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Enhancing Pre-Service Science Teachers' Self-Efficacy, Collaborative Skills and Lesson Planning Competence through Collaborative Lesson Planning

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Abstract. This study examines the effectiveness of collaborative lesson planning in enhancing pre-service science teachers' self-efficacy, collaborative skills, and lesson planning competence, thereby addressing the need for structured, practice-based approaches in teacher preparation. Using an embedded mixed methods design, quantitative pre- and post-surveys measured changes in these variables, while semi-structured interviews and focus group discussions provided deeper insights into pre-service science teachers' experiences during collaborative lesson planning implementation. Findings indicate significant improvements in self-efficacy, particularly in science teaching outcome expectancy, and lesson planning competence, with moderate to large effect sizes. Collaborative skills likewise improved, demonstrating a moderate effect size. Qualitative findings corroborate these results, revealing enhanced confidence, broadened pedagogical perspectives, stronger peer learning, and increased readiness for collaborative professional practice. Overall, the findings demonstrate that collaborative lesson planning fosters pre-service teachers' growth as reflective practitioners, strengthens their competence in designing and implementing science lessons. By strengthening teacher quality and promoting collaborative and lifelong learning competencies, the study contributes to the United Nations' Sustainable Development Goal 4 by advancing teacher education that prepares learners for a sustainable future. The findings support ongoing efforts toward curriculum transformation, skills development for pre-service teachers, and the integration of education for sustainable development principles in teacher preparation programs.

Keywords: Collaborative lesson planning; collaborative skills; pre-service science teachers; self-efficacy; lesson planning competence

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1. Introduction

The widespread adoption of blended learning in the post-pandemic period has significantly disrupted the conventional practice and teaching experiences of pre-service science teachers (PSTs). A number of studies show that limited opportunities for classroom engagement and peer interactions in online and blended environments have impeded the development of self-efficacy, collaborative skills, and lesson planning competence. Consequently, during online or modular internships, opportunities for mastery and social persuasion have been reduced, increasing reliance on affective states and vicarious learning (Tynan & Mallaburn, 2023). Gibbons (2025) found that self-efficacy and preparedness are strongly influenced by hands-on practicum experiences, mentorship, and sustained engagement, and a lack of these experiences is associated with reduced confidence and instructional readiness. These findings highlight a critical gap in teacher preparation, underscoring the need for flexible training models and strengthened mentorship systems to sustain self-efficacy, across both in-person and remote learning environments.

Notably, beyond these disruptions, the pandemic exposed persistent structural limitations in teacher preparation. In many contexts, including the Philippines, lesson planning remains largely an individual task—even during teaching internships—which constrains opportunities for collaborative reflection, peer modelling, and shared problem-solving. Teachers in blended learning environments report challenges such as low student motivation, absenteeism, and increased instructional demands, often relying on reflective practices to adapt (Kim & Muhammad, 2025). Concurrently, heightened emotional exhaustion associated with pandemic-related stress has underscored the need for targeted support (Sofia et al., 2026). Together, these conditions highlight the necessity of intentional, practice-based approaches that systematically embed collaboration into teacher preparation.

Developing strong self-efficacy among PSTs remains a central goal of teacher education, as efficacy beliefs shape instructional decision-making, persistence in challenging situations, and ultimately student learning outcomes. Grounded in the social cognitive theory, self-efficacy refers to individuals' beliefs in their capability to plan and perform actions necessary to achieve desired performance (Bandura, 1986; Schunk & DiBenedetto, 2020). In science education, these beliefs are particularly critical because effective teaching requires not only content mastery but also the ability to facilitate inquiry, manage laboratory activities, address misconceptions, and promote higher-order thinking. Self-efficacy develops primarily through mastery experiences, vicarious learning, and social persuasion, all of which rely on meaningful teaching practice and professional interaction.

The collaborative lesson planning (CLP) model, developed by Canalita and Jugar (2025), offers a promising approach by promoting structured collaboration that enhances instructional practice and professional growth. Gutierez (2021) demonstrated that CLP generates productive dissonance, strengthening teaching practices through continuous reflection and professional support. Similarly, Buan

and Lahoylahoy (2019) reported that collaborative planning improves pre-service teachers' competence, enriches teacher–student interactions, and fosters critical thinking and interactive discourse. Likewise, Bentley (2023) further emphasized that group planning and mentoring deepen understanding through reflective dialogue, and better prepare pre-service teachers for professional demands.

However, despite these contributions, empirical evidence on CLP as a structured intervention remains limited, particularly in post-pandemic or blended internship contexts. Few studies have examined its combined effects on self-efficacy, collaborative skills, and lesson planning competence, revealing a critical gap in understanding how collaborative practices holistically support pre-service teacher development. Addressing the identified gap, the present study investigates the effectiveness of implementing CLP in enhancing pre-service teachers' self-efficacy, collaborative skills, and lesson planning competence during their teaching internships. By providing empirical evidence on structured collaboration, this study sought to inform the design of science education programs, particularly in integrating collaborative practice approaches that strengthen professional competence. Ultimately, fostering these competencies is essential for preparing reflective, resilient, and collaborative science teachers capable of delivering effective inquiry-based instruction in diverse and evolving educational contexts.

1.1 Research Questions

The study primarily aimed to examine the effectiveness of implementing CLP in enhancing pre-service science teachers' self-efficacy, collaborative skills, and lesson planning competence during teaching internships. It specifically sought to answer the following research questions:

1. To what extent does the implementation of the CLP enhance the self-efficacy, collaborative skills and lesson planning competence of pre-service science teachers?
2. How do pre-service science teachers perceive CLP on their professional development particularly on self-efficacy beliefs, collaborative skills and lesson planning competence?

