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Critical Pedagogy Implementation in Science Education as Perceived by Science Educators

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Abstract: Critical pedagogy (CP) is a crucial instructional approach that aims to increase students' knowledge while fostering a greater awareness of justice and social equality. This approach is used in different disciplines to foster meaningful learning. In science education, CP is used by educators to deepen conceptual learnings by allowing learners to think the social implications of the concept being learned. Thus, this study is created to assess science educators' understanding of CP in basic science education, considering their length of service and gender. The used of quantitative research design is employed to accomplish the objectives of the study. In addition, respondents were drawn using simple random sampling technique and curated with the inclusion criteria. Based on this, 109 science educators across the province of Davao del Sur, Philippines were randomly selected as respondents to the study. The use of mean, standard deviation, Mann-Whitney U-Test, and Kruskal-Wallis H Test were used to analyze the data. The findings of the study revealed that science educators have an overall high level of understanding of CP with a very high level in the indicator, program structure. Moreover, data shows a moderate level of understanding in the indicators evaluation and teacher development. The analysis further revealed that gender does not play a significant role in understanding CP. However, when analyzed by length of service, data shows a statistically significant difference in the overall CP along with the indicators of philosophical orientation and teacher-student relationship. The findings of the study imply that science educators should be empowered to integrate CP in the classroom and implement professional development programs to improve CP understanding, especially for newly employed science educators.

Keywords: Critical pedagogy; Educational justice; Pedagogical practices; Science education; Science teacher development

Introduction

Education is constantly changing and developing over time. In today's educational landscape, there is a need for reconstructing the educational setting, which enables learners to intervene in the spaces where social identities are shaped, values are distributed, and people's lives are shaped by power. Critical pedagogy (CP) is a crucial instructional method that aims to increase students' knowledge while fostering greater awareness of justice and social equality (Uddin, 2019). Exploring the principles of CP as an educational philosophy is essential, given the likelihood that education will take on oppressive forms in theory and practice (Palbusa, 2021). In a study by Thiet (2017), theoretical and practical elements of CP can be used in any science classroom. However, according to Dasas (2020), there is still little research on how CP is used in Philippine education, particularly in science education. Therefore, this study aims to evaluate the general understanding of CP and science education implementation among science educators in Davao del Sur and to investigate any relationships between critical factors and variables that might influence how it is implemented in science classrooms.

Today's societal context and issues call for modern educators who are transformative. CP is not only concerned with the change that occurs in students as a

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result of learning but also with the change that occurs in teachers (Koay, 2021). However, according to Peng (2023), educators need to be flexible and adaptive to their teaching roles with the demands of changed settings. In a study conducted in Turkey (Aksakalli, 2018), CP principle-based science education positively enhanced the classroom climate and demonstrated progress in a constructive course. In addition, as mentioned by Keesing-Styles (2003) in the study conducted in New Zealand; to achieve a critically informed approach to education assessment, it is necessary to establish a dialogue between educators and learners on sharing roles and validating all voices effectively. In addition, a study conducted in Canada by Giroux (2010), states that CP aims to change educational methods and institutions where educators and students can critically inquire and explore the links between knowledge and social change. Education is a political act (Herrera, 2018), and Freire asserts that it is the responsibility of teachers to help their students recognize the injustices and inequalities present in their lives.

Long before CP was recognized as one of the significant components linked to progressive education (McLaren, 2015) it has been gaining increased attention and practice in classrooms around the world. In Africa, Pillay (2014) demonstrated that experiential teaching and learning strategies in a higher education lecture room with a CP framework enable critical thinking, reasoning, and inquiry-based learning. In addition, in the context of India, as suggested by Andrade (2007) even though CP has its roots in a different context, it can still be a valuable tool to address the current crisis in Indian education. The crisis is perpetuating inequality and oppression by suppressing critical literacy. In Southern Europe's context, Borg and Mayo (2006) suggested that education should have a critical approach to engage the people with the region's cultural heritage and politics of representation.

