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Attaining Scientific Knowledge and Skills and Its Implications for Pre-Service Teachers' Approaches to Teaching Science

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Abstract

Purpose: This study examined the dominant modes through which pre-service teachers acquire scientific knowledge and skills, and how these influence their preferred strategies for teaching science. The focus was on Science majors from Northern Iloilo State University – Ajuy Campus during the academic year 2023–2024.

Method: A descriptive-correlational design was used involving 47 pre-service teachers specializing in Science. Participants were profiled by age, sex, and economic background. Data collection was carried out using a validated survey instrument measuring modes of knowledge and skill acquisition, as well as preferred teaching strategies. Descriptive statistics and Pearson's correlation coefficient were employed for data analysis.

Results: The findings identified questioning, studying scientific terminologies, and engaging in inquiry and research as the top three modes for acquiring scientific knowledge. For scientific skills, communication, experimentation, and drawing conclusions ranked highest. The most frequently endorsed instructional strategies included actual demonstration, peer tutoring, and integrative techniques. A statistically significant relationship ($p < .01$) was found between the respondents' modes of knowledge and skill acquisition and their preferred teaching strategies.

Conclusion: The study underscores the importance of engaging, inquiry-based approaches in both learning and teaching science. Question-driven learning, concept engagement, and practical investigation not only enhance cognitive understanding but also shape pedagogical preferences among future science educators.

Implications: Science teacher education programs should prioritize cooperative and experiential learning environments. Policy initiatives should ensure the availability of functional laboratories and regular implementation of hands-on scientific activities to strengthen pre-service teachers' instructional competencies and scientific literacy.

Keywords: Scientific Knowledge, Scientific Skills, Pre-Service Teachers, Science Education, Teaching Strategies, Inquiry-Based Learning, Teacher Preparation, Experiential Learning

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1. Introduction

Science transcends its role as a mere school subject; it fosters a mindset grounded in inquiry, discovery, and a deeper understanding of the natural world. Science education plays a pivotal role in shaping critical thinking, problem-solving abilities, and technological adaptability among learners. It equips students with scientific literacy that goes beyond content memorization, fostering informed decision-making and a sense of curiosity about the world (Batuyong & Antonio, 2018). Contemporary science education is undergoing a transformative shift through the integration of technology and innovative pedagogies. In the Philippine context, educators are increasingly adopting interactive simulations, real-world investigations, and digital platforms that promote student engagement and inquiry-based learning (Saro et al., 2023). These methods aim to cultivate active learners who question, examine, and apply scientific knowledge in practical contexts. Experimental learning activities have been shown to significantly improve students' scientific thinking skills and enhance their ability to conduct investigations and understand scientific processes (Baysal, 2022; Deveci & Kavak, 2020).

Despite such advances, Philippine students continue to underperform in international assessments. The Programme for International Student Assessment (PISA) 2022 results revealed that the Philippines ranked among the lowest of the 81 participating countries—76th in mathematics, 79th in reading, and 80th in science. Only 23% of students reached the baseline level of proficiency in science, compared to the OECD average of 76% (Organisation for Economic Co-operation and Development, 2023). These outcomes underscore the urgent need for systemic reforms in science education, particularly those that address disparities linked to socioeconomic status (World Bank, 2020). Given this context, it is essential to explore how students acquire scientific knowledge and skills and how future teachers intend to apply such understanding in classroom settings. Learning and teaching styles are central to the learning process; students have diverse ways of understanding concepts, while teachers employ various pedagogical strategies to facilitate effective instruction. This study focuses on identifying the dominant modes of acquiring scientific knowledge and skills among third- and fourth-year pre-service teachers majoring in Science at Northern Iloilo State University – Ajuy Campus. It also seeks to examine the teaching strategies they intend to use in science education, with the goal of informing teacher education programs and improving science instruction in basic education.

Aim of the Study

This study aimed to examine the dominant modes of acquiring scientific knowledge and skills among pre-service teachers majoring in Science, as well as their preferred teaching strategies in delivering science instruction. It further sought to explore whether a significant relationship exists between these modes of knowledge and skill acquisition and their chosen teaching approaches.