2. Literature Review

2.1 Theoretical Foundations of Self-Efficacy, Collaborative Skills and Lesson Planning Competence

The theoretical foundations of CLP in science education are anchored in the integration of social cognitive theory and social constructivism, which explain how pre-service teachers develop self-efficacy, collaborative skills, and lesson planning competence through structured interaction and reflective practice. The social cognitive theory highlights that self-efficacy is shaped through mastery experiences, vicarious learning, and feedback, processes embedded in CLP, as pre-service teachers collaboratively design, observe, and refine lessons. In parallel, social constructivism emphasizes the co-construction of knowledge through dialogue and shared engagement, enabling pre-service teachers to develop essential collaborative skills, such as communication, negotiation, and joint decision-making, which are critical in science teaching.

Furthermore, literature underscores the role of collaboration in mitigating professional isolation and instructional challenges, particularly those intensified during the COVID-19 pandemic, positioning CLP as a responsive framework for fostering resilient and reflective practitioners (Iradel et al., 2021). Empirical evidence supports this claim, with Guo et al. (2026) demonstrating that CLP significantly enhances pre-service teachers' technological pedagogical content knowledge, especially in technology-integrated instruction. Collectively, these theoretical and empirical insights establish CLP as an effective approach for simultaneously strengthening self-efficacy, collaborative skills, and lesson planning competence in science education.

2.1.1 Social cognitive theory

The development of teacher self-efficacy is strongly anchored in the social cognitive theory, which explains human behaviour as the result of an ongoing interaction among personal beliefs, actions, and environmental influences. Central to this theory is the concept of self-efficacy—an individual's belief in his or her capability to perform specific tasks successfully. In the context of teaching, self-efficacy shapes how teachers plan instruction, respond to classroom challenges, adopt innovative strategies, and persist when students struggle. Lee et al. (2022) found that enhancing pre-service teachers' subjective and psychological well-being can play a crucial role in strengthening their teaching self-efficacy, particularly during periods of disruption such as the COVID-19 pandemic. This underscores the need for teacher education programs to integrate well-being interventions such as peer support to enhance both personal resilience and professional competence.

Bandura identifies four primary sources of self-efficacy: mastery experiences, vicarious experiences, social persuasion, and physiological or emotional states. Among these, mastery experiences—actual successful performance of a task—are considered the most influential. For pre-service teachers, mastery develops through authentic teaching opportunities such as lesson implementation, classroom facilitation, and reflective evaluation of practice. When pre-service science teachers experience success in delivering a lesson or effectively addressing students' misconceptions, their confidence in teaching science strengthens.

Furthermore, CLP reflects these principles in practice by engaging pre-service teachers in shared problem-solving, anticipating classroom challenges, and refining instructional strategies prior to implementation. This process creates structured opportunities for mastery through preparation and reflection, while also fostering vicarious learning as teachers observe peers' approaches to content delivery and assessment design. At the same time, ongoing feedback and professional dialogue serve as forms of social persuasion that strengthen teachers' confidence in their instructional capabilities. Supporting this, Chen et al. (2025) show that shared CLP which is grounded in socially shared regulation of learning, enhances prospective teachers' professional development by structuring collaboration, improving skills, and promoting adaptive regulatory behaviours through computer-supported collaborative learning environments, although

challenges related to technical proficiency and emotional regulation remain evident.

In contexts in which teaching internships are conducted online or blended modalities—such as during the post-pandemic—opportunities for direct classroom mastery and observational learning are often constrained. In such situations, online or face-to-face CLP becomes particularly valuable, as it sustains professional interaction and reflective engagement despite limited in-person teaching experiences. From the perspective of the social cognitive theory, it provides the environmental conditions necessary for the development of self-efficacy.

Consistent with this, the study of Wang (2022) demonstrates that integrating lesson study into teaching internships enhances pre-service teachers' learning effectiveness by supporting the progressive development of lesson design and implementation through microteaching and intensive practice, while also revealing persistent challenges in understanding learners—thereby emphasizing the need for sustained reflection, iterative refinement of instructional strategies, and broader application across teacher education contexts.

2.1.2 Social constructivism

Grounded in the social constructivist perspective of Lev Vygotsky (1978), learning is understood as a socially mediated process in which knowledge is co-constructed through interaction. Vygotsky's concept of the zone of proximal development (ZPD) highlights the gap between what learners can accomplish independently and what they can achieve with the support of a more knowledgeable other or through peer collaboration. While the social cognitive theory explains how self-efficacy beliefs develop, social constructivism clarifies why collaboration enhances professional growth. It posits that learning emerges through the exchange of ideas, critical dialogue, and the negotiation of meaning, enabling individuals to challenge assumptions and develop deeper, shared understanding. This is also evident in CLP practice, wherein teachers collaboratively plan lessons, observe students' responses during lesson implementation, and reflect on what worked well and why certain aspects did not.

In teacher education, lesson planning has traditionally been treated as a solitary task in which the teacher planner will have to think deeply on their own about the lesson, often overlooked as a source of professional development and collegial reflection (Shen et al., 2007). Social constructivism suggests that planning becomes more meaningful when it is approached as a collective intellectual activity. Through CLP, pre-service teachers articulate their pedagogical reasoning, negotiate instructional decisions, and reflect on content delivery strategies together. This shared engagement promotes deeper understanding of science concepts and pedagogical approaches, because ideas are examined from multiple perspectives.

Additionally, CLP cultivates essential professional skills. For example, effective collaboration requires active listening, openness to feedback, shared responsibility, and mutual respect. As pre-service teachers participate in structured planning sessions, they gradually develop these competencies. They learn to defend instructional choices with evidence, accept constructive criticism, and integrate diverse viewpoints into coherent lesson plans. These experiences mirror real-world professional practice, in which teachers work within departments or professional learning communities to design and refine instruction.

