

Article

Science and Mathematics Teachers' Perceptions of the Sustainability of Lesson Study Professional Development

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Abstract

Improving the quality of science and mathematics teaching remains a persistent challenge in resource-constrained education systems, highlighting the need for effective, sustainable professional development approaches. This study employed a quantitative cross-sectional survey designed to investigate science and mathematics teachers' retrospective perceptions of the sustainability and professional value of lesson study professional development. Data were collected from 117 teachers who had participated in a lesson study intervention facilitated through a university–school partnership. The lesson study intervention occurred between 2012 and 2014, and data were collected retrospectively in 2018 to examine teachers' sustained perceptions of its professional value. Descriptive and inferential statistical analyses revealed that teachers generally experienced lesson study as a meaningful, collaborative, and school-embedded professional development approach. Participants reported perceived improvement in content knowledge, pedagogical practices, lesson planning, reflective teaching, and professional collaboration. Strong positive correlations were found among teachers' understanding of lesson study, collaboration, preparation, implementation, and professional learning. However, time constraints and the need for sustained institutional support were identified as key challenges to implementation. The findings suggest that teachers perceived lesson study as having sustained professional value within their school contexts. While based on retrospective self-reports, the results suggest that lesson study may contribute to collective professional cultures when supported institutionally. By fostering collaborative learning cultures and embedding professional learning into everyday teaching practice, lesson study may strengthen education systems and align with broader sustainable development goals. It is recommended that lesson study be institutionalised as a sustainable, school-embedded professional development approach, with future research examining its long-term impact on authentic teaching practices and learning outcomes.



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1. Introduction

Professional development (PD) interventions that promote sustained teacher learning are central to delivering quality, sustainable education ([Bascopé et al., 2019](#); [Brandisauskiene et al., 2020](#)). Such PD interventions require PD models that are contextually responsive, collaborative, and embedded within everyday school practices. Lesson study (LS) supports continuous teacher learning, strengthens institutional capacity, and contributes to

systematic improvement of education systems (Bendtsen et al., 2022; Hunter & Back, 2011). Within this framework, the enduring capacity of education to maintain instructional quality, support professional learning, and advance equitable learner outcomes constitutes sustainable education. However, the present study conceptualises sustainability in education as the extent to which professional learning experiences are perceived by teachers as enduring, meaningful, and transferable to their ongoing practices over time. It encompasses the continuity of professional learning beyond initial intervention, retention of knowledge and collaborative practices, and their capacity to be integrated into routine school-based activities. Importantly, sustainability is examined in terms of teachers' perceived professional value and not as direct evidence of long-term institutionalisation or continuous implementation.

In the context of teaching science and mathematics, quality and sustainable education remain a central concern globally, given the central role these subjects play in learner achievement, economic development, and participation in a knowledge-based society (Coenders & Verhoef, 2019; da Ponte et al., 2023; Pham et al., 2023; Shingphachanh, 2019). In South Africa, persistent underperformance in science and mathematics across schooling phases has drawn attention to the effectiveness of teacher PD initiatives (Helmbold et al., 2021; Letloenyane & Jita, 2020; Sekao & Engelbrecht, 2022; Thobela et al., 2023). Traditional PD models, often characterised by short-term workshops and externally driven training, have been criticised for their limited impact on classroom practice and teacher learning (Desimone, 2009).

In response, collaborative and practice-embedded PD models have gained prominence in recent years. Among these, lesson study has the potential to function as a sustainable PD approach that places teachers at the centre of instructional improvement (Ding et al., 2024; Dudley et al., 2019; Vermunt et al., 2019). Originating in Japan, lesson study (LS) involves cycles of collaborative lesson planning, classroom observation, and reflective analysis aimed at improving both teaching practice and learner understanding (Khokhotva, 2018; Lewis et al., 2019). Rather than positioning teachers as passive recipients of knowledge, lesson study frames them as co-researchers who systematically examine their own classroom practices.

Internationally, lesson study has been adapted across educational contexts, including science and mathematics education, with research suggesting that it supports sustainable professional learning, strengthens pedagogical content knowledge, and fosters collaborative teacher cultures (Akerson et al., 2017; Dudley et al., 2019). In South Africa, LS has increasingly been implemented as part of university-school partnerships and professional learning initiatives aimed at strengthening teaching quality in underperforming subjects (Letloenyane & Jita, 2020). However, the effectiveness of LS depends not only on its design, but also on how teachers experience, perceive, and engage with the process within their specific school contexts. Although the lesson study intervention examined in this study occurred between 2012 and 2014, subsequent recent international research is referenced to situate the findings within the current body of scholarship. These later studies do not inform the original intervention but provide contemporary corroboration and conceptual framing for interpreting the retrospective data.

