Formosa Journal of Science and Technology (FJST)
Vol. 4, No. 4, 2025: 1037-1056

Engagement in the Lesson Study and Competence of Science Teachers: Basis for Contextualized Lesson Study Model

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A R T I C L E I N F O
Keywords: Instructional Improvement, Lesson Study, Professional Development, Science Education, Science Teacher Competence

Received : 25, March
Revised : 8, April
Accepted : 22, April

A B S T R A C T
This study examined the impact of Lesson Study on the teaching competencies of science teachers and the challenges they encountered during its phases, with the aim of developing a contextualized Lesson Study model. Using a quantitative descriptive design, 15 in-service Junior High School science teachers in Rizal were observed before and after engaging in Lesson Study, and their teaching competence was evaluated using a validated classroom rating tool. A survey was followed and measured their engagement and identified challenges. Data were gathered over a month and analyzed using descriptive and inferential statistics. Results showed enhanced competencies and high engagement, with some implementation challenges as inputs to the proposed model. Findings offer insights for improving science instruction through collaborative professional development.

ISSN-E: 2964-6804
DOI: https://doi.org/10.55927/fjst.v4i4.52
https://traformosapublisher.org/index.php/fjst

INTRODUCTION

In the 2018 PISA science literacy assessment, the performance of Filipino students was notably poor. Out of 7,233 15-year-old participants from the Philippines, only 22% met the minimum competency level (Level 2) in science literacy. The 2022 PISA results for Filipino students in Science were similar to the results in 2018 (OECD, 2O19). In Science, 23% of the students achieved at least Level 2 proficiency, indicating that less than a quarter of the participants could understand and explain basic scientific phenomena and validate conclusions (PISA 2022 Results, 2023).

The National Achievement Test (NAT) in Grade 10 School Year 2022-2023 in Science for the Division of Rizal Province obtained a mean percentage score of 35.36, which is below the national target. In addition, the average mean percentage score of the four quarterly assessments in the division for the school year 2023-2024 in Science Grade 7 to Grade 10 obtained an MPS of 60.03 or verbally interpreted as "Nearly Proficient".

The PISA, NAT and assessment results highlight an opportunity for teachers to innovate and enhance students' science literacy (Cordon & Polong, 2020). Effective science teachers develop students' abilities to investigate and understand environmental materials and phenomena, empowering them to become informed decision-makers within their communities. Teachers may need to modify their traditional instructional methods, becoming well-versed in both the pedagogical and technological requirements of the new learning approaches in Science (MATATAG Curriculum, 2023).

Consequently, dedicated science teachers should be reflective, collaborative, and lifelong learners (Cordon & Polong, 2020). Collaborative professional development and sharing best practices are essential for improving instruction. Without these, the adoption of innovative teaching methods may be significantly delayed (Cojorn & Sonsupap, 2024).

A great way to promote meaningful collaboration among teachers is through lesson study, a hands-on, school-based approach to professional learning. In this process, teachers work together to study a lesson, plan its delivery, teach it, observe its impact, reflect on the outcomes, and refine it for improvement. This cycle helps educators continuously enhance their teaching strategies and student learning experiences (Erbilgin & Robinson, 2025).

This study examined the impact of teachers' participation in lesson study on the enhancement of their teaching competencies in Science. It also identified the degree of the challenges they encountered throughout the process. Based on the data collected and analyzed, a contextualized lesson study model for teaching Science was developed, which can be further validated and potentially adopted across the province of Rizal.

THEORETICAL REVIEW

Social Constructivism

Social constructivism proposes that knowledge is created through social interactions, emphasizing the importance of social negotiation, discourse, reflection, and explanation. This theory highlights the necessity for teachers to engage in activities that promote frequent verbal communication and

collaboration with both novices and experts in their field (Rock & Wilson, 2005). It also supports the lesson study process, where teachers work together to evaluate and refine their teaching practices.

As teachers engage in lesson study, they encounter numerous opportunities to reflect, analyze, develop action steps, evaluate outcomes, and share their understandings with colleagues, thus promoting continuous professional growth and development.

H1: There is no significant difference between the level of competence of the participants before and after their engagement in the lesson study.

The study conducted by Mengistu et al. (2023) demonstrated how primary school English teachers perceived and used Lesson Study (LS) to improve classroom practices. The study discovered that the participating teachers' opinions of LS and their methods in the classroom improved following a six-week intervention. When it came to creating, executing, and reviewing their lesson plans, teachers who participated in the lesson study performed better. When comparing post-intervention scores to pre-intervention scores, the paired sample t-test revealed a substantial improvement. The study also indicates that Lesson Study improved teachers' abilities and encouraged teamwork among colleagues.

Situated Learning Theory

As proposed by Lave and Wenger (1991), this theory aligns with both the Lesson Study and Vygotsky's Social Constructivism Theory. It emphasizes that learning takes place within a community of practice, where newcomers acquire the necessary skills by engaging with experienced members. According to Lanni (2024), who discussed their work, to become active participants, learners must familiarize themselves with the community's norms, including its language, activities, and expectations, a process known as legitimate peripheral participation.