Moreover, social constructivism emphasizes positive interdependence; each member's contribution is necessary for the success of the group. In CLP, pre-service teachers rely on one another's strengths, whether content knowledge, creativity, or classroom management strategies. This shared responsibility fosters accountability and a sense of collective ownership over instructional quality. Particularly in science education, in which lessons often involve inquiry activities and conceptual complexity, collaborative planning ensures more thoughtful alignment of objectives, instruction, and assessment. Canalita et al. (2019) supported this by showing that iterative refinement of lessons through lesson study—guided by observations of student responses and interactions—enhances learning and motivation, particularly when teachers use effective scaffolding and connect concepts to real-life contexts. Similarly, CLP not only enhances the technical quality of lesson plans but also rebuilds professional connectedness by providing a space in which future science teachers can think critically together, support one another, and develop confidence in both their individual and collective abilities.

2.2 Science Teaching Self-Efficacy

Science teaching self-efficacy refers to teachers' belief in their ability to teach science effectively and influence student learning outcomes. It is commonly examined through two dimensions: personal science teaching efficacy (PSTE), which reflects confidence in one's own teaching capability, and science teaching outcome expectancy (STOE), which reflects the belief that effective teaching can positively affect student achievement regardless of external factors. These constructs are widely measured using the science teaching efficacy belief instrument, originally developed by Enoch and Riggs (1990), and later revised by Bleicher (2004), for pre-service teachers.

Research consistently shows that self-efficacy plays a central role in shaping instructional practices. The social cognitive theory (Bandura, 1977) indicates that teachers with high self-efficacy are more likely to implement inquiry-based strategies, facilitate hands-on activities, and persist when students encounter conceptual difficulties. They are also more open to innovation and more resilient in addressing classroom challenges. In contrast, teachers with low efficacy may rely heavily on textbook-driven instruction, avoid laboratory activities, or feel uncertain about handling students' questions, particularly in science topics perceived as complex.

For pre-service teachers, science teaching efficacy develops progressively through coursework, laboratory experiences, and, most critically, teaching practicum. Authentic classroom engagement allows them to apply pedagogical knowledge in real contexts, in which successful lesson delivery strengthens their sense of competence, and reflective feedback from mentors refines their instructional practices. However, efficacy beliefs do not develop automatically; they are shaped by the quality and structure of these experiences. When pre-service teachers encounter repeated challenges without adequate support, their confidence may decline. This underscores the need for strengthened professional development, adequate resource allocation, and collaborative frameworks to sustain their growth and maintain confidence in practice (Al-Zyoud et al., 2025).

In science education, this issue becomes even more significant. Teaching science requires integrating content knowledge, pedagogical strategies, classroom management, and sometimes laboratory safety considerations. Pre-service teachers who lack strong preparation or supportive mentoring may feel overwhelmed. Therefore, structured interventions that intentionally support planning, reflection, and peer dialogue—such as CLP—are important in strengthening science teaching self-efficacy.

2.3 Collaborative Skills as Professional Competency

Collaboration is increasingly recognized as a core professional competency in teaching, particularly within contemporary educational environments that require teachers to engage actively in departments, professional learning communities, and interdisciplinary teams. In this context, collaboration extends beyond the simple exchange of materials to encompass collective decision-making, open communication, constructive feedback, and shared accountability for student learning. Supporting this view, Hornyák et al. (2026) asserted that collaboration and professional networking are essential competencies in teacher education, significantly enhancing teacher commitment, job satisfaction, retention, and adaptability to evolving labour market demands. Together, these perspectives underscore collaboration as a critical foundation for both effective instructional practice and sustained professional growth.

Collaborative skills—such as active listening, respectful exchange of ideas, conflict resolution, flexibility, and the ability to synthesize diverse perspectives into coherent instructional plans—are essential for effective teaching practice. However, these competencies are not acquired automatically; they require deliberate and sustained practice within structured learning environments. Despite their importance, lesson planning in many teacher preparation contexts remains largely individualized, with pre-service teachers working independently and submitting outputs for evaluation, thereby limiting opportunities for meaningful professional dialogue and shared reflection.

Addressing this gap, Gao et al. (2025) demonstrated that integrating knowledge-building activities—such as collaborative inquiry, reflective journaling, and peer observation with feedback—into teacher education programs effectively cultivates reflective mindsets and enhances creative teaching practices among EFL

pre-service teachers. These insights highlight the need to embed structured collaborative experiences within teacher preparation to develop essential professional competencies systematically.

The development of collaborative competence is particularly important in science education, in which lesson design requires anticipating misconceptions, aligning experiments with learning objectives, and ensuring conceptual clarity, and collaborative planning allows teachers to draw on distributed expertise that enhances instructional quality and reflective practice. In this regard, Norton et al. (2019) showed that collaborative lesson study in initial teacher education creates a dialogic space in which student-teachers, mentors, and university tutors jointly plan, teach, and evaluate lessons, supporting deeper understanding of teaching and learning processes. These findings suggest that despite existing challenges, collaborative planning bridges theory and practice while strengthening instructional coherence and facilitating induction into the professional community of practice.

Despite its recognized importance, collaboration can be challenging. Differences in teaching philosophy, communication styles, and confidence levels may create tension within teams. For pre-service teachers who are accustomed to working independently, engaging in collaborative processes may initially feel uncomfortable. Structured models such as CLP can help scaffold this development by providing clear roles, shared goals, and guided reflection. Over time, repeated engagement in collaborative planning not only improves lesson quality but also nurtures professional habits that extend beyond the internship experience.

2.4 Lesson Planning Competence of Pre-Service Teachers After the COVID-19 Pandemic

The COVID-19 pandemic significantly disrupted teacher education worldwide, as teaching internships shifted abruptly from face-to-face classrooms to online or modular modalities, often with minimal preparation. For pre-service teachers, this transition reduced opportunities for direct classroom interaction, hands-on science experimentation, and real-time feedback from mentors, resulting in heightened uncertainty about their instructional readiness—particularly in disciplines such as science that depend on inquiry-based and demonstrative approaches. This pattern of disruption is reflected in other professional fields. For instance, Siddiqui et al. (2025) reported that when dental schools in Pakistan went online, poor internet and electricity stopped the practical clinical training students needed, causing worry about the readiness and competence of the graduates. Considering this, universities should strengthen support and implement relevant recovery plans.