In the current education system, science education has evolved to encompass much more than just acquiring factual knowledge (Khan & Sharma, 2023). However, in the Philippines, the teaching of science education is highly customary. CP being applied in science education highlights domestic-related teaching culture, challenging conventional schemes to equip individuals and showcase the desired multi-faceted aspects of the community. As indicated by Faux & Watson (2020), typically, most strategies and methods are composed of knowledge-level instructions and not deeper inquiry-oriented and independent learning. In addition, local advocates of CP in science education underscore the paradigm shift into practical classroom outputs from the mere conceptualization of ideological claims (Breunig, 2010).

Emphasizing science education teaching, Thiet (2017) asserts that CP is suitable and highly encouraged to be administered in science classrooms. Accordingly, Macugay and Bernardo (2013), also mentioned that critically applied teaching that involves enhancing problem-solving aspects, creativity, literacy, and the gist of CP is rarely observed in the Philippines. Furthermore, Filipino students score poorly in science; these include the caliber of teachers, the teaching-learning process, the curriculum of the school, teaching materials, and administrative support (SEI-DOST & UP NISMED, 2011). This emphasizes the significance of investigating deeper, specifically in Philippine science education's method and the applications of CP aspects.

Education should encourage a combined approach towards theory and practice, or what Freire (1970), the father of CP, would prefer the term praxis, which means reflection and action on the world to transform it. As CP aims to create a more just and equitable society, and science education seeks to recognize and address real-world problems, these two bodies of knowledge serve as an integrative foundation and a paradigm shift to creating a more transformative quality of education that produces critical educators and critical learners. According to Santos et al. (2020), this synchronization between CP and science education amplifies students' critical thinking skills and encourages a more inclusive and dynamic learning ambiance. Furthermore, as Chalaune (2021) discussed, educational transformation necessitates a significant pedagogical shift, and in these contexts, CP is a potent instrument for educational reform.

This study is anchored in Paulo Freire's aim to create a just and empowered social citizen through education. Freire's work stresses how education must challenge the status quo, power imbalances, and social structures among educators and learners. According to Ural and Öztürk (2020), there is an inadequateness of interest in acknowledging the pedagogical groundwork of higher education as a deeply civic, administrative, and ethical practice. This perspective examines CP as a bridge to furthering freedom and thus, greatly influencing individuality. As per Darder et al. (2023), comprehending the essence of education in such a manner emphasizes its immense potential to be deeply involved in active citizenship. With this critical lens, CP recognizes that science education and its implementation are vulnerable to power inequalities (Bosio, 2021).

CP is grounded on the impression that education is not just a method of imparting knowledge but a way to give individuals the ability to analyze and question societal norms critically. Based on Jay and Graff (2020), CP encourages learners to participate in their instructional atmosphere proactively, enhancing critical thinking skills. In addition, Aliakbari and Faraji (2011) highlighted that the implementation of CP can enhance the quality of teaching sessions by prioritizing the topics that students need to address, allowing them to engage in conversations about their interests, and ultimately empowering them to bring about societal change. Moreover, Gibson (2020) discussed that science education operates within the domain of empirical investigation and reasoning based on evidence that is supported by Gordon and Nieto (2018), that the teacher envisions and enables students' contributions to society. Therefore, combining these theoretical perspectives implies that CP can be a strong framework in science education. It allows teachers to develop socially conscious students and encourages them to not only understand scientific concepts but also question the social and ethical aspects of science (Thiet, 2017).

This study was conducted to determine the critical pedagogy of science educators, specifically in the context of the province of Davao del Sur, Philippines. The purpose of this study is not just to determine science educators' critical pedagogy but to provide insights into the status of critical pedagogy in the current scope of the study. Thus, this study is guided by the following objectives; (1) determine the profile of respondents in terms of (1.1.) gender, and (1.2.) length of service; (2) determine the respondent's level of understanding of critical pedagogy in science education in terms of; (2.1.) philosophical orientation, (2.2.) program structure, (2.3.) curriculum and materials, (2.3.) curriculum and materials, (2.4.) teacher development, (2.5.) teacher-student relationships, and (2.6.) evaluation; (3) determine if there is a significant difference in the level of understanding towards critical pedagogy in science education when analyzed by respondent's profile.