Specifically, the study sought to answer the following research questions:

a. What are the top three modes of acquiring scientific knowledge and skills among pre-service teachers, both as an entire group and when classified according to age, sex, and economic status?

b. What are the top three preferred teaching strategies among pre-service teachers, both as an entire group and when classified according to age, sex, and economic status?

c. Is there a significant relationship between the modes of acquiring scientific knowledge and skills and the preferred teaching strategies among pre-service teachers majoring in Science?

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Research Framework

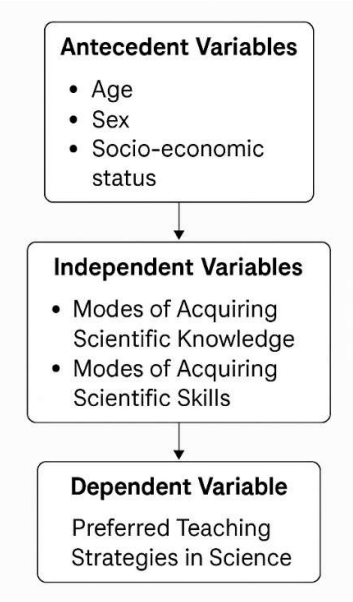

Figure 1. Schematic diagram showing of the antecedent, independent and dependent variables.

Figure 1 illustrates the conceptual framework of the study, showing the relationship between the antecedent variables (age, sex, and socio-economic status), the independent variables (modes of acquiring scientific knowledge and skills), and the dependent variable (preferred teaching strategies in science). The framework suggests that background characteristics influence how pre-service teachers acquire knowledge and skills, which in turn shape their instructional approaches in teaching science.

2. Literature Review

Educational research has consistently shown that inquiry-based laboratory activities significantly enhance the scientific knowledge and skills of pre-service teachers. In a study by Valls-Bautista, Solé-Llussà, and Casanoves (2021), pre-service teachers who engaged in inquiry-based laboratory work demonstrated improved science process skills and a deeper conceptual understanding. These findings support the use of inquiry as a pedagogical tool in science teacher education. Similarly, Asmoro, Suciati, and Prayitno (2021) found that guided inquiry instruction led to significant development in students' scientific thinking, particularly in hypothesis formulation, critical observation, and reasoning. Their quasi-experimental study affirmed the value of teacher-guided scientific exploration in strengthening thinking skills.

Complementing these insights, Panuluh (2022) observed that students enrolled in guided inquiry practicums improved in core science process skills such as observation, classification, and drawing conclusions. Moreover, Kyriazis, Stylos, and Kotsis (2025) demonstrated that the use of inquiry-based instruction on heat concepts not only improved scientific understanding among pre-service teachers but also increased their teaching self-efficacy. This indicates that engaging with inquiry content supports both pedagogical competence and confidence in science instruction.

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Inquiry-based learning is further strengthened through the integration of technology. A meta-analysis of recent studies (2018–2023) highlighted that STEM-based guided inquiry models have a high impact on students' creative thinking and process skills development. These models, characterized by real-world applications and collaborative experimentation, equip learners with competencies relevant to 21st-century science education (Sari et al., 2023). Furthermore, inquiry-based methods that incorporate simulations and digital activities have been shown to enhance scientific process skills, such as interpreting data, analyzing results, and engaging in reflective reasoning (Baysal, 2022).

Language also plays a crucial role in inquiry-based science education. Askelson (2012) emphasized that the explicit teaching of scientific vocabulary, coupled with the use of visual supports, helps students better articulate scientific ideas. In support of this, Adler and Fiedler (2022) demonstrated that collaborative literacy practices—such as interactive reading and writing tasks—enhance students' ability to engage in scientific discourse and critical inquiry. These approaches ensure that students not only understand scientific content but are also able to communicate and justify their reasoning effectively.