This theory suggests that learning is not solely achieved through direct instruction but is deeply embedded in social interactions. Newcomers observe and collaborate with experienced members, gradually gaining expertise and eventually mentoring others. Over time, these learners transition into veteran members who guide new participants, ensuring continuous knowledge-building within the community. Rather than being transmitted through lectures, knowledge is constructed through hands-on engagement, communication, and collaborative participation (Lanni, 2024).

H2: There is no significant relationship between the level of engagement of participants in the lesson study and their level of competence after the engagement in the lesson study.

Similarly, the study by Mapulanga et al. (2023) explored teachers' enacted topic-specific PCK (TSPCK) during the biology lesson study stages: planning, teaching, and reflecting. The findings revealed that the teacher applied both higher-order and lower-order pedagogical strategies when implementing Topic-Specific Pedagogical Content Knowledge (TSPCK) across eight key areas: teaching strategies, classroom interactions, representations, curricular saliency, conceptual teaching strategies, students' prior knowledge and misconceptions,

and challenges in teaching and learning. Additionally, the results indicated that teachers' collectively planned TSPCK was more refined than their individual TSPCK, suggesting that engaging in Lesson Study enhanced their instructional knowledge. This study highlights how teachers apply both personal and collaborative TSPCK in teaching and underscores the effectiveness of Lesson Study in strengthening teachers' pedagogical content knowledge through shared planning and reflective discussions.

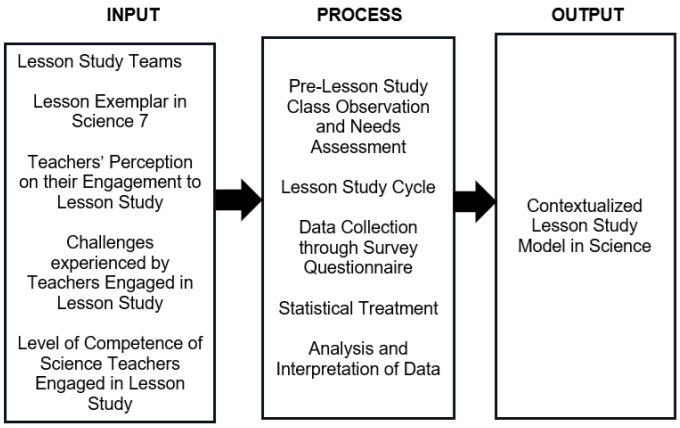

Figure 1. Conceptual Framework

Statement of the Problem

This study aimed to determine the engagement and competence of science teachers as input in developing a contextualized lesson study model. Specifically, this study sought answers to the following questions:

1. What is the level of competence of the participants before and after the engagement in lesson study in terms of:
   1.1 Content Knowledge in Science;
   1.2 Teaching Strategies;
   1.3 Classroom Management; and
   1.4 Assessment of learning outcomes?
2. Is there a significant difference between the level of competence of the participants before and after the engagement in the lesson study?
3. What is the level of engagement in the lesson study in terms of:
   3.1 Planning the research lesson;
   3.2 Implementation of the research lesson; and
   3.3 Post-lesson reflection and discussion?
4. Is there a significant relationship between the level of engagement of participants in lesson study and the level of competence of participants after the engagement in lesson study?
5. What is the degree of the challenges experienced by the participants in their engagement in the lesson study in terms of:
   5.1. planning the research lesson;
   5.2. implementation of the research lesson; and
   5.3. post-lesson reflection and discussion?
6. Based on the findings of this study, what contextualized lesson study model in Science can be developed?

METHODOLOGY

Research Design

This study utilized the quantitative descriptive research design. A quantitative descriptive research design involves systematically collecting and analyzing numerical data to describe characteristics of a phenomenon or population without determining causal relationships. In the context of lesson study research, this design can assess the impact of teachers' participation on their teaching competencies. In this study, quantitative data were collected and analyzed through pre- and post-lesson study rating sheets to assess changes in teachers' competence resulting from their participation in the lesson study. A survey questionnaire also determined teachers' level of engagement and challenges experienced. The results were used as inputs in the development of a contextualized lesson study model in Science.

Population and Sampling

The study was conducted in fifteen public Junior High Schools in the province of Rizal. One school per municipality was chosen to initiate the implementation of the lesson study. Purposive sampling was employed in this study. Purposive sampling allows the researcher to intentionally select participants who will participate in the lesson study process.

Respondents of the Study

The respondents for this study consisted of 15 Grade 7 Science teachers from the selected schools. The selected teachers served as the focus teachers who implemented the research lesson. The focus teachers engaged in lesson study teams in their respective schools, wherein they collaborated with other educators in the lesson study process. A lesson study team is composed of three or more teachers, and each member performs individual roles such as facilitator, documenter, and observer, with the facilitator guiding the lesson study sessions, the documenter recording detailed observations, and observers critically examining teaching practices and student interactions. "Knowledgeable others" were also invited to participate in the lesson study.

