Critical Thinking in Science Education: Insights from Pre-Service Teachers

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Received: 14-01-2025 **Revised:** 24-01-2025 **Accepted:** 15-02-2025 **Published:** 01-03-2025

ABSTRACT

This study explores the perspectives of pre-service teachers on incorporating critical thinking in science instruction and lesson planning. It aims to understand how these educators perceive critical thinking skills, how they integrate these skills into their teaching, and how their perspectives vary based on demographic factors. The study emphasizes the need for improved teacher training programs that focus on developing critical thinking skills, particularly in adaptability and problem- solving. Ultimately, this research aims to enhance the preparation of future educators to effectively implement critical thinking in their classrooms, fostering a more dynamic and thoughtful educational experience for students.

***Keywords**: Critical Thinking, Pre-service Teachers, Science Instructions, Lesson Planning*

INTRODUCTION AND BACKGROUND

Critical thinking play very essential role in teaching and learning, highlighting its importance in problem-solving, decision-making, analytical skills development, effective communication, and fostering life long learning. To remain competitive, CT able student to think critically and engage in regular, intensive innovation (Zhang, 2022). In science education critical thinking play very important role, highlighting how it enables students to engage deeply with scientific concepts, evaluate evidence, and solve complex problems (Jamil et al., 2024).

Students learn science to understand various concepts they learn through direct experience and interact with familiar ideas without losing their sense of performance, which is actually "the real world" for children. Children's critical thinking abilities are another goal of science education (Harahap & Rafida, 2020). This encompasses not just knowledge acquisition but also hands on experience, which develops decision making learning, make able to utilize the information (Santos, 2017). This entails encouraging critical thinking, inventiveness, creativity, and problem-solving abilities. For changes in the educational system (Ledward & Hirata, 2011).

Re-centre search on educational reforms and curriculum development (Cox,2014;Boholano,2017) focuses on the implementation and impacts of strategies such as blended and project-based learning. Multifaceted approach promises to elevate the educational landscape and catalyze regional development. Its purpose is to resolve issues and identify workable answers (Darmaji, 2018). The theoretical foundation of this investigation is rooted in multiple educational theories, function in gas a conceptual compass to direct the integration of theoretical perspectives to dissect and comprehend educational phenomena, as discussed by

Varpio et al. in 2020.

Research objectives

1. To examine the way in which pre-service teachers incorporate critical thinking skills in their lesson planning.
2. To investigate the variations in pre-service teachers' perspectives to integrating critical thinking based on demographic factors.

Research Questions

1. How do pre-service teachers incorporate critical thinking in their lesson planning?
2. What variations exist in pre-service teachers' perspectives on critical thinking concerning demographic factors?

2. LITERATURE REVIEW

The literature focus on CT and the perspectives of pre-service teachers about critical thinking to incorporate in science teaching. Critical thinking is a vital component of scientific education in order to develop students' analytical and evaluative abilities. Educational establishments have an important influence that how CT is incorporated into the curriculum and how the teaching and Learning environment is shaped (Dinsmore&Fryer,2023).To meet the demands of today's society but also to contribute positively to their communities.(Zulyusri et al., 2023).

Theoretical Framework

Several studies highlight the role of philosophical educational theories in developing critical thinking skills. The framework used in this study to incorporate critical thinking into instruction was Bloom's Taxonomy. Cognitive talents are divided into six levels by Benjamin Bloom and his colleagues' hierarchical frame work, Bloom's Taxonomy: remembering, comprehending, applying, analyzing, evaluating, and producing (Anderson & Krathwohl, 2001).

Integration in Science Teaching Practices

Bringing together Bloom's Taxonomy and critical thinking methods in science education really shakes things up when it comes to lesson planning and designing curriculum. So, educators, they can create assessments and tasks that help students navigate through all the different levels of the taxonomy. This way, students can develop their critical thinking skills in a well-rounded manner, (Meyer, 2005).

Pre-service teachers perspectives on Critical Thinking

Critical thinking really is a key part of science education. It's what helps students break down, evaluate, and put together information. When we emphasize critical thinking in science classes, it's not merely about cramming facts into students' heads; it's about getting them ready to be engaged, thoughtful individuals who actively participate in their communities,(Chen & Xiao, 2021).