Another essential component of inquiry-based education is the use of questioning techniques. According to Blosser (2018), effective science educators use questions to guide student thinking and foster higher-order reasoning. This aligns with findings from Darmaji et al. (2020), who concluded that science process skills are integral to helping students address complex scientific problems and environmental challenges. Dakabesi and Louise (2019) further argued that students need sustained practice and support to develop proficiency in skills such as observing, predicting, measuring, and experimenting—all of which form the foundation of scientific inquiry.

The context in which inquiry is implemented also matters. Ngozi (2021) found that context-based learning approaches, particularly in chemistry instruction, resulted in stronger acquisition of experimental and analytical skills. Students in these settings learned to control variables, interpret data, and apply scientific concepts in real-life contexts. Similarly, Beichumila et al. (2022) noted that when students engaged in inquiry learning were supported by digital tools—such as computer simulations and animations—they developed stronger skills in observation, prediction, communication, and drawing conclusions.

Finally, Ekici (2020) highlighted the positive influence of mobile scientific inquiry on pre-service teachers' development of science process skills. His mixed-methods research showed that mobile technology, when combined with inquiry-based tasks, significantly enhanced pre-service teachers' ability to conduct investigations and apply scientific methods in diverse settings.

3. Methodology

Research Design

This study employed a descriptive-correlational research design, which is appropriate for identifying patterns and examining relationships between variables without manipulating the research environment. As defined by Creswell (2023), descriptive research aims to systematically describe characteristics of a given population or phenomenon, while correlational research examines the statistical relationship between two or more variables. To implement this design, the researchers utilized a descriptive survey method through a researcher-made instrument designed to collect data on the modes of acquiring scientific knowledge and skills and the preferred teaching strategies of pre-service teachers majoring in Science.

Research Respondents

The participants of this study were 47 pre-service teachers enrolled in the Bachelor of Secondary Education major in Science at

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Northern Iloilo State University – Ajuy Campus. These included 23 third-year students and 24 fourth-year students. The respondents were further classified based on demographic variables such as age, sex, and socio-economic status. In terms of age, 55.3% were 22 years old and below, while 44.7% were 23 years old and above. Regarding sex, 23.4% of the respondents were male and 76.6% were female. Concerning socio-economic status, 91.5% of the respondents were identified as belonging to the low-income group, while 8.5% belonged to the high-income group.

Research Instrument

To gather the necessary data, the researchers developed a structured questionnaire tailored to the objectives of the study. The instrument consisted of thirty (30) items distributed across two main sections. Part I focused on the personal profiles of the respondents, while Part II contained a checklist of statements aimed at assessing their modes of acquiring scientific knowledge and skills, as well as their preferred teaching strategies. The questionnaire was validated by a panel of experts in the field of science education to ensure content validity. For reliability testing, the instrument was pilot-tested on 30 Bachelor of Elementary Education students at the same institution. The computed Cronbach's alpha values were 0.895, 0.911, and 0.786 for various sections of the questionnaire, indicating high reliability and internal consistency.

Data Gathering Procedure

Prior to data collection, the researchers sought approval from the Chairperson of the Secondary Education Department and the Campus Administrator of Northern Iloilo State University – Ajuy Campus. Upon receiving the necessary clearance, the validated researcher-made questionnaire was disseminated online using Google Forms. The online format was chosen for accessibility and ease of data collection. Participation in the study was voluntary, and respondents were informed about the nature and purpose of the study. In compliance with Republic Act No. 10173, also known as the Data Privacy Act of 2012, all data collected were treated with strict confidentiality and were used solely for academic purposes.

Data Analysis Procedure

The data collected were analyzed using both descriptive and inferential statistical techniques. Frequencies and percentages were used to determine the top three modes of acquiring scientific knowledge and skills, as well as the most preferred teaching strategies among the pre-service teachers. To explore differences based on demographic factors, t-tests were conducted. Moreover, Pearson product-moment correlation coefficients were computed to assess the relationship between the respondents' modes of acquiring scientific knowledge and skills and their preferred teaching strategies. A licensed statistician assisted in the analysis to ensure the accuracy and validity of the results.