Research Instrument

The following research instruments were used in collecting data:

Researcher-Made Questionnaire Checklists

The questionnaires are designed to quantitatively assess teachers' perceptions of their engagement and challenges experienced in the lesson study across three key phases: planning the research lesson, implementation of the research lesson, and post-lesson reflection and discussion. Utilizing a 4-point Likert scale for a.) questionnaire 1 (1 = Not Engaged, 2 = Slightly Engaged, 3 = Moderately Engaged , 4 = Highly Engaged) and b.) questionnaire 2 (1 = Not Challenging, 2 = Slightly Challenging, 3 =Challenging, 4 = Very Challenging) each questionnaire comprised 30 statements each that gauge teachers'

confidence, preparedness, and perceived value of their participation in each phase of the lesson study.

Researcher-Made Rating Sheet for Teaching Competence

This tool is designed to assess the level of competence of Science teachers before and after the lesson study cycle across four key areas: content knowledge in Science, teaching strategies, classroom management, and assessment of learning outcomes. Observers rated the teacher's performance using a 4-point scale (1 = Novice, 2 = Developing Competence, 3 = Competent, 4 = Highly Competent).

Validation of the Instrument

The instruments used in the study were validated by seven experts, including two Education Program Supervisors and five professors from different universities in the Philippines, to ensure their reliability and appropriateness for the research. Based on the validation results, the instruments achieved an overall average rating of 3.71, which falls within the "Highly Valid" category. Each criterion, including relevance, clarity, technical soundness, and cultural acceptability, was carefully assessed, with ratings ranging from 3.57 to 3.86. These results indicate that the instruments are well-structured and suitable for gathering meaningful data.

Data Gathering Procedure

The researcher first secured a permit from the Schools Division Superintendent of Rizal Province to conduct the study. Next, a capacity-building activity on lesson study in Science was conducted among the study participants. Consequently, the lesson study teams were formulated, assigning roles to each participant. One teacher was assigned as a research lesson implementer or focus teacher, while the rest served as facilitators, documenters, and classroom observers. Prior to the first lesson study session, the lesson implementers were observed in the classroom. The classroom teaching was rated by the master teacher using the rating sheet for teaching competence, and the classroom observers investigated teachers' practices and student participation. The team documented the findings based on classroom observation.

The implementation of the Lesson Study in this research followed a structured cycle based on the model of Ulep (2013), outlined in the guidebook published by UP NISMED (2016), consisting of three main phases: Planning the research lesson, Implementation of the research lesson, and Post-lesson reflection and discussion. The lesson study cycle began with planning. The lesson study team collaborated on designing the lesson plan, including the topic, lesson objectives, strategies to be used, and assessment tools to be applied. The focus teacher implemented the research lesson with the class while the rest of the team observed. The observers collected data and noted the changes in students' learning outcomes. The master teacher rated the classroom teaching for the second time. The lesson study team then convened for the post-lesson reflection and discussion. The team discussed what went well and what things could be done to improve the lesson. The lesson is then revised based on observations made during the implementation, the insights of the team and the results of the

group discussion. Survey questionnaires were given to lesson study participants, particularly the focus teacher, after one cycle to determine their perceptions of their participation during the lesson study in Science and the challenges they experienced.

Statistical Treatment of Data

A weighted mean was applied to determine the level of competence of science teachers engaged in lesson study regarding the different aspects. A paired t-test was used to determine whether there was a significant difference in the level of competence of Science teachers before and after engagement in the lesson study. To determine the teachers' perceptions of their level of engagement in the lesson study, weighted mean was used. Likewise, the weighted mean was used to determine the degree of challenges teachers experienced in engaging in the lesson study. To determine the correlation between the level of engagement in the lesson study and the level of competence of Science teachers, Pearson r and t-test for correlation were used.

RESULTS AND DISCUSSION

The study's results and implications for our current knowledge of the topic are discussed in this section.

Level of competence of the participants before and after the engagement in lesson study in terms of the different aspects

Table 1. Level of Competence of the Participants Before and After the Engagement in Lesson Study in terms of Content Knowledge in Science

Indicators	Before		After	
The teacher…	$\bar{x}$	VI	$\bar{x}$	VI
1. demonstrates thorough and accurate knowledge of Science content.	3.47	Competent	3.93	Highly Competent
2. provides clear and comprehensive explanations of scientific principles.	3.27	Competent	3.80	Highly Competent
3. integrates cross-curricular connections where applicable.	2.80	Competent	3.87	Highly Competent
4. integrates real-world examples to illustrate scientific concepts.	3.33	Competent	3.87	Highly Competent
5. identifies and corrects student misconceptions in Science.	3.07	Competent	3.67	Highly Competent
Overall Mean	**3.19**	**Competent**	**3.83**	**Highly Competent**

Legend: 3.50 – 4.00 = Highly Competent; 2.50 – 3.49 = Competent, 1.50 – 2.49 = Developing Competence, 1.00 – 1.49 = Novice

The table shows the overall level of competence of the participants before the lesson study as to content knowledge in Science was found to be "Competent" with an overall mean of 3.19, while their level of competence after the lesson study was found to be "Highly Competent" with an overall mean of 3.83. The findings indicate that Lesson Study is an effective professional

development approach that enhances teachers' scientific content knowledge and pedagogical competence.

