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Evaluating Science Readiness of Pre-Service Elementary Teachers Through Diagnostic Assessment and Parental Feedback: Implications for Teacher Education

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ABSTRACT

Purpose of the study: This study aimed to measure the science education readiness of BEEd pre-service teachers through diagnostic assessments, gather parental feedback on curriculum implementation and available resources, and identify priority areas for improvement that will enhance licensure preparation, instructional quality, and stakeholder engagement in teacher education.

Methodology: The study employed a census of BEEd pre-service teachers and their parents from Bataan Peninsula State University-Bagac Campus during Academic Year 2024–2025. Data were collected through a diagnostic test aligned with the Licensure Examination for Teachers (LET) science component, structured parental questionnaires, and a 4-point Likert-scale survey. Descriptive statistics were used to analyze the diagnostic test and survey responses, while thematic analysis was applied to the qualitative parental feedback.

Main Findings: The diagnostic test results showed a low mean science score of 2.68 out of 10 among BEEd pre-service teachers. Parents reported satisfaction with curriculum relevance and teaching quality but expressed concerns about the adequacy of science resources, the consistency of academic updates, and the level of school–parent communication. Thematic analysis confirmed the need for improved instructional materials, strengthened stakeholder engagement, enhanced academic support systems, and the integration of culturally responsive and technology-based approaches in science education.

Novelty/Originality of this Study: This study is distinct in combining diagnostic test results with parental feedback to evaluate the readiness of BEEd pre-service teachers in science education. While earlier works have mainly focused on student performance, this research highlights the importance of parental perspectives, curriculum evaluation, and innovative approaches.

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1. INTRODUCTION

Science education plays a vital role in preparing future elementary teachers by equipping them with competencies needed to deliver quality instruction and meet the demands of licensure examinations [1]. Within the Bachelor of Elementary Education (BEEd) program, readiness in science is particularly significant since mastery of content and pedagogy directly affects licensure success [2]. Despite curriculum reforms and innovations, several studies have identified persistent gaps in pre-service teacher preparation, including lesson planning, pedagogical strategies, classroom management, and content knowledge [3]–[6]. These challenges

emphasize the importance of early interventions such as diagnostic assessments to evaluate readiness before field practice and licensure testing [5].

Diagnostic assessments have long been regarded as reliable tools for measuring preparedness and predicting licensure outcomes [3], [5], [6]. Admission tests and pre-board examinations also serve as strong predictors of academic readiness and professional exam performance [3], [4]. However, reliance on diagnostic data alone may not fully capture the complexity of teacher preparation. Stakeholder perspectives, particularly from parents, provide valuable complementary insights for accountability and curriculum review [7]–[9]. Parental involvement has been consistently associated with program quality, academic performance, and institutional responsiveness, yet their role in evaluating pre-service teacher readiness remains underexplored [7].

Teacher preparation is further shaped by institutional accreditation, access to resources, curriculum innovations, and teacher agency [10]–[16]. Adequate learning facilities and instructional materials contribute to stronger pedagogical outcomes [16], while culturally responsive and discipline-based approaches foster meaningful engagement [14], [15]. Furthermore, science teaching effectiveness is influenced by the alignment of curriculum, teacher specialization, and professional development [17]. These conditions highlight that readiness is not limited to student test scores but extends to institutional practices, stakeholder collaboration, and teaching environments.

Recent developments also point to the influence of digital technologies and artificial intelligence (AI) in education [18]–[30]. Studies have demonstrated the potential of AI to support diagnostic testing, assessment design, and personalized feedback in both science and teacher education [23], [24]. While these innovations offer opportunities, scholars caution against uncritical adoption, emphasizing ethical and pedagogical considerations [25], [28], [30]. As such, teacher preparation must adapt to emerging technologies while ensuring their integration enhances diagnostic accuracy and instructional support.

Globally, teacher licensure systems have been linked to professionalism, motivation, and retention, reinforcing the need for strong preparation before practice [31]–[36]. In the Philippine context, curriculum reforms and program evaluations continue to address challenges in teacher readiness and licensure performance [37], [38], [42], [43], [47]. Research also highlights the influence of out-of-field teaching, administrative supervision, and institutional management on teacher performance and student learning outcomes [44]–[46], [50]. Likewise, innovations in curriculum and teacher education programs emphasize the role of continuing professional development in sustaining teacher quality [48], [51].