4. Results and Discussion

This part provides the results of the statistical data aligned to the problems viewed. The corresponding analysis and interpretation of data are included in this portion of the study. Table 2 shows the top three modes of acquiring scientific knowledge among pre-service teachers.

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Table 1: Modes of Acquiring Scientific Knowledge by Category

Category	Mode of Acquiring Scientific Knowledge	n	Mean	Standard Deviation	Rank
Entire Group	Questioning	47	4.77	0.476	1
	Studying Scientific Terminologies	47	4.36	0.605	2.5
	Inquiry and Research	47	4.36	0.605	2.5
Age: 22 years old and below	Questioning	26	4.88	0.431	1
	Studying Scientific Terminologies	26	4.54	0.508	2
	Inquiry and Research	26	4.38	0.571	3
Age: 23 years old and above	Questioning	21	4.62	0.498	1
	Inquiry and Research	21	4.33	0.658	2
	Experiment	21	4.29	0.717	3
Sex: Male	Questioning	11	4.55	0.688	1
	Experiment	11	4.45	0.688	2
	Analysing Theoretical Foundation	11	4.27	0.647	3
Sex: Female	Questioning	36	4.77	0.378	1
	Studying Scientific Terminologies	36	4.36	0.554	2.5
	Inquiry and Research	36	4.36	0.598	2.5
Socio-economic Status: High	Questioning	4	5.00	0.000	1
	Investigating Hypothesis	4	4.80	0.500	2.5
	Inquiry and Research	4	4.80	0.500	2.5
Socio-economic Status: Low	Questioning	43	4.74	0.492	1
	Studying Scientific Terminologies	43	4.37	0.578	2
	Inquiry and Research	43	4.33	0.606	3

Table 1 presents a comparative analysis of the modes through which pre-service science teachers acquire scientific knowledge. The data are disaggregated by total group, age, sex, and socio-economic status, with each mode evaluated based on the number of respondents (n), mean score, standard deviation, and rank. Across the entire group of 47 respondents, "Questioning" emerged as the most preferred and frequently used method of acquiring scientific knowledge, receiving the highest mean score of 4.77 and ranking first. Both "Studying Scientific Terminologies" and "Inquiry and Research" followed with an equal mean score of 4.36, indicating a moderate preference among the respondents, and were jointly ranked second.

When age groups were considered, respondents aged 22 years old and below (n = 26) demonstrated a strong inclination towards "Questioning" with a mean of 4.88, followed by "Studying Scientific Terminologies" (M = 4.54) and "Inquiry and Research" (M = 4.38). In contrast, those aged 23 years old and above (n = 21) also prioritized "Questioning" (M = 4.62) but showed greater preference for "Inquiry and Research" (M = 4.33) and "Experiment" (M = 4.29), indicating a slight shift toward more practical or research-based learning as learners mature.

Sex-based comparisons revealed similar trends. Male respondents (n = 11) ranked "Questioning" highest (M = 4.55), followed by "Experiment" (M = 4.45), and "Analysing Theoretical Foundation" (M = 4.27), suggesting a leaning toward practical and conceptual approaches. Female respondents (n = 36), on the other hand, mirrored the pattern of the entire group, placing "Questioning" at the top (M = 4.77) and assigning equal preference to both "Studying

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Scientific Terminologies" and "Inquiry and Research" (M = 4.36), reflecting a balanced The influence of socio-economic status was also evident in the results. Respondents from high socio-economic backgrounds (n = 4) showed unanimous agreement in favor of "Questioning" (M = 5.00) and also demonstrated strong preferences for "Investigating Hypothesis" and "Inquiry and Research" (both M = 4.80). Meanwhile, those from low socio-economic backgrounds (n = 43) maintained the highest rating for "Questioning" (M = 4.74), with "Studying Scientific Terminologies" (M = 4.37) and "Inquiry and Research" (M = 4.33) trailing behind. These findings suggest that regardless of socio-economic background, questioning remains the most effective and widely used method, although access to resources may influence the variety and depth of learning strategies employed.

approach to theory and investigation.