1.1. Lesson Study as Teacher Professional Development

Lesson study differs fundamentally from traditional PD models by embedding learning within teachers' daily instructional work (Dudley et al., 2019; Vermunt et al., 2019; Warwick et al., 2019). Research indicates that lesson study aligns closely with features of effective PD, including active learning, focus on content, coherence, duration, and collaborative participation (Desimone, 2009). Coenders and Verhoef (2019) assert that collaborative

planning and reflection enables teachers to engage deeply with subject matter, anticipate learner misconceptions, and refine instructional strategies. In science and mathematics education, lesson study is reported to support inquiry-based teaching practices and more learner-centred pedagogies (Elliott, 2012). Teachers participating in lesson study often report enhanced confidence in teaching complex concepts, improved lesson coherence, and greater awareness of learners' thinking processes. These findings suggest that lesson study holds potential as a sustainable PD model for strengthening instructional quality in subjects that are traditionally challenging for both teachers and learners. Lesson study is increasingly recognised as a form of sustainable professional development, as it builds internal school capacity, promotes continuous learning, and reduces reliance on externally driven training programmes. Embedding professional learning within routine teaching practice supports the long-term resilience and adaptability of education systems.

1.2. Teachers' Perceptions of Lesson Study

While the structural features of lesson study are well documented, research increasingly emphasises the significance of understanding how teachers experience and perceive participation in lesson study. Teachers' beliefs, attitudes, and professional identities shape how they engage with collaborative inquiry and determine whether lesson study is embraced or resisted (Dudley et al., 2019; Shingphachanh, 2019). International studies show that teachers often perceive lesson study as professionally empowering, particularly due to opportunities for collaboration, peer learning, and reflective dialogue (Conceição et al., 2022; da Ponte et al., 2023; Lewis, 2009). However, teachers' experiences are not fully positive. Some report initial discomfort with peer observation, increased workload, and uncertainty about the purpose of lesson study, especially during early implementation phases (Verhoef & Tall, 2011). These perceptions are strongly influenced by contextual factors such as school leadership, time allocation, and institutional support.

Understanding teachers' perceptions is therefore critical, particularly in contexts where collaborative professional cultures are still developing. This supports the need to explore the perceptions of science and mathematics teachers who participated in the lesson study. Teachers' positive perceptions of collaboration and shared responsibility are significant as they contribute to the development of professional cultures that can be maintained over time and across changing policy contexts.

1.3. Teacher Learning in Lesson Study

A central claim of lesson study is that participation enhances teachers' professional knowledge and skills. Empirical research supports this claim, showing that lesson study results in enhanced pedagogical content knowledge, reflective practice, and collaborative skills (Coenders & Verhoef, 2019; Vermunt et al., 2019). Dudley et al. (2019) assert that lesson study improves teachers' professional knowledge, while Adler et al. (2023) argue that lesson study enables teachers to learn from collaboration, teaching, and discussions in communities of practice. Teachers engaged in lesson study learn not only from their own practice, but also from observing colleagues and engaging in structured post-lesson discussions focused on student learning (Coenders & Verhoef, 2019; Mapulanga et al., 2023). Such findings suggest that lesson study supports sustainable teacher learning by fostering reflective practice, peer knowledge exchange, and professional agency. These elements are key to maintaining instructional quality in the long term.

In science education, lesson study has been associated with improved instructional strategies, better use of learner-centred approaches, and deeper engagement with scientific reasoning (Akerson et al., 2017; Elliott, 2012; Mapulanga et al., 2023). In mathematics education, lesson study supports teachers in refining lesson sequencing, addressing mis-

conceptions, and using multiple representations to enhance conceptual understanding (Adler et al., 2023; Richit, 2022; Scott et al., 2023).

South African studies report several benefits of LS as a tool for teacher professional development. According to Mhakure (2019), lesson study enhanced teachers' pedagogical content knowledge, collaboration, confidence, and knowledge of students. Meanwhile, Adler et al. (2023) report that lesson study supports mathematics teachers' lesson planning and reflection. Letloenyane and Jita (2020) add that lesson study enhances instructional practice and decision-making through improved collaboration. Lesson study is beneficial for expanding content knowledge and pedagogical skills (Ogegbo et al., 2019; Sekao & Engelbrecht, 2022; Tachie, 2020; Thobela et al., 2023). However, the extent to which teachers believe they acquire new knowledge and skills varies across contexts and individuals (Helmbold et al., 2021). This variability underscores the importance of empirically examining teachers' self-reported learning outcomes.