In online or modular settings, pre-service teachers encountered persistent challenges in student engagement, assessment monitoring, and classroom management, compounded by the absence of immediate learner feedback and reduced opportunities for informal interaction with mentors and peers. This professional isolation limited observational learning and weakened mentorship, both critical for developing teaching confidence. Even before the pandemic, lesson

planning was largely an independent undertaking, but the shift to remote learning further intensified this isolation. Student teachers were left creating digital slides and modules entirely on their own, missing out on the shared advice and peer support they needed most.

Those challenging times showed just how important it is for teachers to be creative, flexible, and ready to adapt. According to Woreta et al. (2026), cooperating teachers mostly give directions but rarely offer post-lesson reflection and feedback that help students to grow. In contrast, the data show that the right kind of support can make a significant difference, even online. For instance, Songsiengchai (2025) discovered that when student teachers received structured coaching and mentoring through a specific system called the SAIFON framework, their teaching and problem-solving skills improved during live online classes. Overall, these findings suggest us that embarking on a structured CLP model can improve student teacher preparation. By fostering professional connection and shared reflection, CLP mitigates feelings of isolation and strengthens both teaching competence and self-efficacy.

3. Methodology

3.1 Research Design

This study employed an embedded mixed-methods design, wherein qualitative data served as a supportive and secondary role to the predominantly quantitative component (Creswell et al., 2003). The quantitative phase utilized a quasi-experimental one-group pre-test–post-test design to evaluate the effects of CLP on the three key dependent variables (self-efficacy, collaborative skills, and lesson planning competence). While the one-group design alone was not sufficient to establish causal inferences, a qualitative component was embedded within the study to provide a richer understanding of the CLP implementation, insights into participants' experiences, challenges encountered, and other factors related to the assessed variables. The qualitative component did not remove the design's limitation but strengthened the credibility, interpretation, and contextual understanding of the quantitative findings.

3.2 Participants of the Study

The study involved three groups of participants: 31 PSTs, 17 in-service cooperating teachers, three expert validators, and three teacher raters—each with at least seven years of teaching experience and mentoring roles. Purposive sampling was employed to ensure alignment with the study objectives and the specific characteristics or traits of the particular group of interest, which is subsequently examined in detail. Pre-service science teacher participants (31 PSTs) were selected based on their enrolment status in the practice teaching program during the second semester of 2023–2024 academic year, together with their corresponding cooperating teachers.

For teacher raters and evaluators, eligibility was determined based on relevant experience in science teaching and lesson planning, advanced educational attainment (master's or doctoral degree), and demonstrated expertise in science education. A single cohort of 31 PSTs from higher education institutions

participated in the study. They initially completed a survey to establish baseline data on their self-efficacy, collaborative skills, and lesson planning competence prior to the implementation of CLP and subsequently applied the approach during their 45-day teaching internship. Selected PSTs (n = 6) from this cohort, particularly those with high, low, and average self-efficacy were interviewed. Also, their corresponding cooperating teachers participated in the focus group discussions to provide deeper insights into the implementation and effectiveness of the approach.

The expert validators, who were all doctoral degree holders actively engaged in science education, evaluated the content validity of the lesson plan assessment tool. Alternatively, the three teacher raters assessed the PSTs' lesson plans before and after implementation to ensure objective measurement of changes in lesson planning competence. The adequacy of the sample was supported through both qualitative and quantitative considerations. Data saturation was achieved in the qualitative phase, as indicated by recurring patterns across responses. The sample size of 31 PSTs was considered sufficient, as the central limit theorem suggests that a sample size greater than 30 (n = 31) generally yields a sampling distribution of the mean that approximates normality (Islam, 2018).

3.3 Ethical Considerations

The study was reviewed and approved by the Research Ethics Committee of a training University in Cebu City, Philippines. Prior to implementing the CLP model, formal permission was obtained from the dean of the teacher education institution in Iligan City, Lanao del Norte, as well as from the principals of the participating national high schools through official transmittal letters.

Informed consent was secured from all pre-service and in-service science teacher participants, ensuring voluntary participation and adherence to ethical standards of anonymity and confidentiality. Participants were fully informed about the purpose and procedures of the study. The consent forms clearly outlined the data collection methods—including survey questionnaires, in-depth interviews, and focus group discussions—and provided detailed information regarding potential risks, benefits, and participants' rights.

3.4 Data Collection and Analysis

In this study, data collection was conducted before and after implementing the CLP model, embedding qualitative data within the quantitative methods to facilitate a comprehensive and evidence-based evaluation of the CLP approach effectiveness and practicality. This integration allows for a more nuanced understanding of the research problem by leveraging the strengths of both paradigms within a single phase of data collection. Data were gathered before and after the internship period.

3.4.1 Pre-implementation phase

An online survey was administered to 31 PSTs during the second semester of the academic year, prior to internship deployment. Prior to implementation, semi-structured interviews were conducted purposely to selected PSTs using a pilot-tested interview protocol. Each interview lasted approximately 45 minutes

to one hour and aimed to gather initial insights into participants' perceptions of conventional lesson planning practices.

3.4.2 Implementation phase

Prior to the implementation of the CLP approach, the researcher conducted a training workshop to prepare PSTs and cooperating teachers. The workshop introduced the principles and procedures of CLP through lectures, lesson planning activities, and classroom demonstrations. Cooperating teachers were oriented on their roles as knowledgeable others, and all participants provided informed consent and were informed of the requirements, such as maintaining weekly reflection journals. Subsequently, 15 teams implemented the CLP model during the teaching internship. Each team collaboratively planned lessons with their cooperating teachers, conducted classroom teaching, engaged in post-lesson discussions, and revised lessons across cycles. The process consisted of iterative teaching and observation cycles, with up to three lesson implementations conducted within each cycle over approximately six cycles. Throughout the implementation, the researcher observed and documented the process during the entire duration of 45-day teaching internships.