In sum, the results from Table 1 indicate a consistent preference among pre-service science teachers for acquiring knowledge through questioning, emphasizing the value of critical inquiry and learner curiosity in science education. However, secondary modes of learning such as studying terminologies, engaging in inquiry and research, or conducting experiments varied slightly depending on demographic characteristics. These differences imply the importance of responsive and differentiated instructional strategies in teacher education programs to accommodate diverse learner needs and enhance scientific literacy.

Table 2. Top Three Modes of Acquiring Scientific Skills Among Pre-Service Teachers by Entire Group, Age, Sex, and Socio-Economic Status

Category	Scientific Skill	n	Mean	Standard Deviation	Rank
Entire Group	Communication	47	4.38	0.610	1.5
	Experiment	47	4.38	0.610	1.5
	Conclusion	47	4.21	0.720	3
Age: 22 years old and below	Experiment	26	4.48	0.643	1
	Communication	26	4.37	0.637	2
	Conclusion	26	4.19	0.749	3
Age: 23 years old and above	Communication	21	4.38	0.590	1
	Experiment	21	4.33	0.577	2
	Conclusion	21	4.24	0.700	3.5
	Hypothesis	21	4.24	0.700	3.5
Sex: Male	Communication	11	4.36	0.809	1.5
	Experiment	11	4.36	0.674	1.5
	Conclusion	11	4.10	0.701	3
Sex: Female	Communication	36	4.39	0.549	1.5
	Experiment	36	4.36	0.674	1.5
	Conclusion	36	4.25	0.732	3
Socio-Economic Status: High	Communication	4	4.25	0.500	3
	Conclusion	4	4.25	0.500	3
	Prediction	4	4.25	0.500	3
Socio-Economic Status: Low	Communication	43	4.40	0.623	1.5

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Category	Scientific Skill	n	Mean	Standard Deviation	Rank
	Experiment	43	4.40	0.623	1.5
	Conclusion	43	4.21	0.742	3

Table 2 presents the top three modes of acquiring scientific skills among pre-service science teachers, categorized by the entire group, age, sex, and socio-economic status. For the entire group (n = 47), both **communication** and **experiment** ranked highest (M = 4.38), while **drawing conclusions** followed (M = 4.21). Among students aged 22 and below, **experiment** was the most preferred method (M = 4.48), whereas those aged 23 and above rated **communication** slightly higher (M = 4.38). Both age groups consistently placed **conclusion** in third place.

In terms of sex, male and female respondents showed almost identical preferences, with **communication** and **experiment** both receiving top ranks, though females slightly favored communication (M = 4.39). Among students from low socio-economic status backgrounds, both **communication** and **experiment** were equally rated as most important (M = 4.40). In contrast, respondents from high socio-economic backgrounds rated **communication**, **conclusion**, and **prediction** equally (M = 4.25). Overall, **communication** and **experiment** consistently emerged as key skills valued across all groups.

Table 3. Preferred Teaching Strategies of Pre-Service Teachers by Entire Group, Age, Sex, and Socio-Economic Status

Category	Teaching Strategy	n	Mean	Standard Deviation	Rank
Entire Group	Actual Demonstration	47	4.47	0.620	1
	Peer Tutoring	47	4.45	0.619	2
	Integrative Technique	47	4.40	0.648	3
Age: 22 years old and below	Differentiated Instruction	26	4.38	0.679	1.5
	Integrative Technique	26	4.38	0.697	1.5
	Peer Tutoring	26	4.36	0.643	3
Age: 23 years old and above	Actual Demonstration	21	4.57	0.598	1
	Peer Tutoring	21	4.48	0.602	2
	Integrative Technique	21	4.43	0.598	3
Sex: Male	Reflective Teaching	11	4.55	0.786	1
	Integrative Technique	11	4.45	0.688	2
	Peer Tutoring	11	4.36	0.674	3
Sex: Female	Peer Tutoring	36	4.47	0.609	1
	Actual Demonstration	36	4.44	0.607	2
	Integrative Technique	36	4.39	0.645	3
Socio-Economic Status: High	Reading	4	4.50	0.577	1
	Integrative Technique	4	4.25	0.500	2.5
	Problem Solving Approach	4	4.25	0.500	2.5
Socio-Economic Status: Low	Actual Demonstration	43	4.49	0.631	1

