of the findings, discusses the limitations of the literature review, and proposes directions for future research.

6.1 Summary of the Review

This comprehensive literature review, "Pre-Service Science Teacher Training Needs at the College of Basic Education in Kuwait: A Comprehensive Literature Review," systematically examined the critical components necessary to prepare future science educators in Kuwait effectively.

The review established the **critical importance of robust pre-service teacher training for quality education**, particularly within the science discipline. It highlighted that well-prepared teachers are the cornerstone of student success and the development of a scientifically literate populace, essential for navigating the complexities of the 21st century.

The paper then delved into the **theoretical foundations underpinning** adequate **teacher preparation**, drawing primarily from Bandura's Social Learning Theory, Piaget and Vygotsky's Constructivist Learning Theory, and contemporary theories of Professional Competence Development. Social Learning Theory underscores the significance of mentorship and observational learning for enhancing teacher efficacy and practical skills. Constructivism emphasised the need for pre-service teachers to facilitate active, student-centred, and inquiry-based learning environments. Theories of Professional Competence highlighted the crucial role of pedagogical knowledge, strong content knowledge, and particularly Pedagogical Content Knowledge (PCK), and the importance of reflective practice for continuous growth.

A core conceptual understanding of **training needs and their systematic identification** was established. Training needs were defined as the gap between existing and required competencies, categorised into cognitive, psychomotor (skill-based), and affective (attitudinal) needs. The systematic process of identifying these needs through task, individual, and organisational analyses was presented as crucial for designing targeted and effective training programs.

Through a rigorous systematic literature review focused on the Kuwaiti context, the paper identified **specific and pressing training needs for pre-service science teachers at the College of Basic Education**. These included:

- Significant **gaps in Pedagogical Content Knowledge (PCK)** limit their ability to convey scientific concepts effectively.
- **Insufficient practical skills and classroom experience**, leading to feelings of unpreparedness in laboratory instruction, classroom management, and general teaching efficacy.
- A clear need for enhanced training in **inquiry-based learning approaches** to foster critical thinking and active student engagement.
- A deficiency in strategies for fostering **scientific creativity** among students.
- Challenges in **technology integration** into science instruction.
- **Gaps in structured mentorship and support** during their training.

Finally, the review culminated in an **overarching call for comprehensive reform** in pre-service science teacher training programs at the College of Basic Education. This reform must be grounded in these identified needs, integrate robust theoretical frameworks, enhance practical experiences, and be responsive to the evolving demands of the 21st-century educational environment.

6.2 Directions for Future Research

Based on this literature review's findings and limitations, several promising directions for future research emerge.

Firstly, there is a pressing need for **empirical, mixed-methods studies** specifically designed to assess the current training needs of pre-service science teachers at the College of Basic Education in Kuwait. Such studies could employ surveys, interviews, observations of teaching practices, and content analyses of curriculum documents to gain a more granular understanding of actual competencies and perceived needs.

Secondly, **longitudinal studies** tracking CBE graduates' professional development and classroom effectiveness would be invaluable. This would provide direct evidence of how pre-service training translates into in-service performance and identify areas where initial training could be strengthened.

Thirdly, research focusing on the **effectiveness of specific intervention strategies** to address the identified needs is crucial. For instance, studies could evaluate the impact of redesigned PCK modules, enhanced mentorship programs, or dedicated workshops on inquiry-based learning and technology integration on pre-service teachers' skills and confidence. This could involve quasi-experimental designs comparing outcomes in intervention and control groups.

Furthermore, comparative studies examining **best practices in science teacher education from other culturally similar or high-performing educational systems** could offer valuable insights and models for potential adaptation in Kuwait. Research exploring the perceptions of in-service science teachers and school administrators regarding the preparedness of newly qualified teachers from the CBE would also provide crucial feedback for program improvement.

Finally, given the increasing emphasis on digital literacy, future research could explore the **optimal integration of emerging educational technologies**, such as artificial intelligence and virtual reality, into pre-service science teacher training curricula and assess their impact on pedagogical effectiveness and student engagement.

By pursuing these research avenues, the educational community in Kuwait can continue to build a robust evidence base, ensuring that pre-service science teacher training programs are continuously refined to meet the evolving demands of quality education in the 21st century.

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