3.4.3 post-implementation phase

Following the implementation of the CLP model, post-assessment survey and focus group discussions were conducted to gather both quantitative and qualitative data. Separate FGDs were held with selected PSTs and cooperating teachers involved in the classroom application of the CLP model. The primary objective of these sessions was to elicit in-depth feedback, including participants' ideas, suggestions, and critical reflections regarding the CLP process. All discussions were recorded using Google's online recording tool to ensure the accuracy and integrity of the data for subsequent analysis.

3.5 Treatment of Data

This study utilized three instruments, namely the science teacher efficacy instrument adapted from Bleicher (2004), the self-assessed collaborative skills instrument (Hinyard et al., 2019), and lesson plan assessment tool for science (LPATS), which was developed and validated by Canalita (2025). The LPATS underwent face and content validation, demonstrating excellent content validity indices (I-CVI – 1.00; kappa = 1.00). The data for self-efficacy and collaborative skills scale survey underwent re-coding in order to align the interpreted meaning with the theoretical construct. Since the survey questionnaire for self-efficacy and self-assessed collaborative skills scale were answered using a 5-point Likert scale, using strongly agree (5), agree (4), neutral (3), disagree (2) and strongly disagree (1), the means of these Likert scale responses were converted and re-categorized into 5-point scale descriptors which included very high (4.21-5.00), high (3.41-4.20), moderate (2.61-3.40), low (1.81- 2.60) and very low (1.00-1.80) levels. This re-coding was patterned from the study of Shahat et al. (2022).

In contrast, the individually-made lesson plans were rated by three teacher experts using the LPATS. Each statement in the instrument was rated as highly competent (3), fairly competent (2) and needs improvement (1). The mean of every statement was computed and entered to IBM Statistical Package for the Social

Sciences software to analyse the data to generate descriptive statistics which included the number of respondents, minimum and maximum ratings, means and standard deviations.

4. Results and Findings

4.1 Normality Test Results for Self-Efficacy, Collaborative Skills and Lesson Planning Competence

The Shapiro–Wilk test was conducted to assess the normality of the pre- and post-test scores for self-efficacy, collaborative skills, and lesson planning competence. A p-value less than 0.05 indicates a violation of the normality assumption, leading to the rejection of the null hypothesis (Yang & Berdine, 2021). As shown in Table 1, the results reveal varying distribution patterns across the variables.

Table 1: Shapiro-Wilk test of normality (*n* = 31)

	W Statistic	Df	Sig.	Remarks
Pre-self-efficacy	0.981	31	0.841*	Normally distributed
Post-self-efficacy	0.961	31	0.308*	Normally distributed
Pre-collaborative skills	0.78	31	0.001	Non-normal
Post-collaborative skills	0.806	31	0.001	Non-normal
Pre-lesson planning competence	0.933	31	0.052*	Normally distributed
Post-lesson planning competence	0.935	31	0.059*	Normally distributed

Specifically, self-efficacy and lesson planning competence (both pre- and post-test) yielded p-values greater than 0.05, indicating that their distributions do not significantly deviate from normality. In contrast, collaborative skills (pre- and post-test) produced p-values of 0.001, suggesting non-normal distributions. Accordingly, parametric tests are appropriate for analysing self-efficacy and lesson planning competence, whereas non-parametric methods are more suitable for collaborative skills to ensure robust and valid statistical inferences.

4.2 Effects of CLP on PSTs' Self-efficacy

Self-efficacy is categorized into PSTE and STOE. Table 2 shows the descriptive statistics of PSTs' self-efficacy scores before and after the implementation of CLP.

Table 2: Paired samples statistics of PSTs' self-efficacy (*n* = 31)

		Mean	Std. Deviation	Std. Error Mean	Level of Self-efficacy
Pair 1	Post PSTE	3.93	0.31	0.06	High
	Pre- PSTE	3.79	0.32	0.06	High
Pair 2	Post STOE	4.22	0.27	0.05	Very High
	Pre- STOE	3.81	0.38	0.06	High

Note: The mean values of self-efficacy are interpreted using the descriptive levels adopted from Shahat et al. (2022). These levels are as follows: 1.00 - 1.80 (very low), 1.81 - 2.60 (low), 2.61 – 3.40 (moderate), 3.41 - 4.20 (high), and 4.21 - 5.00 (very high)

The descriptive results in Table 2 show an initial indication of enhancement in PSTs' self-efficacy across two measurement periods. PSTE increased modestly from 3.79 to 3.93, with both levels remaining within the "high" category, while STOE demonstrated a more pronounced increase from 3.81 (high) to 4.22 (very high), suggesting stronger beliefs in the impact of effective science teaching on student learning. The slightly lower variability in post-test scores further indicated greater consistency in participants' self-efficacy beliefs. These findings are supported by participants' experiences, particularly the statement of PST14, who noted that engaging in collaborative discussions with experienced educators boosts confidence both in planning and lesson implementation.

> *''I think the CLP model did give me a boost of confidence. Having a collaborative conversation with two educators with years of expertise gave me multiple insights and techniques on how to improve my skills in lesson planning and implementing my lessons. Having them observe my class implementation also helped boost my confidence and allowed me to practice conducting my lesson with ease and a relaxed mind when someone with expertise observes my lesson. During my final demonstration, it felt weird for me since I did not feel nervous at all. It just felt like the usual class that I have.''* PST14

The opportunity to be observed and receive feedback enhances pre-service teachers' confidence, as reflected in reports of greater ease and reduced anxiety during teaching. This suggests that CLP strengthens both instructional practices and self-efficacy by fostering confidence through structured collaboration, feedback, and authentic teaching experiences. However, contrasting evidence from Konakbayeva et al. (2025) indicates that while microteaching lesson study improves lesson plan quality and overall teaching competence, particularly with generative AI support, it is accompanied by a consistent decline in teaching self-efficacy across groups, underscoring the need for further investigation into how technology-enhanced training influences both skill development and confidence. To determine whether these changes are statistically significant, paired sample tests were conducted comparing pre- and post-assessments of PSTE and STOE (Table 3).