Despite the breadth of research on licensure, diagnostics, curriculum, and institutional support, few studies have simultaneously examined diagnostic test performance and parental perspectives in assessing pre-service teacher readiness in science education. This research gap provides the basis for the present study. This research aimed (1) to assess the diagnostic readiness of BEEd pre-service teachers in science education, (2) to determine parents' perspectives on the curriculum, resources, and institutional support, and (3) to integrate these findings to identify areas for improvement in licensure preparation.

2. RESEARCH METHOD

This study forms part of a series of research initiatives aimed at identifying the evolving demands of current and future industry-related educational practices. Following formal review and approval, which included evaluation of the diagnostic tool and data collection procedures, the study was implemented. A diagnostic tool designed to assess components of the Licensure Examination for Teachers (LET) was adopted and purposively utilized among all BEEd pre-service teachers at Bataan Peninsula State University Bagac Campus for the Academic Year 2024–2025. Likewise, their parents were included as participants. The study employed a census approach, involving the entire population to eliminate sampling error and enhance validity.

The study proceeded through several phases of data collection. The first phase involved administering the diagnostic tool to measure components of general education and professional education, particularly focusing on science. Based on the results, the performance in the science component was determined. The second phase consisted of disseminating a structured questionnaire (interview protocol) to parents, who responded using a 4-point Likert scale and provided qualitative feedback regarding the BEEd program. These processes facilitated the identification of strengths and challenges within the curriculum, particularly in science education, and provided an overall perspective from the parents' responses.

The parental questionnaire and 4-point Likert-scale survey were developed specifically for this study to align with the competencies required for the Licensure Examination for Teachers (LET) and the local context of the Bachelor of Elementary Education program. Content validity was ensured through careful review by two faculty experts in science education and teacher preparation, who evaluated the clarity, relevance, and alignment of the items. Minor refinements were made based on their feedback to optimize comprehension and appropriateness for the participants.

Given that this is the only Bachelor of Elementary Education program within the community, all available participants (N = 31) were included in the study. To promote reliability, the instruments were carefully

designed, reviewed by content experts, and administered under standardized conditions with clear instructions, helping to minimize measurement errors and maintain consistency of responses. While formal statistical reliability testing, such as Cronbach's alpha, was not conducted due to the small population size, the combination of expert validation, careful instrument design, and standardized administration collectively ensured that the data collected were reliable and meaningful for addressing the research objectives. This approach allows for meaningful insights while transparently acknowledging the methodological constraints inherent to studies with limited populations.

Data from the diagnostic test and parental questionnaire were analyzed using descriptive statistics (mean, median, standard deviation) and thematic analysis for qualitative feedback. Given the exploratory nature of the study and the small sample size (N = 31). The chosen methods provided a comprehensive understanding of pre-service teachers' science readiness and parental perceptions, which aligns with the objectives of this study.

3. RESULTS AND DISCUSSION

This section presents the findings from both the quantitative and qualitative phases of the study. Descriptive statistical data provide a summary of key trends in the diagnostic results and Likert-scale responses, offering a numerical overview of pre-service teachers' science readiness and parental perceptions of the BEEd program. Complementing this, the qualitative analysis explores the emerging themes derived from the significant open-ended statements of the respondents. These themes were identified through a thematic analysis of parental feedback, highlighting critical insights on curriculum relevance, instructional delivery, resource availability, and stakeholder engagement. By combining statistical trends with narrative depth, the study aims to offer a comprehensive understanding of the factors influencing science education in teacher preparation, with implications for curriculum refinement and institutional development.

Diagnostic Test Results

Table 1 summarizes the descriptive statistics of the students' science scores (N = 31). The mean score of 2.68 out of 10 (SD = 1.89) indicates generally low performance in science. The platykurtic distribution (kurtosis = -1.11) suggests that scores are clustered at the lower end without extreme outliers, highlighting consistent gaps in content mastery. No participant achieved full mastery, reflecting challenges in the theory-to-practice continuum of science instruction [2], [3]. These findings emphasize the need for targeted interventions to improve pre-service teachers' readiness for the LET science component. In this context, emerging technologies such as AI-based tools and ChatGPT can provide personalized learning support, offer instant explanations, generate practice questions, and simulate problem-solving scenarios, potentially enhancing content understanding and fostering self-directed learning among pre-service teachers [18]–[30].