Pre-service teachers struggle with weaving critical thinking into their teaching methods. It often boils down to not having enough training and resources. To address these challenges, teacher education programs should provide comprehensive training that emphasizes the importance of critical thinking and equips pre-service teachers with practical strategies to integrate these skills into their teaching Xu and Wang, (2023).

Critical Thinking in Science Education

When we talk about science education, one thing really stands out: critical thinking. It's not just some buzzword; it's a vital skill that requires not only analytical abilities but also a deep understanding of scientific principles. In science education and practice, critical thinking has two Main purposes: it connects the teaching and learning process to the scientific process and supports democracy and accountability in the use and application of science (Yacoubian, 2015). Critical thinking is becoming a part of university curricula in an effort to encourage engaged learning. Critical thinking skills (CTS) are one of the higher-order thinking competencies needed in the twenty-first century (Saleh, 2019).

Pre-Service Teachers and Critical Thinking

An important factor in the development of pupils' critical thinking skills is pre-service teachers, encourage students to approach learning with a similar mentality by being willing to take into account other points of view, engage in careful analysis, and be open to changing their ideas in response to new information, inquiry-based learning (IBL) promotes practical experimentation (Zulyusrietal.,2023). Numerous other organizations have highlighted the importance of personal growth, creativity, autonomy and the development of thinking skills, particularly the improvement of critical thinking (Maričić, 2015). Remaining strong has made it necessary for nations to adopt policies that keep up with this evolution.

3. METHODOLOGY

Mixed method research design used Researcher to explore pre-service teacher's perspectives on critical thinking for more comprehensive understanding of the research problem. Researchers pull from different sources and techniques to tackle complex issues in their surroundings (Vries,2020). The Concurrent triangulation design was applied, which means simultaneously both qualitative and quantitative data collection and analysis methods, to increase the validity and reliability. "The combination of both types of data tends to provide a better understanding of their search problem than one type of data in isolation" (Mertler, 2017, p. 12).

Sampling and participants

This research involved eighty four (84) pre-service teachers from two separate educational institutions. Stratified sampling method was used, there searcher divide the population into distinct sub groups or strata to collect data randomly, forty pre-service teachers at the Faculty of Education ofLasbelaUniversitycompletedtheirfieldworkbyinstructingcurriculuminvariousCityschools. Forty pre-service teachers from GCEE College in Lasbela participated in my study as well.

Instruments

To investigate pre-service teachers' views on critical thinking, there searcher used both quantitative and qualitative approaches. To gather information, they employed a lesson plan analysis, an interview to ask questions to accomplish certain goals, and a questionnaire to evaluate critical thinking abilities. Since tools were used to measure and test results, they were essential for data collecting. Even if the researchers used a variety of tools, it's possible that they weren't familiar with how to use them effectively to get the intended findings.

4. DATA ANALYSIS

Quantitative Data analysis from questionnaires, a survey distributed to pre-service teachers. Data measured on Likert-scale to analyses various dimensions of perspectives regarding critical thinking.

Table1: Descriptive statistics

Teacher's Perspectives on Critical thinking Influencing in Their Science Instructions and Analysis on Agreement Levels