Table 3: Paired samples test of PSTs' self-efficacy (n = 31)

		Mean diff	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)	Cohen's D
Pair 1	Post PSTE - Pre- PSTE	0.14	0.47	0.08	1.67	30	0.10	n/a
Pair 2	Post STOE - Pre- STOE	0.41	0.40	0.07	5.77	30	<0.01*	1.04

Note: level of significance (α=0.05)*
The effect size is interpreted according to Cohen (1988) and Sawilowsky (2009): - 0.10 (very small effect), 0.20 (small effect), 0.50 (medium effect), 0.80 (large effect), 1.20 (very large effect) and 2.00 (huge effect)

Inferential analysis using paired samples t-tests (Table 3) showed that the increase in PSTE was not statistically significant, $t(30) = 1.67$, $p = 0.10$, suggesting that CLP had limited influence on enhancing pre-service teachers' personal confidence in their teaching ability within the duration of the intervention. This finding may be attributed to the developmental nature of personal teaching efficacy, which typically requires prolonged classroom experience to strengthen. During teaching internship, PSTs may not have had enough time and opportunities to demonstrate competence independently or overcome challenges on their own that would substantially enhance their self-efficacy. This interpretation was further supported by a qualitative narrative, as the PSTs reported increase in pedagogical understanding but did not explicitly express boosting their personal confidence. These findings align with Bandura's (1997) assertion that mastery experiences are critical in enhancing self-efficacy.

In contrast, STOE showed a statistically significant increase, $t(30) = 5.77$, $p < 0.01$, with a large effect size ($d = 1.04$), indicating that CLP had a strong impact on participants' beliefs about the effectiveness of teaching in influencing student learning outcomes. While such large effect sizes in STOE can sometimes be influenced by factors like familiarity or repeated exposure to the assessment items, the qualitative data provide contextual evidence supporting genuine change. For example, participant PST2, expressed, "*My teaching confidence has improved after implementing the CLP… I was able to see the other strategies and point of view of my co-teachers… I was able to grasp what are the better teaching strategies and activities to use for students to learn science easily.*" This statement illustrates a meaningful shift in the teacher's perceived effectiveness and confidence, aligning with the quantitative results. It suggests that the observed improvement in STOE reflects changes in teachers' professional outlooks, rather than being merely an artifact of repeated assessment. The integration of quantitative and qualitative evidence therefore provides robust support for the positive influence of CLP on science teachers' outcome expectancy (STOE).

Hence, the findings demonstrate that CLP enhances pre-service teachers' self-efficacy through multiple mechanisms, including vicarious learning, social persuasion, mastery experiences, and improved emotional states. Consistent with Bandura's theory, these sources collectively contribute to the development of stronger professional beliefs. Notably, the results highlight that CLP is particularly effective in strengthening STOE, suggesting that collaborative approaches play a critical role in shaping teachers' beliefs about the impact of effective instruction on student learning. This distinction represents an important contribution of the study, emphasizing the differential effects of CLP on dimensions of self-efficacy.

4.2 Effects of CLP on PSTs' Collaborative Skills

Developing collaborative skills among remains a persistent challenge in the Philippine context, in which lesson planning is traditionally treated as an individual responsibility. During teaching internships, PSTs often prepare lessons independently, with minimal opportunities for structured collaboration, peer feedback, or shared decision-making. In this context, Table 4 presents a

comparison of PSTs' collaborative skills before and after participation in the CLP model.

Table 4: Paired samples statistics of PSTs' collaborative skills (*n* =31)

		Mean	Std. Deviation	Std. Error Mean	Level of Collaborative skills
Pair 1	Post-collaborative skills	3.92	0.21	0.04	High
	Pre-collaborative skills	3.84	0.18	0.03	High

Note: The mean values of collaborative skills are interpreted using the descriptive levels adopted from Shahat et al. (2022). These levels are as follows: 1.00 - 1.80 (very low), 1.81 - 2.60 (low), 2.61 – 3.40 (moderate), 3.41 - 4.20 (high), and 4.21 - 5.00 (very high)

The results indicate an enhancement in the collaborative skills, as reflected by the increase in the mean scores from 3.84 (sd= 0.18) to 3.92 (sd = 0.21), with both interpreted as "high." Although the improvement is minimal, it suggests a modest enhancement in collaborative skills following the intervention. This limited change may indicate that the duration or structure of CLP was not sufficient to produce substantial gains, or that collaborative skills require longer-term development. To determine whether this observed change is statistically significant, the Wilcoxon signed-rank test was employed due to the non-normal distribution of the data as shown in Table 5.

Table 5: Wilcoxon Signed Rank Tests of PSTs' collaborative skills (*n* = 31)

		Test Statistic	Standard Error	Standardized Test Statistic	Asymptotic Sig. (2-sided test)	Wilcoxon effect size (r)
Pair 1	Post-collaborative skills Pre-collaborative skills	250.50	36.82	2.39	0.02*	0.43

Note: Significant (**α**=0.05)*
The effect size r was interpreted according to Cohen (1988)) - /r/ < 0.1 (no effect), /r/ = 0.1 (small effect), /r/ = 0.3 (medium effect) and /r/ = 0.5 (large effect)

The analysis revealed a statistically significant enhancement in PSTs' collaborative skills following the intervention (W = 250,50, z =2.39, p = 0.02), indicating that the observed increase in collaborative skills was unlikely to have occurred by chance, as shown in Table 5. Furthermore, the calculated effect size (r = 0.43) indicates medium effect according to Cohen's (1988) criteria. It implies that CLP had a practically meaningful influence on PSTs' collaborative skills.