This finding was supported by the study of Benedict et al. (2020), which investigated how lesson study, combined with the content-focused professional development (PD) model, influences reading teachers' competence in content knowledge within a structured PD framework. Results revealed that through collaborative interactions during Lesson Study sessions, teachers enhanced their understanding of word study content, improved pedagogical techniques, identified students' literacy challenges, and refined strategies for coordinating instruction across different learning levels.

Table 2. Level of Competence of the Participants Before and After the Engagement in Lesson Study in terms of Teaching Strategies

Indicators	Before		After	
The teacher…	$\bar{x}$	VI	$\bar{x}$	VI
1. uses a variety of teaching strategies to engage students in learning Science.	3.20	Competent	3.73	Highly Competent
2. actively involves students in the learning process.	3.33	Competent	3.87	Highly Competent
3. tailors instruction to accommodate students' diverse learning needs and abilities.	3.00	Competent	3.73	Highly Competent
4. integrates technology effectively to enhance learning.	3.33	Competent	3.80	Highly Competent
5. encourages students to think critically and solve problems.	3.07	Competent	3.80	Highly Competent
Overall Mean	**3.19**	**Competent**	**3.79**	**Highly Competent**

Legend: 3.50 – 4.00 = Highly Competent; 2.50 – 3.49 = Competent, 1.50 – 2.49 = Developing Competence, 1.00 – 1.49 = Novice

It can be gleaned from Table 2 that the overall level of competence of the respondents before the lesson study as to teaching strategies was found to be "Competent" with an overall mean of 3.19, while their level of competence after the lesson study was found to be "Highly Competent" with an overall mean of 3.79. The findings indicate that Lesson Study is an effective professional development tool for improving Science teachers' pedagogical strategies.

Similarly, the study by Dibaba et al. (2024) showed that when secondary school mathematics teachers participated in lesson study, they became more confident and skilled in their teaching strategies when planning their lessons. They started putting more thought into designing detailed lesson plans, making better use of curriculum materials, and creating lessons that focused more on student engagement. Lesson study proved to be a valuable tool in helping teachers improve their approach to lesson planning.

As revealed in Table 3, the overall level of competence of the respondents before the lesson study as to classroom management was found to be "Competent" with an overall mean of 3.32, while their level of competence after the lesson study was found to be "Highly Competent" with an overall mean of 3.83. Science teachers promote collaborative learning experiences that encourage

peer engagement and support, allowing students to create a good learning atmosphere favorable to learning.

Table 3. Level of Competence of the Participants Before and After the Engagement in Lesson Study in terms of Classroom Management

Indicators	Before		After	
The teacher….	$\bar{x}$	VI	$\bar{x}$	VI
1. creates a positive and conducive learning environment.	3.40	Competent	3.87	Highly Competent
2. effectively manages student behavior and maintains discipline.	3.27	Competent	3.73	Highly Competent
3. manages class time efficiently to maximize learning.	3.20	Competent	3.80	Highly Competent
4. ensures students have access to necessary materials and resources during activities.	3.40	Competent	3.87	Highly Competent
5. promotes collaborative learning experiences that foster peer interaction and support.	3.33	Competent	3.87	Highly Competent
Overall Mean	**3.32**	**Competent**	**3.83**	**Highly Competent**

Legend: 3.50 – 4.00 = Highly Competent; 2.50 – 3.49 = Competent, 1.50 – 2.49 = Developing Competence, 1.00 – 1.49 = Novice

A study that confirms this is Altınsoy (2021), which states that the Lesson Study intervention influenced participants' classroom management skills in different ways and to varying extents. It was particularly effective in enhancing their awareness of student learning observations, improving how they give instructions, and refining their lesson planning strategies.

Table 4. Level of Competence of the Participants Before and After the Engagement in Lesson Study in terms of Assessment of Learning Outcomes

Indicators	Before		After	
The teacher…	$\bar{x}$	VI	$\bar{x}$	VI
1. uses a range of assessment methods (e.g., quizzes, projects, performances) to measure student learning.	3.27	Competent	3.80	Highly Competent
2. provides timely and constructive feedback to students.	3.33	Competent	3.73	Highly Competent
3. aligns assessments with the learning objectives and standards.	3.40	Competent	3.80	Highly Competent
4. integrates formative assessment practices that support continuous learning and growth.	3.33	Competent	3.87	Highly Competent
5. clearly communicates assessment criteria and expectations to students.	3.07	Competent	3.87	Highly Competent
Overall Mean	**3.28**	**Competent**	**3.80**	**Highly Competent**

Legend: 3.50 – 4.00 = Highly Competent; 2.50 – 3.49 = Competent, 1.50 – 2.49 = Developing Competence, 1.00 – 1.49 = Novice

Based on Table 4, the overall level of competence of the respondents before the lesson study as to the assessment of learning outcomes was found to be "Competent" with an overall mean of 3.28, while their level of competence after the lesson study was found to be "Highly Competent" with an overall mean of 3.80. Teachers improved their approaches to assessing learning outcomes, notably by including formative assessment practices that promote ongoing learning and growth and communicating assessment criteria and expectations to students.