Method

Research Design

To comprehensively examine, quantify, and measure the level of comprehension of science instructors regarding CP and its application in the science classroom, this study utilized a quantitative research method and a descriptive research design through a survey. Quantitative research involves systematically collecting and analyzing numerical data to identify trends, calculate averages, make predictions, and draw conclusions that can be applied to larger populations (Mrabti & Alaoui, 2024). Furthermore, Manjunatha (2019) discussed that descriptive research as a quantitative research design aims to gather measurable data for statistical analysis of a sample population of the phenomenon under study. Moreover, survey research is a quantitative research method that aims to collect numerical data about a population's attitudes, views, or trends by investigating a representative sample from that population (Rahi, 2017). This research approach facilitates the systematic collection of data to arrive at generalizable findings and explore CP elements in science education.

Research Locale and Respondents

The study was conducted in Davao del Sur, Philippines. This province is located on the main island of Mindanao, which is located in the southern part of the Philippines (Guiamalodin et al., 2024). The respondents of this study were secondary science educators in the province of Davao del Sur who were selected through a simple random sampling technique. Simple random sampling is frequently used in surveys and quantitative research designs involving many respondents (Rahi, 2017). Furthermore, given the specific goals of the research, a simple random sampling strategy was utilized due to its appropriateness and efficiency as it allows the researchers to randomly select participants without any bias (Noor et al., 2022).

The respondents were selected based on these inclusion criteria: secondary science teachers teaching in any municipalities within Davao del Sur; gender: resulting in two categories: Male and Female; and length of service, resulting in three categories: Novice Teachers (1-3 years of experience), Intermediate Teachers (4-9 years of experience), and Experienced Teachers (10+ years of experience). Only teachers who meet the specific inclusion criteria mentioned were considered as respondents for this study. Furthermore, teachers with less than one year of teaching experience, teachers who do not teach science, teachers who do not teach within Davao del Sur, and teachers who are not secondary science educators were excluded from participating in the study. Given these criteria, the researchers have selected a total of 109 respondents of the study. Respondents were entitled to withdraw from the study at any time with prior notice given to the researchers through any form of communication.

Research Instrument

The primary research instrument for this study is a Critical Pedagogy Survey Questionnaire (CPSQ) developed by Roohani et al. (2015). This survey questionnaire consists of 35 items with six (6) indicators, including Philosophical Orientation, Program Structure, Curriculum and Materials, Teacher Development, Teacher-Student Relationship, and Evaluation. The CPSQ provides a holistic view of teachers' grasp of CP. It aligns with the educational goals of CP, making it a suitable instrument for measuring the critical dimensions of CP understanding among secondary science educators in Davao del Sur. In addition, reliability analysis is also implemented to determine the suitability of the questionnaire in the current context of the study.

Pilot testing was carried out on 30 science teachers, and the results yielded an overall Cronbach Alpha of

0.91, indicating that the questionnaire has excellent internal consistency (Habiddin et al., 2020). In addition, all indicators of the questionnaire also exhibit excellent internal consistency (philosophical orientation=0.90, program structure=0.93, curriculum and materials=0.90, teacher development=0.92, teacher-student relationships=0.90, and evaluation=0.91). This shows that the questionnaire has excellent internal consistency. The level of perception and range of mean value presented in Table 1 was adapted from Shahat et al. (2022). Furthermore, the researchers created the verbal interpretation used to comprehensively describe and interpret the quantified results of the study.

Table 1. Level of Perception, Range of Means, and Verbal Interpretation

Level of Perception	Range of mean value	Verbal Interpretation
Very High	4.21-5.00	Demonstrated an in-depth comprehension of CP principles and how they are utilized in the field of science education.
High	3.41-4.20	Demonstrated a strong understanding of CP principles and can confidently integrate them into their teaching practices.
Moderate	2.61-3.40	Demonstrated an adequate grasp of CP principles but may need further development to fully implement them.
Low	1.81-2.60	Demonstrated limited understanding of CP principles and may require significant support to utilize it effectively.
Very Low	1.00-1.80	Have little to no understanding of CP principles.