Table 1. Descriptive Statistics of Students' Science Scores (N = 31)

Descriptives	Science Score
N	31
Missing	0
Mean	2.68
Median	3
Standard deviation	1.89
Variance	3.56
Minimum	0
Maximum	6
Kurtosis	-1.11
Std. error kurtosis	0.821

Parental Feedback

Table 2 presents parental responses on key aspects of the BEEd program. The majority of aspects, including overall program quality, teaching quality, and curriculum relevance, received high satisfaction ratings (modal rating = 4). This indicates strong parental confidence in the program's ability to prepare pre-service teachers for elementary education [7]-[9].

However, areas such as learning resources, communication with parents, and frequency of academic updates received lower ratings, suggesting that support mechanisms require improvement. These quantitative findings align with prior studies emphasizing that adequate instructional materials and effective school-family engagement are critical to teacher readiness and program quality [11], [16], [39].

Table 2. Summary of Parental Feedback on Key Aspects of the BEEd Program (N = 31)

Aspect Evaluated	Predominant Rating	Interpretation
Overall quality of the BEEd program	4	Very satisfied
Program prepares child for a teaching career	4	Confident
Curriculum alignment with elementary education needs	4	Well-aligned
Teaching quality of the faculty	4	Positive
Support from instructors and academic advisors	4	Satisfactory
Learning resources available	3	Somewhat adequate
Field Study & Student Teaching programs provide practical experience	4	Effective
Communication between faculty, administration, and parents	3	Needs improvement
Frequency of academic updates from the school	Regularly/Occasionally	Inconsistent

The structured responses gathered from parents provide a generally positive view of the BEEd program. Most focus areas received a modal rating of 4, suggesting that parents are satisfied with the overall quality of the program, confident in its ability to prepare their children for a teaching career, and perceive alignment between the curriculum and the requirements of elementary education. The effectiveness of the Field Study and Student Teaching components was also affirmed, indicating strong support for practical experience integration within the curriculum.

However, some areas warrant attention. Learning resources were rated somewhat adequate, and communication between the school and parents, as well as the frequency of academic updates, emerged as less consistent. These insights suggest that while the academic core is strong, the supporting mechanisms, such as resource provision and school-parent engagement, need targeted improvements to strengthen the program's holistic impact on pre-service teacher development.

Learning resources should be regularly evaluated by facilitators to ensure their continued effectiveness and relevance. Although their study focused on in-service teachers, the broader implication is that quality learning resources are important in supporting effective instruction in science and technology education. This principle is also applicable in tertiary education, where careful selection and ongoing evaluation of instructional materials can contribute positively to pre-service teachers' preparedness [52].

Similarly, the role of resourceful teachers who strategically utilize various educational tools and adapt them to meet students' learning needs. Their findings suggest that such resourcefulness may influence academic performance and motivation. These insights emphasize the potential benefits of providing teacher educators with access to appropriate resources and opportunities for professional growth that foster adaptability and creativity [53], [54].

In addition, the findings of this study indicated that communication and school-parent engagement emerged as areas requiring improvement. Parental involvement holds important implications for the practice of teacher education. In the context of the current study, parents, as key stakeholders, provided responses that offer valuable insights into the perceived strengths and areas for development in the BEEd program. These perspectives can serve as a basis for enhancing collaboration between teacher education institutions and families, particularly in curriculum design and feedback mechanisms to overcome challenges in science education and theory-to-practice gaps.

Moreover, science education could benefit from integrating culturally-based learning (CBL) and ethnoscientific approaches in classroom activities. Embedding local wisdom and cultural relevance into science instruction not only contextualizes learning but also fosters deeper engagement and understanding among learners. This approach is particularly relevant in teacher education programs that aim to prepare future educators for diverse and multicultural classroom environments.