Abate et al. (2023) study examined how the Lesson Study for Teacher Assessment (LSforTA) helped secondary school mathematics teachers improve their classroom assessment practices. Findings revealed that LSforTA enhanced teachers' understanding and use of various levels of mathematics assessment tasks. Overall, teachers responded positively to the program, noting that it improved their ability to assess student learning effectively. They also felt more confident in providing meaningful feedback and gained a clearer understanding of their student's knowledge and skills.

Significant Difference Between the Level of Competence of the Participants Before and After the Engagement in the Lesson Study

Table 5. Significant Difference Between the Level of Competence of the Participants Before and After the Engagement in the Lesson Study

Variables	Coefficient of t		P-value	Decision	Interpretation
	Critical	Computed			
Content Knowledge in Science	2.145	4.824	<0.001	***Reject Ho***	***Significant***
Teaching Strategies	2.145	4.922	<0.001	***Reject Ho***	***Significant***
Classroom Management	2.145	3.965	0.001	***Reject Ho***	***Significant***
Assessment of Learning Outcomes	2.145	2.284	0.038	***Reject Ho***	***Significant***

Legend: t = Paired t-test

Based on Table 5, the overall level of competence of the participants in terms of content knowledge in Science, teaching strategies, classroom management, and assessment of learning outcomes significantly differ before and after the engagement in the lesson study. The teachers of Science were already competent in teaching and learning Science in its entirety, but with the assistance of the lesson study, they were able to differentiate themselves as capable educators. It was determined that the teaching competencies of the science teachers, as well as their teaching experience of classroom pedagogical approaches, were remarkable and that they demonstrated improvement in the teaching-learning process as part of their professional development.

The study conducted by Mengistu et al. (2023) demonstrated how primary school English teachers perceived and used Lesson Study (LS) to improve classroom practices. The study discovered that the participating teachers'

opinions of LS and their methods in the classroom improved following a six-week intervention. When it came to creating, executing, and reviewing their lesson plans, teachers who participated in the lesson study performed better. When comparing post-intervention scores to pre-intervention scores, the paired sample t-test revealed a substantial improvement. The study also indicates that Lesson Study improved teachers' abilities and encouraged teamwork among colleagues.

Level of Engagement of the Participants in the Lesson Study

Table 6. Summary of the Level of Engagement of the Participants in the Lesson Study

	Before	
	$\bar{x}$	VI
Planning the Research	3.89	Highly Engaged
Implementation of the Research Lesson	3.89	Highly Engaged
Post-lesson Reflection and Discussion	3.96	Highly Engaged
Mean	3.91	Highly Engaged

Legend: 3.50 – 4.00 = Highly Engaged; 2.50 – 3.49 = Moderately Engaged, 1.50 – 2.49 = Slightly Engaged, 1.00 – 1.49 = Not Engaged

It was evident in Table 6 that overall, the level of engagement in the lesson study in terms of the different phases was found to be "Highly Engaged," with an overall mean of 3.91. Participants consistently demonstrated active involvement and collaboration throughout the Lesson Study, which may have contributed positively to their professional growth and instructional effectiveness.

A study that confirms this is Bozkurt and ÖzdemiR (2023), which states that the engagement of mathematics teachers in lesson study as a professional development model helped them to transition from focusing on content delivery to prioritizing how students actively engaged with the material while planning the research lesson. They became more intentional about structuring lessons, carefully considering how to present concepts effectively. In addition, Paldy et al. (2023) found that instructors' perceptions of the implementation of lesson study were positive. In this study, four teachers from Bua Secondary School acted as respondents and model teachers for lesson study activities. According to the results, lesson study increased student engagement and teachers' inventiveness and creativity in developing and executing differentiated instruction. Observers' comments helped to raise the standard of instruction. Benefits like the opportunity to create creative and captivating classes, give students pleasurable learning experiences, and improve the general standard of education to be more meaningful and student-centered were also mentioned by the teachers. The findings above were consistent with the research conducted by Lertdechapat and Faikhamta (2021) found that participating in post-lesson discussions within their lesson study groups helped teacher candidates develop their pedagogical content knowledge (PCK) for STEM without needing multiple rounds of LS engagement.

Significant Relationship Between the Level of Engagement and the Level of Competence of Participants After the Engagement in Lesson Study

Table 7. Results of the Significant Relationship Between the Level of Engagement and the Level of Competence of Participants After the Engagement in Lesson Study

	r-value	interpretation	P-value	Decision	Interpretation
Level of Engagement VS Level of Competence	0.518255	Strong Correlation	0.048	***Reject Ho***	***Significant***

Table 7 shows a statistically significant relationship between the level of engagement in Lesson Study and the teaching competence of participants, as indicated by a p-value of 0.048. The correlation coefficient of 0.518255 suggests a strong positive relationship, meaning higher engagement is associated with improved teaching competence. These findings highlight the importance of active participation in Lesson Study to enhance science teachers' instructional skills.