Procedure and Data Analysis

Before gathering the needed data, the researchers secured an approved letter of permission. The researchers submitted letters to the Research and Publication Center, the Dean of the College, and the VP of Branch Operations of University of Mindanao - Digos College for approval to conduct the study outside the school. Furthermore, to gather data from secondary science educators in Davao del Sur, the researchers have also sent a letter of permission to conduct the study to the Office of the Division of Davao del Sur. With the approved letters of permission, the researchers then started the data collection.

Online surveys and printed paper questionnaires were primarily used. An online survey was conducted using a Google Form link for those respondents who can be reached online. In addition, the researchers visited the distant schools across some rural municipalities of Davao del Sur. A letter of permission, an informed letter of consent, and the approved letter from the Division of Davao del Sur were given to be signed by each school's school principals, officers-in-charge, and research coordinators. After the approval, an informed consent letter was also distributed to the respondents. The researchers coordinated with school heads so respondents could complete the survey within a given time frame and retrieve the finished survey papers.

The researchers employed statistical measurements such as mean, standard deviation, Mann-Whitney U-Test, and Kruskal-Wallis H Test to analyze the gathered data. According to Fabián (2021), the mean offers information about the central position of values in a dataset. The researchers utilized the standard deviation of the mean to assess the dispersion of the data. The standard deviation is a statistical measure that evaluates the reliability and consistency of data and identifies patterns (Martinez & Bartholomew, 2017).

Furthermore, to compare two separate groups, specifically the male and female respondents, the researchers conducted the Mann-Whitney U Test to assess differences in CP comprehension levels. The Mann-Whitney U Test is a nonparametric statistical test that assesses whether one group exhibits significantly higher or lower values than another group by comparing the ranks of observations (MacFarland & Yates, 2016). The researchers employed the Kruskal-Wallis H Test to determine if there were any variations in the distributions of CP understanding levels between novice, intermediate, and experienced teachers. This test aims to identify whether there is a statistically significant difference in the medians of three or more separate groups (Kruskal & Wallis, 1952).

Result and Discussion

Profile of the Respondents

Table 2 below presents the Profile of the Respondents in terms of Gender and Length of Service. A total of n = 109 respondents participated in this study. Regarding gender, female respondents (f=64, % =59.7) consist of the majority of the respondents over male respondents (f=45, % = 41.3). In terms of length of service, science teachers with 4-9 years of teaching experience (f=48, %=44.0) comprise the majority of the respondents, followed by teachers with 1-3 years of length of service (f=32, %=29.4), and teachers with 10+ years of teaching experience (f=29, %=26.6) respectively.

Table 2. Profile of the Respondents (n=109)

	Frequency (f)	Percentage (%)
Gender		
Male	45	41.28
Female	64	58.72
Length of Service		
1-3 years	32	29.36
4-9 years	48	44.04
10+ years	29	26.60

Level of Critical Pedagogy of Science Teachers

Table 3 summarizes the level of CP understanding of science teachers. Based on the results, science educators revealed a high level of CP understanding ($\bar{x}$= 3.79, SD= 0.26). The results have also shown that science teachers have a very high level of program structure knowledge ($\bar{x}$= 4.45, SD = 0.44). Furthermore, in terms of the following indicators: curriculum and materials ($\bar{x}$= 4.09, SD = 0.44), philosophical orientation ($\bar{x}$= 3.81, SD = 0.08), and teacher-student relationship ($\bar{x}$= 3.73, SD = 0.45) presented a high result. Meanwhile, the indicators: evaluation ($\bar{x}$= 3.34, SD = 0.54), and teacher development ($\bar{x}$= 3.29, SD = 0.47) presented a moderate result.