This quantitative trend is supported by the qualitative findings, which indicate gradual development of collaborative skills among participants. PST explained that while collaboration was initially challenging due to difficulty in expressing ideas, the CLP experience helped them become more open and confident in sharing thoughts, particularly with the support of the cooperating teacher. As stated, "*At first, it was hard for me because I am the type of person where I have a hard time expressing my ideas or thoughts. But because of this CLP implementation I learned*

to be more open and express myself especially with the help of my cooperating teacher" PST11.

This narrative explicitly justifies the slight increase in mean scores, suggesting that CLP fostered emerging collaborative growth but the development appears gradual and may require sustained practice to yield stronger measurable gains. Similarly, Yeşilçınar and Aykan (2022) found that collaborative and reflective practices contribute to the development of pre-service teachers' 21st century skills, but insufficient self-efficacy and fear of criticism may hinder willingness to openly share experiences with peers.

The findings suggest that CLP contributes to the development of collaborative skills by promoting communication, shared responsibility, and professional interaction. Despite challenges, PSTs demonstrate resilience and adaptability, indicating that CLP provides valuable preparation for collaborative practice in the teaching profession. The results imply that CLP not only enhances collaboration but also supports the development of "collaborative-practice readiness" among future teachers.

4.3 Effects of CLP on PSTs' Lesson Planning Competence

Lesson planning competence refers to a teacher's ability to design, organize, and implement lesson plans that effectively support student learning. As noted by Süral (2019), well-prepared lesson plans improve both teaching quality and student achievement, highlighting the need for pre-service teachers to develop strong planning skills. In this study, all PSTs used the 7E lesson plan model (The 7Es are elicit, engage, explore, explain, elaborate, evaluate, and extend) which structures lessons from activating prior knowledge to assessing learning outcomes.

Although many studies have examined teacher training in lesson planning, König et al. (2020) pointed out that empirical evidence on actual lesson planning competence remains limited. To address this gap, PSTs' lesson plans were evaluated before and after the CLP implementation using the LPATS, with ratings provided by three expert teachers. The results were then analysed using paired t-tests, as presented in Table 6 and Table 7, to determine changes in lesson planning competence following the intervention.

Table 6: Paired samples statistics of lesson planning competence (n=31)

		Mean	Std. Deviation	Std. Error Mean	Level of Lesson Planning Competence
Pair 1	Post-Before the Lesson (Post-BtL)	2.54	0.18	0.03	Highly competent
	Pre-Before the Lesson (Pre-BtL)	2.02	0.32	0.06	Fairly competent
Pair 2	Post-The Lesson Proper (Post-tLP)	2.61	0.22	0.04	Highly competent
	Pre-The Lesson Proper (Pre-tLP)	2.14	0.43	0.08	Fairly competent
Pair 3	Post-After the Lesson (Post-AtL)	2.56	0.27	0.05	Highly competent
	Pre-After the Lesson (Pre-AtL)	1.92	0.38	0.07	Fairly competent

Note: Levels of lesson planning competence: 2.34 -3.00 (highly competent), 1.67 – 2.33 (fairly competent) and 1.00 – 1.66 (needs improvement)

As shown in Table 6, PSTs demonstrated enhanced lesson planning competence following participation in CLP model. Mean scores increased across all lesson plan phases before the lesson, the lesson proper, and after the lesson, improving from "fairly competent" to "highly competent". These findings suggest that engagement in CLP contributed to strengthening PSTs' competence in designing, implementing, and reflecting on instruction throughout the lesson cycle.

This is aligned with the PST13 statement, who explained that lesson planning became easier through collaboration with peers and the cooperating teacher. The participant noted that CLP helped address challenges in creating objectives, selecting activities, and aligning lesson components.

> *''For me, writing a lesson plan by group is much easier than writing it alone because if you are in a group, you will be able to share your ideas and receive the ideas of other people as well. In that way, you as a group will be able to make a lesson plan that is made through the collaboration of each member which I believe is very effective. I admit I have improved in writing a lesson plan especially because of the collaboration with my partner and my cooperating teacher. My ability to design a lesson plan has significantly improved after implementing the CLP model because before our teaching internship, when we were still doing teaching demonstration in IIT, I find it really hard to design my own lesson plan because it was always a challenge on how to create lesson objectives, how to find activities, and how to make the entire content align with all the objectives. But after implementing the CLP model, it was easier for me to make the three (cognitive, psychomotor, and affective) learning objectives, make activities and align my lesson content to all the objectives through the help of my CT who always guides us in every step of the way, and my partner whom I can share my thoughts and ideas. Through our collaboration, lesson planning was made easier and my internship was indeed fruitful.''* PST13

With shared input and guidance, PST13 reported improved ability to design well-aligned lesson plans, confirming that collaboration directly contributed to the observed improvement in competence. This positive effect can be further validated through additional statistical tests, such as the paired t-test, as shown in Table 7.

Table 7: Paired Sample Tests of PSTs Lesson Planning Competence (n=31)

		Mean diff	Std. Deviation	Std. Error Mean	T	df	Sig. (2-tailed)	Cohen's D
Pair 1	Post-Before the Lesson Pre-Before the Lesson	0.52	0.32	0.06	9.17	30	<0.001	1.65
Pair 2	Post-The Lesson Proper Pre-the Lesson Proper	0.47	0.43	0.08	6.09	30	<0.001	1.09
Pair 3	Post-After the Lesson Pre-After the Lesson	0.64	0.48	0.09	7.38	30	<0.001	1.33

Note: level of significance (**α**=0.05)*
The effect size was interpreted according to Cohen (1988) and Sawilowsky (2009): - 0.10 (very small effect), 0.20 (small effect), 0.50 (medium effect), 0.80 (large effect), 1.20 (very large effect) and 2.00 (huge effect)

Table 7 shows that lesson planning competence significantly improved after the implementation of CLP across all three domains: before the lesson (mean difference = 0.52), during the lesson (0.47), and after the lesson (0.64). The paired t-test confirmed that these gains were statistically significant ($p < 0.001$), with large to very large effect sizes (Cohen's d = 1.09–1.65), indicating that CLP had a strong impact on enhancing PSTs' lesson planning competence.