Similarly, the study by Mapulanga et al. (2023) explored teachers' enacted topic-specific PCK (TSPCK) during the biology lesson study stages: planning, teaching, and reflecting. The findings revealed that the teacher applied both higher-order and lower-order pedagogical strategies when implementing Topic-Specific Pedagogical Content Knowledge (TSPCK) across eight key areas: teaching strategies, classroom interactions, representations, curricular saliency, conceptual teaching strategies, students' prior knowledge and misconceptions, and challenges in teaching and learning. Additionally, the results indicated that teachers' collectively planned TSPCK was more refined than their individual TSPCK, suggesting that engaging in Lesson Study enhanced their instructional knowledge. This study highlights how teachers apply both personal and collaborative TSPCK in teaching and underscores the effectiveness of Lesson Study in strengthening teachers' pedagogical content knowledge through shared planning and reflective discussions.

Degree of the Challenges Experienced by the Participants in their Engagement in the lesson study

It can be seen from Table 8 that the overall degree of the challenges experienced by the participants in their engagement in the lesson study in terms of planning the research lesson was found to be "Challenging" with an overall mean of 2.80. Time constraints in preparing a detailed and coherent lesson plan and incorporating innovative teaching strategies that develop higher-order thinking skills were primary challenges in planning the research lesson phase.

Table 8. Degree of the Challenges Experienced by the Participants in their Engagement in the lesson study in terms of Planning the Research Lesson

Indicators	$\bar{x}$	VI
1. It was challenging to align the lesson plan with the Science curriculum standards.	2.73	Challenging
2. Time constraints made it difficult to prepare a detailed and coherent lesson plan	3.33	Challenging
3. The inclusion of innovative teaching strategies that cater higher order thinking skills was a challenge.	3.13	Challenging
4. Identifying appropriate materials and resources for the lesson was difficult.	2.93	Challenging
5. There were communication gaps among team members during planning discussions.	2.27	Slightly Challenging
6. Participants found it challenging to incorporate diverse student needs into the lesson plan	3.07	Challenging
7. Lack of experience in research-based planning slowed down the process.	2.53	Challenging
8. Differing opinions on the teaching approach created delays in finalizing the plan.	2.60	Challenging
9. Participants found it difficult to coordinate roles and responsibilities for lesson delivery	2.40	Slightly Challenging
10. Anticipating possible student misconceptions and preparing responses is challenging.	3.00	Challenging
Overall Mean	**2.80**	**Challenging**

Legend: 3.50 – 4.00 = Very Challenging; 2.50 – 3.49 = Challenging, 1.50 – 2.49 = Slightly Challenging, 1.00 – 1.49 = Not Challenging

The study by Li et al. (2023) revealed that participating in lesson study helps teachers incorporate new teaching strategies into their classrooms. Over time, their perspectives on teaching and learning become more aligned with maker education (ME) principles. However, challenges such as limited time, gaps in research skills, and a lack of adequate learning resources were also noted.

Table 9 presents the degree of the challenges experienced by the participants in their engagement in the lesson study in terms of implementation of the research lesson.

Based from Table 9, the overall degree of the challenges experienced by the participants in their engagement in the lesson study in terms of implementation of the research lesson was found to be “Challenging” with an overall mean of 2.51. The science teachers expertly presented the research lesson because they were guided during the planning phase. For them, facilitating hands-on activities or experiments as planned in the lesson and organizing collaborative student activities proved more complex than anticipated and challenging.

Table 9. Degree of the Challenges Experienced by the Participants in their Engagement in the lesson study in terms of Implementation of the Research Lesson

Indicators	$\bar{x}$	VI
1. The presence of observers caused disruption to the normal flow of the class.	2.47	Slightly Challenging
2. Managing both lesson delivery and student behavior simultaneously was a challenge	2.47	Slightly Challenging
3. Technical difficulties with instructional materials affected lesson delivery.	2.33	Slightly Challenging
4. The focus teacher found it hard to stick to the lesson timeline as planned.	2.60	Challenging
5. Managing classroom resources and materials effectively during the lesson is challenging.	2.40	Slightly Challenging
6. Student misconceptions during the lesson were hard to address effectively.	2.40	Slightly Challenging
7. The pressure of being observed increased the focus teacher's stress during delivery	2.67	Challenging
8. Managing collaborative student activities was more challenging than expected.	2.73	Challenging
9. Unexpected interruptions during the lesson impacted its effectiveness.	2.40	Slightly Challenging
10. Facilitating hands-on activities or experiments as planned in the lesson is challenging.	2.67	Challenging
Overall Mean	**2.51**	**Challenging**

Legend: 3.50 – 4.00 = Very Challenging; 2.50 – 3.49 = Challenging, 1.50 – 2.49 = Slightly Challenging, 1.00 – 1.49 = Not Challenging

A study by Bayram and Bıkmaz (2021) found that making student thinking visible proved to be a significant challenge for the teachers engaged in lesson study. They realized that when lessons were delivered mainly through lectures with little student participation, it became difficult to gauge students' thought processes and reactions, which was an eye-opening realization for them. Acknowledging that this was common in their classrooms, they made efforts to shift their approach by incorporating small group discussions and think-aloud activities to encourage student expression. While they engaged in detailed discussions on how to implement these strategies, their pre-existing beliefs about their students posed a barrier. Many teachers assumed that their students would struggle to articulate their thoughts, especially since they were often reluctant to answer even simple yes-or-no questions. This highlights how teachers' preconceived notions and low expectations of their students can hinder meaningful student engagement and limit opportunities to observe student thinking effectively.