Table 3. Thematic Summary of Open-Ended Comments on the BEEd Program

Feedback Category	Summary of Responses
Curricular Relevance	Parents consistently perceived the curriculum as reflective of current trends and relevant to the needs of contemporary elementary education.
Clarity of Learning Outcomes	Most parents reported that the program's learning outcomes were clearly defined, attainable, and aligned with teacher preparation goals.
Adequacy of Campus Facilities	Feedback on campus facilities was mixed; while some parents viewed them as adequate, others identified the need for infrastructural improvements.
Identified Areas for Improvement	Recurrent concerns were noted regarding the availability of learning resources, quality of instruction, field study experiences, communication practices, and student support mechanisms.
Recommendations and Additional Support	Parents suggested enhancements including updated instructional materials, improved access to science-related resources and educational technology, and the establishment of mentoring or tutoring programs.

Thematic analysis of open-ended feedback revealed that parents consider the curriculum to be relevant and responsive to current educational needs. This alignment supports the program's goal of equipping pre-service teachers with knowledge and pedagogical strategies suited for the 21st-century classroom. The clarity of intended learning outcomes was also highlighted, demonstrating coherence in curriculum planning and outcome-based education. Nonetheless, recurring concerns included the adequacy of facilities, quality of instruction, and the scope of field experience, echoing the quantitative results. Additionally, parents emphasized the need for enhanced science education resources and technological tools, along with mentoring or tutoring support. These suggestions align with a broader vision of teacher education that extends beyond coursework to include robust infrastructure and student support systems.

The diagnostic exam results in science, which revealed a mean score of 2.68 out of 10 and a platykurtic distribution, indicate that pre-service teachers performed consistently but at a generally low level. When considered alongside the parental feedback, particularly comments calling for stronger science resources and updated instructional materials, there appears to be a convergence between parental perception and student readiness. This reinforces the importance of addressing not only content delivery in science education but also systemic factors such as material support, school-parent engagement, instructional quality, and academic scaffolding. Taken together, these findings highlight the need for teacher education institutions to systematically evaluate and enhance their science education programs, with particular attention to the provision of adequate instructional resources, meaningful stakeholder engagement, and robust academic support mechanisms.

Recent advances in artificial intelligence also highlight potential opportunities for supporting teacher education and assessment. Studies have shown that AI tools can assist in generating learning materials, providing feedback, and evaluating performance across various educational contexts [18]–[30]. For instance, ChatGPT has been evaluated on medical licensing exams and teacher assessment scenarios, revealing both potential benefits and limitations in educational applications [18]–[30]. Integrating AI-assisted tools could supplement traditional instruction, provide personalized support, and enhance pre-service teachers' preparedness in science education.

The findings emphasize the need for teacher education institutions to systematically evaluate and enhance their science education programs, with particular attention to the provision of adequate instructional resources, meaningful stakeholder engagement, robust academic support mechanisms, and the judicious integration of AI-enabled educational technologies.

4. CONCLUSION

The findings of this study reveal critical challenges in science readiness among BEEd pre-service teachers, as evidenced by consistently low diagnostic scores (mean = 2.68/10) and corroborated by parental feedback. While parents expressed general satisfaction with the curriculum's relevance, teaching quality, and alignment with elementary education goals, they highlighted persistent concerns regarding learning resources, communication practices, and student support mechanisms. These converging perspectives suggest that teacher education programs must adopt an integrated, stakeholder-informed approach to enhance science education readiness. Strengthening science content coverage, integrating culturally responsive and technology-enhanced teaching, and aligning learning outcomes with licensure expectations are essential. Adequate instructional materials, access to virtual laboratories, and modern educational tools can improve content mastery and

engagement. Mentoring, professional growth opportunities, and continuous pedagogical training can enhance instructional quality and pre-service teacher readiness. Consistent communication, feedback mechanisms, and collaboration with families can support student learning and ensure that institutional efforts align with community expectations. By addressing these interconnected factors, teacher education institutions can prepare pre-service teachers not only to succeed in licensure examinations but also to excel in diverse classroom environments, fostering competent, reflective, and culturally responsive educators. This study contributes to the literature by integrating diagnostic assessments with parental perspectives, offering a comprehensive framework for evaluating pre-service teacher readiness. Practically, the findings provide guidance for policy development, curriculum refinement, and stakeholder engagement strategies aimed at strengthening elementary teacher preparation programs.

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