The significant improvement and large effect sizes in the lesson planning competence suggest that CLP is highly effective. However, it is also important to consider factors such as rater familiarity that may have contributed to these findings. To mitigate this, LPATS was validated by experts prior to the study and the teacher raters were trained to apply the rubric consistently. Moreover, the assessment tool had standardized criteria before and after the intervention, reducing variability caused by rater's familiarity. This finding is consistent with the study of Duarte et al. (2025), which demonstrates that lesson study functions as an effective formative approach in pre-service teacher education by promoting exploratory teaching and fostering collaborative, reflective engagement focused on pupil learning. Moreover, structured lesson study activities—such as lesson design, task selection, and the anticipation of student responses—further strengthen pre-service teachers' didactic knowledge, thereby supporting more effective planning and implementation of instruction.

Despite this significant improvement in lesson planning competence, a few of the participants acknowledged challenges and difficulties associated with its implementation. A cooperating teacher identified several potential weaknesses, including substantial time required for collaboration, conflict possibility, reduced autonomy, and unequal participation of the CLP members.

> *''While CLP offers numerous benefits, it also presents some potential weaknesses like time consuming, conflict and compromise, dependency on the group dynamics, loss of individual autonomy, unequal participation, resources constraints, implementation challenges and resistance to change. These weaknesses can be mitigated through proactive communication, training in collaborative skills, establishing clear processes, fostering a supportive educational culture and recognizing and addressing individual needs and preferences.''* CT17

These concerns suggest that the effectiveness of CLP is influenced not only by the collaborative process itself but also by the organizational and interpersonal conditions under which it is implemented. Consistent with social constructivism theory, successful collaboration requires shared responsibility, effective communication among participants, and supportive culture. This implies that the benefit of CLP is not automatic but depends on the intentional structures and support mechanisms that facilitate meaningful collaboration.

5. Discussion

The findings demonstrate that CLP during teaching internships can significantly enhance pre-service teachers' confidence, collaborative skills, and lesson planning abilities. These outcomes support earlier research, such as Buan et al. (2019), which indicated that collaborative planning positively influences pre-service mathematics teachers by providing opportunities for peer feedback, reflection, and collecting problem solving.

However, some factors may reduce its effectiveness. For example, Irzawati (2023) highlighted that the disadvantages of collaboration include unequal task distribution, interpersonal conflict, and distraction during group work. The study revealed that some participants contributed less and relied heavily on more capable peers, resulting in an unfair workload and reduced individual accountability. Others noted that differences in opinions can lead to conflicts and disagreements. Moreover, collaborative discussions sometimes diverted attention to unrelated topics, reducing focus and productivity. These findings suggest that the success of CLP depends not only on bringing the team members together but also establishing clear roles, promoting equitable participation, and maintaining task-focused interactions.

This study contributes to the literature by providing evidence of the effectiveness of CLP on enhancing pre-service science teachers' professional attributes, such as self-efficacy, collaborative skills, and lesson planning competence within post-pandemic context. Compared to traditional, individual lesson planning, CLP promotes richer dialogue, shared responsibility, and heightened professional interaction—vital in science education, in which collaboration often influences

instructional quality. However, challenges such as maintaining motivation and managing team dynamics remain, especially in online settings, emphasizing the need for ongoing mentorship.

Another critical reflection worth mentioning is that while there was a noticeable improvement in collaborative skills and lesson planning competence, the increase in teachers' personal belief in their teaching ability was modest and not quite statistically significant. This suggests that developing real confidence likely takes more time and repeated success, which may not be fully captured in a short-term intervention. Although the immediate benefits were clear, we do not know yet if these improvements will persist in the long term.

In addition, the improvements observed in participants may have been influenced by factors other than the CLP intervention, limiting the extent to which causal conclusions can be drawn and the generalizability of the findings. Future research should address this limitation by employing more rigorous experimental or comparative designs, examining the long-term effects of CLP, and comparing it with other teacher preparation approaches to strengthen the evidence base for effective science teacher education strategies.

Finally, the findings highlight that structured CLP is a practical approach for developing more reflective, confident, collaborative, and competent science teachers. To maximize its impact, teacher education programs should embed sustained collaborative activities within internship experiences, supported by regular feedback and reflective discussions.

6. Conclusion

The study provided valuable insights into how CLP enhances pre-service science teachers' self-efficacy, collaborative skills and lesson planning competence, grounded in Bandura's social cognitive theory and Vygotsky's social constructivism theory. By illustrating how the collaborative model of practice fostered mastery, vicarious learning and shared reflections, the findings demonstrated that these three dimensions are closely interconnected. As pre-service teachers engaged in collaborative learning, their confidence and competence in designing lessons improved substantially, while their personal teaching efficacy developed progressively.

A notable contribution of this study was its examination of how CLP influenced three key attributes—teacher self-efficacy, collaborative skills, and lesson planning competence among pre-service science teachers during post-pandemic teaching internships. The primary contribution lies in the combined examination of these three outcome variables using a mixed-methods approach within a post-COVID-19 context, providing a more comprehensive understanding of the impact of CLP on pre-service teacher development. The findings suggested that, even within a challenging educational landscape shaped by the pandemic, CLP strengthened resilience and professional capacity among both pre-service and in-service teachers by fostering a community of learners.

The study recommended conducting longitudinal research to determine whether these benefits would be sustained over time and whether CLP produces greater improvement in self-efficacy. In addition, comparing CLP with other scaffolded approaches, particularly in fully online contexts, may offer insights into optimizing teacher preparation. Ultimately, the findings suggested that when pre-service teachers work together meaningfully, they not only enhance their teaching skills but also strengthen their confidence and teamwork skills, creating a positive feedback loop that prepares them to navigate the complexities of real classroom practice.

Conflict of Interest

The author has no conflicts of interest to declare relevant to this article's content.

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