Table 10 presents the degree of the challenges experienced by the participants in their engagement in the lesson study in terms of post-lesson reflection and discussion.

Table 10. Degree of the Challenges Experienced by the Participants in their Engagement in the lesson study in terms of Post-lesson Reflection and Discussion.

Indicators	$\bar{x}$	VI
1. Providing constructive feedback to colleagues without causing discouragement is challenging	2.47	Slightly Challenging
2. Time allocated for reflection was insufficient for meaningful insights.	2.40	Slightly Challenging
3. Finding sufficient time for post-lesson discussion is a challenge during the lesson study process.	2.53	Challenging
4. Identifying specific areas for improvement in the lesson during reflection is challenging.	2.53	Challenging
5. Maintaining consistent engagement and motivation throughout the reflection process is challenging.	2.27	Slightly Challenging
6. Teachers were hesitant to share their mistakes or areas of struggle.	2.27	Slightly Challenging
7. Collaborating with colleagues to finalize and implement the revised lesson plan is challenging.	2.40	Slightly Challenging
8. Maintaining a reflective mindset rather than a defensive one during critiques is challenging.	2.20	Slightly Challenging
9. Ensuring that all feedback is objective and evidence-based is challenging.	2.20	Slightly Challenging
10. Staying focused on specific lesson goals during discussions without deviating is challenging.	2.40	Slightly Challenging
Overall Mean	**2.37**	**Slightly Challenging**

Legend: 3.50 – 4.00 = Very Challenging; 2.50 – 3.49 = Challenging, 1.50 – 2.49 = Slightly Challenging, 1.00 – 1.49 = Not Challenging

The overall degree of the challenges experienced by the participants in their engagement in the lesson study in terms of post-lesson reflection and discussion was found to be "Slightly Challenging" with an overall mean of 2.37. The science teachers made sure that all the criticism was unbiased and supported by data by keeping a constructive, introspective attitude throughout the process rather than adopting a defensive one.

In addition, the study by Moghaddam et al. (2020) revealed that teachers involved in the lesson study encountered challenges, which included determining the goals of the lesson study and offering critical feedback to each other. While this made decision-making more intricate and intentional, there was exceptional value in participating in the lesson study process. The findings highlighted three key themes: (1) difficulties encountered during classroom observations, (2) reluctance to offer constructive feedback to colleagues, and (3) ongoing discussions about the definition of expertise in subject-specific preservice teacher education.