1.4. Lesson Study, Classroom Practice, and Professional Collaboration

Beyond individual teacher learning, lesson study influences classroom practice and promotes sustained professional collaboration. Research suggests that teachers who participate in lesson study tend to adopt reflective instructional practices, collaborate with colleagues, and experiment with new teaching approaches (Dudley et al., 2019; Khokhotva, 2018; Ricks, 2011). Lesson study also aligns with the concept of communities of practice, where learning occurs through shared engagement, mutual accountability, and collective problem-solving (Letloenyane & Jita, 2020; Loyarte & Rivera, 2007). Sustainable changes in the classroom and collaboration are central indicators of educational sustainability, as they reflect the extent to which professional development initiatives become institutionalised within schools rather than remaining isolated interventions.

In the South African context, where teachers often work in isolation and face heavy workloads, lesson study creates opportunities for meaningful professional interaction (Helmbold et al., 2021). Teachers report that lesson study strengthens collegial relationships, enhances lesson preparation, and promotes a shared sense of responsibility for learners' success. At the same time, challenges such as limited time, inadequate management support, and competing school priorities can constrain the perceived impact of LS on classroom practice (Ogegbo et al., 2019). These findings directly inform the need to examine the perceived effect of LS on teachers' knowledge and classroom enactment. Investigating this perceived impact provides insight into whether lesson study translates into meaningful instructional change from the teachers' perspective.

1.5. Problem Statement and Research Questions

Although the LS has gained increasing global attention as a collaborative professional development approach, there remains limited empirical evidence of its potential to function as a sustainable, school-embedded model of teacher learning that supports continuity of professional practice over time, particularly in resource-constrained contexts. Furthermore, research on teachers' experiences and perceptions of participation in the lesson study approach remains limited. While existing studies have documented the structural features and immediate outcomes of LS, considerably less attention has been given to teachers' retrospective perceptions of its longer-term professional value and the durability of learning over time. Existing studies are often small-scale or qualitative, providing insufficient insights into teachers' perceived learning outcomes and the classroom impact of lesson study across diverse teaching contexts. In addition, there is limited quantitative evidence examining the relationship among key lesson study dimensions, within a unified analytical framework, which constrains understanding of how these interrelated processes collectively

support professional development outcomes. Therefore, this study addresses this gap by examining science and mathematics teachers' perceptions of participation in LS, focusing on teacher learning and the perceived impact on classroom practice. Situated within the South African context, where PD is often fragmented and externally driven, the study further seeks to examine whether collaborative, school-based models such as lesson study are perceived by teachers as meaningful and sustainable over time. It frames LS as a potential sustainable PD model that fosters long-term teacher professional learning.

Although lesson study research has expanded internationally, few studies have examined teachers' retrospective perceptions of its sustainability several years after participation. Furthermore, limited quantitative evidence exists within South Africa regarding how key lesson study dimensions interact to support sustained professional learning. This study addresses these gaps by examining teachers' perceptions of lesson study as a potentially sustainable professional development approach. The study examines teachers' perceptions of lesson study across six dimensions: understanding of lesson study collaboration, lesson preparation, implementation experiences, teacher learning, and perceived impact on content knowledge and classroom practice. These dimensions were derived from lessons, study literature, and theories of professional learning and sustainability. The study was guided by the following research questions:

1. How do science and mathematics teachers perceive their participation in the lesson study approach in terms of understanding, collaboration, and professional learning?
2. What is the perceived influence of the lesson study approach on teachers' content knowledge and classroom practice?
3. What relationship exists among lesson study approach dimensions, including understanding, collaboration, preparation, implementation, and teacher learning?

1.6. Rationale and Significance of the Study

Given the persistent challenges in science and mathematics instruction and the limitations of traditional PD models, there is a pressing need to examine collaborative, teacher-centred approaches such as lesson study. By examining lesson study through the lens of sustainability, the study contributes to a deeper understanding of how collaborative, school-based professional development models can support the sustained development of teacher capacity, enhance institutional resilience, and improve the long-term effectiveness of educational systems, particularly within resource-constrained contexts. It provides empirical evidence to inform policy, professional development design, and school-level support structures. The findings are expected to promote understanding of sustained teacher professional development, particularly in resource-constrained contexts, and to provide practical insights for teacher educators, school leaders, and policymakers seeking to implement sustainable and effective PD models. Specifically, the findings are relevant for (a) teachers seeking sustainable professional learning opportunities, (b) School leaders responsible for creating collaborative professional cultures, (c) Teacher educators designing school-based professional development programmes, (d) District officials and policymakers responsible for teacher development initiatives, and (e) Universities engaged in school-university partnerships.