Table 3. Science Teacher's Level of Critical Pedagogy Understanding

Indicators	Mean ($\bar{x}$)	SD
Philosophical Orientation	3.81	0.08
Program Structure	4.45	0.44
Curriculum and Materials	4.09	0.44
Teacher Development	3.29	0.47
Teacher-Student Relationship	3.73	0.45
Evaluation	3.34	0.54
Overall	3.79	0.26

Overall, science teachers have a high level of CP understanding ($\bar{x}$= 3.79, SD = 0.26), indicating that they strongly understand CP and can integrate it into their teaching practices. These findings align with the study conducted by Dasas (2020), which also observed that science teachers possess a practical comprehension of CP and its objectives, purposes, and operational mechanisms. Similarly, Geletu (2022) emphasized that CP understanding is enhanced by the use of cooperative learning and active student involvement while Khan and Sharma (2023) pointed out the role of teachers and students as collaborators in knowledge creation as key factors in deepening CP comprehension.

In terms of program structure knowledge ($\bar{x}$= 4.45, SD = 0.44), Science teachers showed a very high level of understanding of program structure, indicating their ability to integrate student expectations, ideas, and needs into program planning. This is in line with the Philippine Professional Standards for Teachers (PPST) (Department of Education, 2017), which underscores the importance of program structure knowledge. la Velle (2023) mentioned that teachers' deep understanding of program structure comes from continuous exposure to curriculum content. Additionally, Kleickmann et al. (2012) also discussed that program structure knowledge displayed by science instructors are a result of their pedagogical content knowledge. This result indicates an educational approach that adopts student voice and agency, which are crucial elements of CP (Peng, 2023).

Furthermore, science teachers revealed a high result in terms of curriculum and materials ($\bar{x}$= 4.09, SD= 0.44), which indicates their adaptability to teaching materials they utilize and their commitment to promoting equality and justice in the classroom. This is supported by Davis et al. (2016), who noted that a deep understanding of curriculum use enhances teacher decision-making and curriculum design. Arrieta et al. (2020) added that science teachers have maintained expertise in instructional materials despite curriculum changes, aligning with CP principles such as fostering equality and critical thinking (Keesing-Styles, 2003).

In terms of philosophical orientation, science teachers revealed a high result as well ($\bar{x}$= 3.81, SD= 0.08) which indicate that teachers have a solid foundation in philosophical perspectives that influence their teaching practices. This is consistent with Couló (2018), who highlighted the role of philosophical understanding in enhancing a teacher's educational approach. Heilbronn (2022) similarly mentioned that a strong philosophical orientation aids teachers in applying complex educational concepts. Demirdöğen (2016) further noted that philosophical orientation is shaped by interactions with other pedagogical elements, reinforcing CP's focus on reflective teaching.

Moreover, science teachers revealed a high result in terms of teacher-student relationship ($\bar{x}$= 3.73, SD= 0.45), indicating that science teachers value collaboration and foster positive interactions with their students. Poling et al. (2022) found a strong correlation between teacher-student relationships and enhanced academic performance, as well as increased student engagement. Li et al. (2022) also highlighted the important role of these relationships in facilitating innovative teaching methodologies. Moreover, Hofkens and Pianta (2022) conceptualized classrooms as intricate social systems wherein student participation is significantly influenced by teacher interactions, a cornerstone of classroom practices.

Meanwhile, science teachers revealed a moderate evaluation knowledge ($\bar{x}$= 3.34, SD = 0.54), which indicates that science teachers have an adequate, though not fully developed, grasp of evaluative practices. Sofianidis and Kallery (2019) discussed the significant role of professional development in evaluation for enhancing teacher practice. Similarly, McFadden and Williams (2020) emphasized the importance of investing in teacher training on evaluative thinking to elevate student outcomes. Karakaya and Yılmaz (2022) further emphasized the implication of ongoing training in assessment techniques for advancing science education.

In terms of teacher development, science teachers shown moderate results (x̄= 3.29, SD = 0.47), which reflects a need for further professional growth among science teachers. Mork et al. (2021) mentioned that interventions are necessary to support the professional development of science educators. Southerland et al. (2016) also pointed out that modern teaching methods often conflict with traditional practices, necessitating innovative professional growth approaches. Confessor and Belmi (2022) emphasized that sustained professional learning is key to creating transformative learning environments.