Questions			Agree		strongly agree	
	mean	std. deviation	N	#	n	%
CT focuses on investigation.	1.4458	0.8002	56	66.2	21	25
CT encourages open-ended questions.	1.7439	1.02813	43	51.2	26	31
CT makes classroom environment attractive for learning.	1.6049	0.80123	42	50	33	39.3
CT generates curiosity between the students	1.679	0.95952	43	51.2	29	31.5
CT gives importance to discussion, debate And discourse.	1.7024	1.03876	48	57.1	23	27.4
CT prepares the students to communicate with real world problem solving.	1.7625	0.94459	37	44	32	
CT allows the students to make connections and see relationships.	2.1585	1.20154	32	38.1	20	23.8
CT allows for quiet reflection.	2.2195	1.24746	34	40.5	13	15.5
CT makes the students predict events.	2.0513	1.22631	36	42.9	18	21.4
CT allows all students to involve in learning.	1.5904	0.78143	44	52.4	33	39.3
CT helps the students to develop standards to make informed judgments	1.6296	0.96753	47	56	25	29.8
CT helps the students' value different ways of working.	1.7738	1.0905	44	52.4	27	32.1
CT gives opportunities to explore ideas, keep options open and imagine what might be.	2.1084	1.16882	28	33.3	35	21.7
CT develops a balance of thinking.	1.8293	1.08645	43	51.2	20	23.8
CT makes the students more creative.	1.5802	0.66829	42	50	31	36
CT makes the students analyze the information.	1.561	0.70444	45	53.6	29	34.5
CT makes the students evaluate the information.	1.7831	1.11583	44	52.4	26	31
CT makes the students look for evidence.	1.8049	1.23167	49	58.3	15	17.9
CT makes student stake Decision in different situations.	1.7901	0.99644	37	44	33	39.3
CT makes the students more checking with new information.	1.7901	1.04542	41	48.8	26	31
CT stimulates collaborative education.	2.075	1.31952	37	44	21	25

The perceptions of pre-service teacher's concerning the impact of critical thinking skills on teaching instructions were assessed using a Likert scale ranging from Agree to Strongly Agree. The results show that respondents had high degree of agreement: With agreement levels as high as 66%on several issues, the percentage of participants who selected "Agree" suggests a solid consensus. Significant numbers (upto39%) confirmed the beneficial impact of critical thinking abilities, even if fewer people strongly agreed. There was positive influence of teacher's perspective on critical thinking in science instructions.

Table2: Inferential statistics

Analysis of Pre-Service Teachers' Teaching Levels Using Independent Samples Test

			Equal variances assumes	Equal variances not assumes
t-test for Equality of Means	F		0.101	
	Sig.		0.752	
	T		-0.801	-0.789
	Df		65	54.957
	Sig.(2-tailed)		0.426	0.434
	Mean Difference		-0.15385	-0.15385
	Std. Error Difference		0.19206	0.19502
	95%Confidence Interval Of the Difference	Lower	-0.53741	-0.54468
		Upper	0.22972	0.23698

Pre-serviceteacherswithvaryingdegreesofteachingexperiencediffersignificantly, according to the study. An independent samples t-test was used to examine the questionnaire data in order to test the hypothesis that there were no significant differences between the groups. This study aims to determine if pre-service teachers' performance is significantly impacted by their degree of teachingexperience.WeareunabletorejectthenullhypothesissincetheP-values (Sig. (2-tailed)) of 0.426 and 0.434 are both higher than the standard significance threshold of 0.05. This implies that the means of the demographic components do not differ in a way that is statistically significant.

QUALITATIVE ANALYSIS

Thematic and content analysis

The analysis of lesson plans alongside the questionnaire results provides a comprehensive view of pre-service teachers' understanding and application of critical thinking skills. Eight lesson plans from elementary and middle schools, examined for pre-service teachers with varying undergraduate academic years, were utilized in the present research on generated themes. While the majority of lesson plans reflected positive perceptions and values highlighted in the questionnaire, some areas revealed inconsistencies in implementation. Clear objectives and the incorporation of critical thinking activities were strong points in both lesson plans and questionnaire responses.

Pre-service Teachers' Responses to the Interview

In order to get more information for the study's goals and to bolster quantitative data, I had the

opportunity to interview pre-service instructors using three questions as part of the questionnaire distribution procedure. Almost all of the scientific pre-service teachers answered all of the questions in a clear, concise manner.

Theme1: Understanding Critical Thinking

The diverse responses from participants highlight that critical thinking encompasses a multifaceted approach to analyzing information and making informed decisions. Participants emphasized the importance of objectivity, logical reasoning, and the evaluation of arguments. Common themes emerged, including the necessity of considering multiple perspectives, assessing the credibility of sources, and distinguishing between facts and opinions. Ultimately, critical thinking is portrayed as a reflective and independent process that enables individuals to navigate complex problems and arrive at reasoned judgments. One student answered that

"It's about making reasoned judgments that are logical and well-thought out."