Although the present study does not directly measure equity or inclusive teaching practices, sustainable professional development structures such as lesson study may indirectly contribute to more equitable educational outcomes. By fostering collaborative reflection on learners' thinking and shared responsibility for instructional quality, lesson study creates conditions conducive to responsive and contextually sensitive teaching. In resource-constrained contexts, strengthening internal professional capacity is particularly

significant for advancing Sustainable Development Goal 4, including emphasis on equitable access to quality education.

1.7. Theoretical Framework

This study draws on an integrated framework that combines Communities of Practice (Loyarte & Rivera, 2007; Wenger, 2000) and the Social Constructivist theory (Langford, 2005; Santrock, 2011; Sivan, 1986) to explain how science and mathematics teachers learn through participation in lesson study, and how such learning can be sustained through ongoing, school-embedded professional development practices. Together, these perspectives conceptualise teacher professional learning as a socially mediated, collaborative process situated within authentic teaching practice. From a social constructivist perspective, learning occurs through interaction, dialogue, and shared reflection, in which knowledge is co-constructed rather than individually acquired (Langford, 2005; Sivan, 1986). These socially mediated learning processes support sustainable professional development by enabling continuous knowledge construction within teachers' everyday work, rather than through episodic, externally driven training. Lesson study reflects these principles by engaging teachers in collaborative lesson planning, observing lesson delivery, and reflecting on lessons, enabling teachers to examine pedagogical decisions and learner thinking collectively (Lewis et al., 2019). By embedding professional learning within regular teaching activities, lesson study promotes ongoing, context-responsive development that can be maintained over time within existing school structures.

Communities of Practice theory situates this social learning within sustained professional communities characterised by joint enterprise, mutual engagement, and shared repertoire (Loyarte & Rivera, 2007; Wenger, 2000). Through repeated lesson study cycles, teachers develop shared instructional goals, collective resources, and professional identities grounded in collaborative inquiry (Dudley et al., 2019; Warwick et al., 2019). Such cyclical engagement supports the long-term sustainability of professional learning by building collective capacity, shared ownership, and internal expertise among teachers. Learning is therefore understood as participation in a community where individual and collective development are interconnected. This integrated framework provides a coherent lens for interpreting teachers' perceptions of lesson study as a sustainable PD model, in which learning mechanisms and social structures work together to sustain continuity over time. Social constructivism explains the mechanisms of learning, while Communities of Practice accounts for the social structures that sustain learning over time within school contexts. The framework is particularly relevant in the South African context, where collaborative professional learning opportunities are limited. It highlights the importance of collegial interaction and institutional support in fostering meaningful teacher development (Helmbold et al., 2021; Ogegbo et al., 2019). In this context, lesson study offers a logically grounded and socially sustainable approach to professional development by leveraging collegial interaction and institutional support to reduce dependence on short-term, externally driven initiatives. Therefore, lesson study aligns with key principles of sustainable professional development, including continuity, collaboration, contextual relevance, and institutional embeddedness.

Within this study, sustainability is conceptualised at two interconnected levels. Firstly, perceived sustainability refers to teachers' experience that lesson study is embedded in everyday professional practice and can support ongoing learning beyond externally driven interventions. Second, structural sustainability refers to institutional conditions such as allocated collaboration time, leadership support, and policy alignment that enable continuity over time. While this study primarily examines teachers' perceptions of sustainability,

these perceptions are interpreted as indicators of emerging professional cultures that may contribute to longer-term institutional resilience when supported structurally.

2. Materials and Methods

2.1. Research Approach and Design

This study applied a quantitative research approach, collecting data on teachers' perceptions of participating in a lesson study intervention delivered through a university-school partnership programme. The implementation of the partnership programme is described below. A quantitative approach was considered appropriate because it allowed for the systematic examination of patterns in teachers' experiences and perceptions across a relatively large sample, thereby enhancing the generalisability of the findings to similar contexts (Creswell, 2014). Specifically, a cross-sectional survey design was employed to collect data at a single point in time.