Level of Critical Pedagogy when Analyzed by Gender

Table 4 presents the Respondents' Levels of CP Understanding When Analyzed by Gender. Overall, there is no significant difference between female (mean rank= 54.21, Sum of ranks= 2439.50) and male (mean rank= 55.55, Sum of ranks= 3555.50) respondents' understanding of CP (Mann-Whitney U (109) = 1404.5, p = 0.827). Each indicator revealed no significant difference when analyzed in terms of gender, philosophical orientation (Mann-Whitney U (109) = 1307.5, p = .415), program structure (Mann-Whitney U (109) = 1304, p = .398), curriculum and materials (Mann-Whitney U (109) = 1341.5, p = .54), teacher development (Mann-Whitney U (109) = 1206, p = .143), teacher- student relationship (Mann-Whitney U (109) = 1403.5, p = .82), and evaluation (Mann-Whitney U (109) = 3215.5, p = .058).

These findings are supported by the study of Seyedsayamdost (2015), who suggested that gender does not contribute significantly to shaping individuals' grasp of pedagogical concepts and applications within the educational realm. Additionally, as discussed by Mukagiahana et al. (2024), there is no statistically significant disparity in the comprehension and implementation of pedagogical concepts among teachers based on gender. Moreover, Vavrus (2009) stated that educational practices aimed at advancing critical thinking should be equally effective for both genders, facilitating the concept that transformative pedagogical education goes beyond gender disparities.

The study by Hazari et al. (2010) demonstrated that interactive classroom environments, characterized by a conceptual focus and real-world contextual associations, are equally beneficial for both male and female students. Moreover, the research findings of Nurfadilah (2019) suggest that progressive empowering education, incorporating experiential learning and hands-on participatory approaches, does not result in significant disparities in science teaching development between male and female educators. Moreover, (Abdi, 2014) study highlighted the consistent effectiveness of inquiry-based learning in fostering understanding of the foundational branches of science courses among both male and female educators, underscoring the global applicability of these educational approaches.

Table 4. Level of CP Understanding When Analyzed by Gender (**p<.05)*

Indicators	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Z	Asym. Sig.
Philosophical Orientation	Male	45	57.94	2607.50	1307.5	-0.816	0.415
	Female	64	52.93	3387.50			
	Total	109					
Program Structure	Male	45	51.98	2339.00	1304	-0.846	0.398
	Female	64	57.13	3656.00			
	Total	109					
Curriculum and Materials	Male	45	52.81	2376.50	1341.5	-0.613	0.54
	Female	64	56.54	3618.50			
	Total	109					
Teacher Development	Male	45	49.80	2241.00	1206	-1.465	0.143
	Female	64	58.66	3754.00			
	Total	109					
Teacher-Student Relationship	Male	45	54.19	2438.50	1403.5	-0.227	0.82
	Female	64	55.57	3556.50			
	Total	109					
Evaluation	Male	45	61.77	2779.50	3215.5	-1.894	0.058
	Female	64	50.24	3215.50			
	Total	109					
Overall	Male	45	54.21	2439.50	1404.5	-0.218	0.827
	Female	64	55.55	3555.50			
	Total	109					

Level of Critical Pedagogy Understanding when Analyzed by Length of Service

Table 5 presents the Difference in the Respondent's Level of CP Understanding When Analyzed by Length of Service. The result showed that overall, there is a significant difference in respondents' understanding of CP when analyzed by their length of service ($\chi2= 7.604$, $p = 0.022$). Among the indicators, only the philosophical orientation ($\chi2= 9.001$, $p = 0.011$) and teacher-student relationship ($\chi2= 7.574$, $p = 0.023$) indicators showed a significant difference regarding length of service. Moreover, the indicators: program structure ($\chi2= 4.649$, $p = 0.098$), curriculum materials ($\chi2= 3.652$, $p = 0.161$), teacher-student development ($\chi2= 1.372$, $p = 0.504$), and evaluation ($\chi2= 1.259$, $p = 0.533$) showed no significant difference when analyzed by length of service.