Theme2: Importance of Critical Thinking for Students

The responses from participants illustrate that developing critical thinking skills is vital for students in numerous ways. Critical thinking empowers students to make informed decisions, enhances their problem-solving abilities, and fosters academic success and lifelong learning. It equips them to critically evaluate information, thereby avoiding misinformation and navigating the complexities of the real world. Participants noted that these skills promote independence, creativity, and effective communication, while also encouraging respect for diverse viewpoints. Furthermore, critical thinking nurtures intellectual curiosity and ethical decision-making, ultimately preparing students to be active, engaged citizens in a democratic society. This comprehensive understanding underscores the essential role of critical thinking in shaping well- rounded individuals. Both personal and professional contexts. A Student reflected

"It promotes intellectual curiosity and love for learning."

Theme3: Application of Critical Thinking in Daily Life and Teaching

Participants shared a variety of practical applications for critical thinking in their daily lives, tutoring and educational environments. Many emphasized its role in evaluating information, such as news articles and student feedback, which aids in making informed decisions about health, finances, and teaching methods. In tutoring, critical thinking fosters an interactive learning environment where students are encouraged to ask questions and engage deeply with the material. Participants also highlighted its importance in lesson planning, problem-solving at work, and writing essays. This collective insight demonstrates that critical thinking is not only essential for academic success but also serves as a valuable tool for personal and professional growth, enhancing decision-making and fostering a reflective approach to challenges. Student responded

"I apply critical thinking to analyze student performance data and adjust my teaching accordingly"

5. DISCUSSION

Let's discuss the results which highlight the overall positive attitudes of pre-service teachers towards critical thinking, while also revealing areas for improvement in their training and understanding, particularly concerning reflection and adaptability. Pre-service teachers' perspectives on integrating critical thinking into science instruction and lesson planning. The study aims to understand how these educators perceive critical thinking skills, their incorporation into teaching practices, and variations based on demographic factors. The research underscores the importance of enhancing teacher education programs to better prepare future educators for the challenges of integrating critical thinking into their

classrooms, ultimately fostering a more engaging and reflective learning environment for students.

Implications for Teacher Education

The findings from this study suggests ever al implications for teacher education:

Teacher training programs should prioritize the development of critical thinking skills through targeted coursework and practical experiences that focus on adaptability, problem-solving, and reflective practices. Ongoing professional development for in-service teachers can reinforce critical thinking skills and provide strategies for implementation in diverse classroom settings. Educational institutions should align their curricula with the identified importance of critical thinking, ensuring that pre-service teachers receive comprehensive training that prepares them for contemporary teaching challenges.

6. CONCLUSION

Perspectives of pre-service teachers regarding the integration of critical thinking in science instruction and lesson planning. The findings reveal a generally positive attitude among pre-service teachers towards critical thinking skills, highlighting their importance in fostering an engaging and effective learning environment. High mean scores and significant statistical results affirm that these educators recognize the value of critical thinking in their teaching practices. The analysis also uncovered variability in perceptions, particularly concerning areas like quiet reflection and making connections, suggesting that not all aspects of critical thinking are equally emphasized or understood. Additionally, while there were no significant differences based on demographic factors such as teaching experience, the identified areas for improvement, particularly in adaptability and problem-solving, indicate ongoing challenges within teacher training programs.

Qualitative insights from interviews further enrich these findings, illustrating that pre- service teachers are not only aware of the necessity of integrating critical thinking into lesson planning but are also actively engaging with these concepts. This alignment between quantitative and qualitative data strengthens the overall conclusions of the research. This study underscores the critical role of preparing future educators to effectively implement critical thinking in their classrooms. It calls for enhanced teacher training programs that focus on developing a comprehensive understanding of critical thinking skills, equipping pre-service teachers to create dynamic, reflective, and inquiry-based learning experiences. By addressing the identified gaps and fostering a deeper engagement with critical thinking, we can better prepare educators to meet the demands of contemporary science education and cultivate the critical thinkers of tomorrow.

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