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Category	Teaching Strategy	n	Mean	Standard Deviation	Rank
	Peer Tutoring	43	4.47	0.631	2
	Integrative Technique	43	4.42	0.663	3

Table 3 presents the preferred teaching strategies of pre-service teachers, both as an entire group and when categorized by age, sex, and socio-economic status. As a whole, the respondents most favored actual demonstration (M = 4.47), followed by peer tutoring (M = 4.45) and integrative technique (M = 4.40). Among those aged 22 and below, both differentiated instruction and integrative technique were equally preferred (M = 4.38), while those aged 23 and above strongly favored actual demonstration (M = 4.57).

Male participants ranked reflective teaching highest (M = 4.55), whereas females chose peer tutoring (M = 4.47) as their top strategy. Respondents from high socio-economic backgrounds preferred reading (M = 4.50), while those from low socio-economic backgrounds echoed the overall group preference, selecting actual demonstration and peer tutoring as their top strategies. These findings suggest that while some preferences vary by subgroup, strategies that emphasize practical engagement and collaboration remain consistently valued.

Table 4. Relationship Between Teaching Strategy of Pre-Service Teachers and Their Mode of Acquiring Scientific Knowledge and Skills

Variables Correlated	n	r	Sig. (P-value)
Scientific Knowledge and Teaching Strategy	47	.706**	.000
Scientific Skills and Teaching Strategy	47	.694**	.000

Note: *Significant at the 0.05 level of significance.

Table 4 presents the results of a correlational analysis examining the relationship between the preferred teaching strategies of pre-service teachers and their modes of acquiring scientific knowledge and skills. The analysis used Pearson's correlation coefficient (r) to determine the strength and significance of these relationships. The first correlation, between scientific knowledge and teaching strategy, shows a strong positive relationship with a correlation coefficient of r = .706 and a p-value of .000, which is statistically significant at the 0.05 level. This means that as pre-service teachers increasingly prefer certain teaching strategies, there is a corresponding increase in how they acquire scientific knowledge. In other words, those who favor practical and collaborative teaching strategies are more likely to also adopt effective methods of gaining scientific knowledge.

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Similarly, the second correlation, between scientific skills and teaching strategy, also shows a strong positive relationship (r = .694, p = .000), again significant at the 0.05 level. This suggests that the teaching strategies preferred by the pre-service teachers are closely associated with how they acquire scientific skills. The strength of the correlation indicates that those who are inclined to use learner-centered strategies such as demonstrations, peer tutoring, or integrative approaches also tend to adopt modes that enhance skill development, such as experimentation, communication, and drawing conclusions.

In summary, the findings in Table 4 highlight that the teaching strategies employed by pre-service teachers are significantly aligned with how they acquire both scientific knowledge and skills. These strong and statistically significant correlations suggest the importance of aligning instructional strategies with learning approaches to foster more effective science education among future teachers.

5. Implications of Results

The findings presented in Table 4 reveal strong and statistically significant correlations between the teaching strategies of pre-service teachers and their modes of acquiring scientific knowledge (r = .706, p = .000) and scientific skills (r = .694, p = .000). These results carry important implications for instructional design and policy in teacher education programs. First, the strong relationships suggest that pre-service teachers are more likely to adopt instructional strategies that align with how they personally acquire knowledge and skills. Therefore, teacher education curricula must intentionally integrate and model learner-centered strategies such as actual demonstrations, peer tutoring, integrative techniques, and inquiry-based learning. These strategies not only support conceptual understanding but also reflect how pre-service teachers learn most effectively, fostering pedagogical coherence.