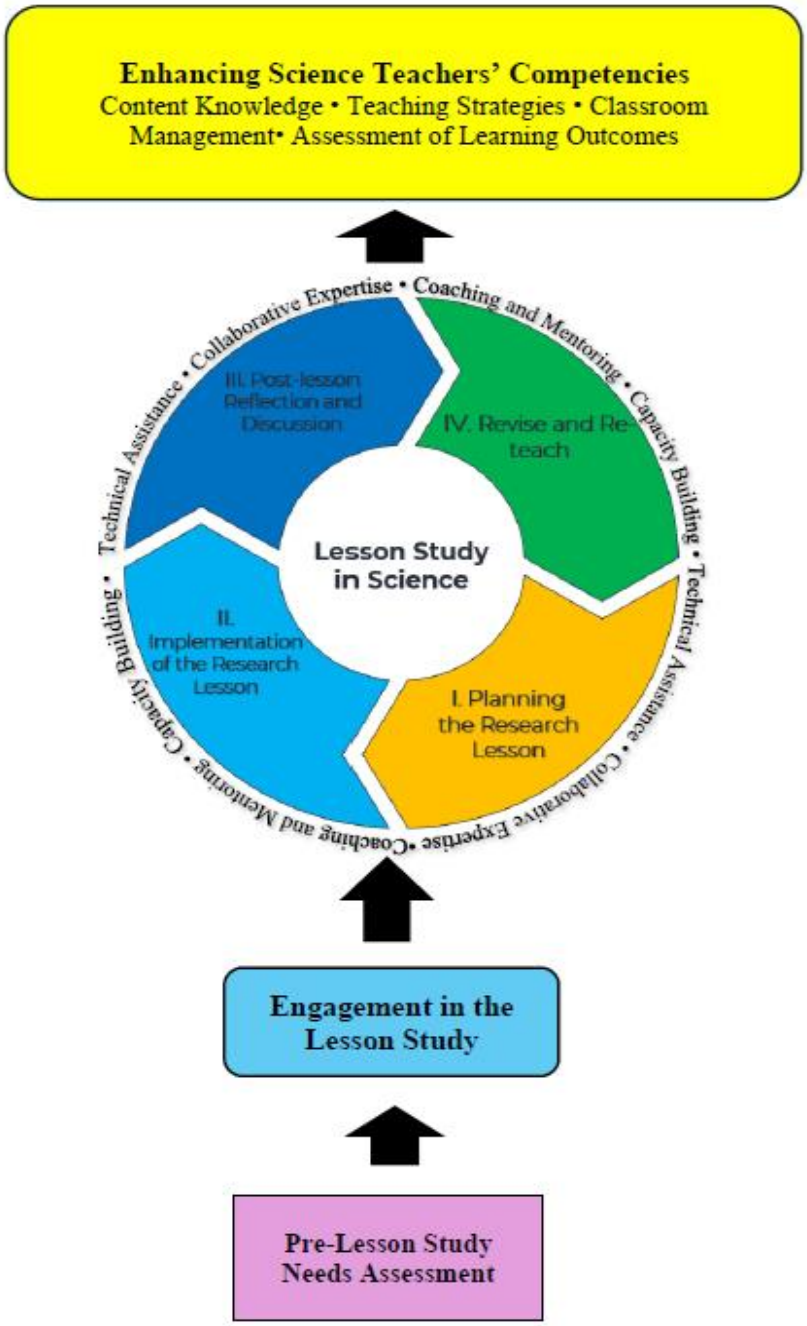

Figure 2 *Contextualized Lesson Study in Science (CLaSS) Model*

The **Contextualized Lesson Study in Science (CLaSS) Model** was designed to enhance the competencies of Science teachers through an iterative process of collaborative planning, implementation, reflection, and revision. This proposed model is based on current research findings that highlight significant improvements in teachers' competencies and engagement after participating in lesson study. It also integrates solutions to challenges encountered by participants during the lesson study process.

The CLaSS Model begins with a needs assessment, during which the focus

teacher is observed by colleagues while teaching in the classroom. This is also known as the pre-lesson study observation. The observers note key areas for improvement, as identified during the observation.

This is followed by the engagement of Science teachers in the lesson study, a cyclical process consisting of four key phases:

1. Planning the research lesson
2. Implementing the research lesson
3. Post-lesson reflection and discussion
4. Revision and re-teaching of the lesson

This study acknowledges the challenges teachers encounter in lesson study. In the proposed model, the support of educational leaders, such as head teachers, master teachers, principals, and supervisors, is emphasized to help address these difficulties. The provision of technical assistance throughout all phases of the lesson study is considered vital to ensuring the success of this initiative. Additionally, continuous coaching and mentoring by educational leaders will help teachers enhance the effectiveness of the research lesson.

Furthermore, the implementation of capacity-building activities will equip teachers with the skills, confidence, and updated knowledge necessary to actively engage in the lesson study process. The CLaSS Model also includes collaborative expertise sessions, which propose dedicated time within the class program for teachers and educational leaders to work together to improve instructional practices in Science.

The proposed CLaSS Model can be adopted in schools and educational institutions as part of teachers' continuous professional development. It can also serve as a framework to promote a culture of collaboration between Science teachers and educational leaders, fostering teaching competence and excellence in Science education.

CONCLUSION

In light of the findings, the following conclusions were drawn:

1. The science teachers' pedagogies improved upon employing the lesson study. Their collaborated efforts produced positive outcomes in science classes.
2. The science teachers showed improvement in the teaching-learning process, and their teaching competencies and classroom pedagogical techniques were enhanced after engagement in the lesson study.
3. Science teachers encountered challenges throughout the lesson study process. This suggests a need for additional support, such as technical assistance, time allocation, and capacity-building activities, to enhance the effectiveness of lesson study.
4. The Contextualized Lesson Study in Science (CLaSS) Model was developed to assist Science teachers in honing their skills through a cycle of planning, teaching, reflecting on, and refining lessons to improve them. The model intends to foster collaboration between teachers and school leaders to improve science teaching and learning.

RECOMMENDATIONS

Based on the findings and conclusions of the study, the following recommendations are suggested:

1. The teachers should increase their engagement in the lesson study to promote collaboration and camaraderie among the science teachers, making refined teaching pedagogies in the field of science education.
2. Since teachers' competencies improved significantly after engaging in the lesson study, schools should formally integrate the CLaSS Model into their collaborative expertise sessions. Educational leaders can also provide inputs to the lesson study through technical assistance, coaching and mentoring, and capacity-building activities aside from just supervising the teachers to sustain these improvements.
3. The contextualized lesson study model should be further validated by experts and implemented in more schools in the Division to determine its effectiveness.
4. A lesson study support manual can be developed based on the proposed contextualized lesson study model to support schools and learning centers in conducting the lesson study.

FURTHER STUDY

Future studies can focus on the long-term impact of the lesson study on teaching practices and student learning outcomes in Science and other disciplines.

ACKNOWLEDGMENT

My decade-long journey toward earning a Ph.D. in Education has been filled with challenges and obstacles. However, the support of several individuals and institutions has helped ease the path. To them, I will always be deeply grateful and sincerely appreciative! To my wife, Cara, for being my source of strength in difficult times, for her unwavering love, and for her constant support in all my endeavors. To my parents, Mizael and Lolita, for the invaluable gift of education and for instilling in me lifelong values that have shaped who I am today. Above all, to Him, for granting me wisdom, resilience, perseverance, and guidance throughout this journey.

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