The philosophical orientation indicator showed a significant difference when analyzed by their length of service. These findings align with the research of Fobes and Kaufman (2008), who emphasized that teachers with at least four years of experience often recognize the broader role of education beyond knowledge transmission. Furthermore, Duarte (2006) suggests that CP should be an ongoing mindset for teachers is supported by these results. Moreover, Aksakalli (2018) also provides evidence for the positive impact of applying CP principles in science classrooms, leading to improved environments and relationships between students and teachers. Teachers with more experience may better comprehend the pragmatic obstacles associated with incorporating these elements, such as the intricacies of power dynamics within the classroom and encouraging authentic student engagement (Aliakbari & Faraji, 2011).

In the study of Katz (2014), it was discussed that teachers with 5-9 years of experience who had previously practiced or were interested in practicing critical pedagogy responded positively to the ideas. In addition, the study of Podolsky et al. (2019) indicated that the most significant noticeable increases in teacher CP awareness happen over in the mid-career phases (years 4–9), notable gains in understanding are the most promising, underscoring the continuous growth and honing of teaching abilities that result from prolonged classroom experience. Moreover, Kareepadath (2018) emphasized that making educational practices that can aid in forming a democratic society; hence, intermediate teachers keep in mind the social transformation needed in the education system.

Moreover, the teacher-student relationship indicator also revealed a significant difference when analyzed by length of service. These findings align with the study of Giroux (2013), who mentioned that experienced teachers can act as citizen-intellectuals to fight for democratic values in education. Additionally, Roohani and Haghparast (2020) discussed that the quality of teacher training is linked to effective teaching and academic achievement, which is connected to the teacher's pedagogical skills and the student's drive to absorb new information. Furthermore, Keesing-Styles (2003) highlighted that critical pedagogy fundamentally reshapes the student-teacher relationship, impacting assessment practices. Also, Monchinski (2008) emphasized that central to this approach is a shift towards dialogic interactions, where teacher and student roles become more shared.

However, the indicators: program structure, curriculum and materials, teacher development, and evaluation exhibit no significant difference when analyzed by length of service. This means that CP understanding is the same for these indicators when analyzed by length of service. This result is supported by the study of Kincheloe (2011) who state that CP goes beyond simply teaching critical thinking. It encourages students to question societal norms and actively try to alter them. While program structure is essential, teachers require continual development to adopt this method (la Velle, 2023). Subsequently, in the study of Dasas (2020), because there is a shortage of particular data on how CP is being employed in Philippine science classrooms, program structures, and materials might be devised to instill fundamental awareness of CP concepts in all teachers. Moreover, it is worth noting that changes in the science curriculum are also a factor, especially since the country is currently transitioning to the new basic education curriculum (Diquito, 2024). In addition, materials in the science program in the province vary across schools, thus adding to the factor of CP among science teachers in the province (Caballes et al., 2024).

Conclusion

This study aims to determine science educators' grasp of critical pedagogy in science education. The findings of the study indicate a high level of critical pedagogy among science educators. This suggests that science educators have a high level of grasp on this concept. Moreover, further analysis revealed that science educators have a very high level of understanding of the indicator program structure, however, evaluation and teacher development show a moderate level of understanding. This implies that science educators are not quite familiar with how these two indicators are used in the current context of science education. When analyzed by profile, only the length of service shows a statistically significant difference. This means that length of service is a factor to consider critical pedagogy among science educators. Thus, based on these findings the following recommendations are offered: (1) empowering educators to incorporate CP principles into their science instruction can be achieved by providing resources and support, such as collaborative planning sessions or improved lesson plans; (2) for less experienced science educators, implement professional development programs that are specifically designed to address CP: workshops, mentorship opportunities, should be incorporated into these programs to improve their comprehension and application of CP elements; and lastly, (3) educational institutions must ensure that CP training and professional development opportunities are designed to be gender-inclusive. These recommendations can be helpful in increasing critical pedagogy among science educators.

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