Furthermore, the findings highlight the importance of developing reflective teaching practices among pre-service teachers. Since there is a tendency for future educators to replicate their own learning preferences in the classroom, reflection must be embedded as a core component of teacher training. Structured opportunities for reflection—through lesson planning, microteaching, and mentoring—can help student-teachers critically assess their instructional choices, consider the diverse learning needs of their future students, and make pedagogical decisions that are both intentional and inclusive. This reflective dimension strengthens the ability of teachers to adapt strategies beyond their personal preferences and in response to varied classroom contexts.

The strong correlation between teaching strategies and skill acquisition also reinforces the value of experiential, inquiry-based approaches in science education. Strategies such as hands-on experimentation, communication, and drawing scientific conclusions are not only preferred by learners but also foundational to scientific literacy. Teacher education institutions should, therefore, prioritize the integration of these methods into their instructional frameworks. By doing so, they ensure that future science teachers are equipped to engage learners in practices that mirror authentic scientific inquiry and problem-solving.

In addition, these findings have practical implications for individualized support in teacher education. Recognizing that student-teachers have varied learning profiles, institutions can use diagnostic assessments early in the program to identify patterns in how students learn and teach. Tailored support—such as workshops, coaching, and peer collaboration—can be provided to those whose teaching preferences may not naturally align effective practices for knowledge and skill development. This kind of targeted intervention ensures that all future educators receive the support needed to become versatile and effective in diverse classroom environments.

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Finally, the results contribute valuable insights for educational policymakers and curriculum developers. The demonstrated link between learning modalities and teaching approaches suggests that training programs should be designed with deliberate attention to pedagogical alignment. Embedding strategies that develop both knowledge and skills within teacher education policies ensures that pre-service teachers are not only knowledgeable in science content but are also capable of delivering instruction that is engaging, inquiry-driven, and outcomes-based. In essence, the study underscores the need for a responsive, reflective, and research-informed approach to science teacher education—one that nurtures the development of scientifically literate and pedagogically competent educators.

6. Conclusion and Recommendations

The results of this study underscore a significant and positive relationship between the teaching strategies preferred by pre-service teachers and their respective modes of acquiring scientific knowledge and skills. The strong correlations suggest that how future educators learn science greatly influences how they plan to teach it. Notably, learner-centered and experiential strategies such as actual demonstrations, peer tutoring, and integrative techniques are not only preferred for teaching but also reflect the dominant modes through which these pre-service teachers acquire scientific content and competencies. These findings emphasize the need for alignment between instructional strategies and learning preferences to enhance the quality of science education and teacher preparation programs.

In light of these findings, several recommendations are proposed. First, teacher education institutions should embed a variety of effective, evidence-based instructional strategies in their curricula, particularly those that promote active learning and scientific inquiry. These strategies should not only be modeled by teacher educators but also practiced by pre-service teachers through microteaching, practicum, and peer-led sessions. Second, reflective teaching practices should be institutionalized as a core component of teacher training. This would encourage pre-service teachers to critically examine the connection between their learning styles and teaching methods, allowing for adaptive and inclusive instructional planning.

Third, differentiated support systems must be established to address the diverse needs and learning profiles of pre-service teachers. Diagnostic assessments can be used to identify individual preferences and tendencies early in their training, enabling faculty to provide targeted mentoring and pedagogical coaching. Fourth, institutions should develop mechanisms to regularly evaluate and update their instructional frameworks to ensure they remain responsive to evolving best practices in science education. Lastly, policy makers and curriculum developers must ensure that the design of teacher education programs promotes the integration of strategies that simultaneously support content mastery, skill development, and pedagogical competence.

In conclusion, bridging the gap between how pre-service teachers learn and how they intend to teach is essential to fostering effective and reflective science educators. Aligning teaching strategies with learning modes contributes not only to professional growth but also to improved classroom instruction and student outcomes in the sciences.

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