2.2. Description of the University-School Partnership Programme

The University School partnership programme was a collaborative initiative between the University of the Free State and the Free State Department of Education. Developed in response to persistent challenges in science and mathematics teaching and learner underperformance in South African primary and secondary schools. The programme was facilitated by personnel from the University and aimed to provide a sustained, contextually relevant professional development intervention to strengthen teachers' instructional practices and improve learner outcomes. The intervention was based on the Japanese lesson study approach, which emphasises collaborative planning, classroom-based inquiry, and reflective practice. It comprised six workshop days over six months, with two-day contact sessions held every second month. These sessions were interactive and practice-oriented, engaging teachers in researching, planning, and presenting lessons, followed by structured reflection on the lessons they taught. Between sessions, teachers implemented the approach in their schools, established lesson study groups, and documented their practice in a portfolio of evidence (PoE). The intervention program consisted of three modules:

2.2.1. Module 1: Contact Session—Introduction to the Lesson Study Approach

This module introduced teachers to the principles and processes of lesson study through literature and video case studies. In addition, teachers participated in one full lesson study cycle conducted within the workshop environment, including topic research, collaborative lesson planning, lesson presentation, and group reflection. The focus was on developing collaborative and reflective teaching practices among participating teachers.

2.2.2. Module 2: Contact Session—Strengthening Pedagogical Knowledge for Science and Mathematics Teaching

This module aimed to strengthen teachers' conceptual and pedagogical understanding of mathematics, focusing on curriculum areas identified by the Free State Department of Education as challenging. Teachers analysed key concepts, addressed common learner misconceptions, and explored effective instructional strategies through hands-on activities and the use of visual and concrete resources in their respective subjects.

2.2.3. Module 3: School-Based Practicum—Lesson Study Cycle

This module required teachers to implement a lesson study cycle in their school contexts by establishing collaborative groups and completing at least one full lesson study cycle. Teachers jointly planned, taught, observed, and reflected on a research lesson. Implementation was documented in a PoE, including lesson plans and reflections, and

was formally endorsed by school leadership (e.g., principals, deputy principals, or head of department) to ensure accountability.

2.3. Sampling

The original intervention cohort consisted of 123 teachers from 60 secondary schools. Of these, 117 teachers participated in the present study, representing a retention rate of approximately 95%. This high retention rate strengthens the credibility of the findings, as the sample closely represents the original population of participants involved in the lesson study intervention between 2012 and 2014. Participation in the study was voluntary, and no additional sampling procedures were applied.

2.4. Data Collection Procedures

The data for the present study were collected from 60 secondary schools in Motheo district, Free State. The self-administered questionnaire was distributed to the school by the first author. The school principals assisted in coordinating the distribution and collection of the paper-based questionnaires. The principals assisted only with logistical arrangements, ensuring that completed questionnaires were returned for collection by the researcher. They were not involved in the study's content, and their role did not influence teachers' participation or responses, which were voluntary and confidential. The questionnaire was administered to teachers who had participated in a lesson study PD intervention facilitated by the University of the Free State between 2012 and 2014. The data were collected from July 2018 to September 2018. The questionnaire focused on teachers' reflective perceptions of their experiences and professional learning, which remain relevant for understanding the long-term value and sustainability of the lesson study professional development approach. The participants were given one week to complete the questionnaires to accommodate their professional responsibilities. The response rate ($RR = (117/123) \times 100 = 95\%$) was high, largely due to the advanced arrangements with the school principals.

It is important to note that the lesson study intervention occurred between 2012 and 2014, while data were collected in 2018, and the present study reflects a later stage of scholarly dissemination. The time lapse between the intervention and data collection was not designed as a formal longitudinal study. Rather, it provided an opportunity to examine teachers' retrospective perceptions of the sustained professional value of lesson study. It must also be noted that the time lapse between data collection and the present reporting is attributable to the study forming part of a doctoral research project (for the first author) completed in December 2025. Therefore, this article is derived from a broader doctoral study. The present paper reports specifically on the quantitative component, examining teachers' perceptions of lesson study as a sustainable professional development approach. While this resulted in a delay in dissemination, it enabled a more comprehensive and conceptually grounded interpretation of the findings, as the dataset was subject to extended analysis, theoretical development, and integration within the broader doctoral study. From a methodological perspective, the time lapse between participation and reporting aligns with the study's focus on perceived durability of professional learning. Retrospective research designs are commonly used to examine how past educational experiences are recalled and interpreted in the present, providing insight into their long-term influence and perceived value, rather than only immediate post-intervention effects (Finn, 2015; Staus et al., 2021; Zhai et al., 2024). Such approaches may enable the identification of aspects of PD interventions that are retained and regarded as meaningful over time (Staus et al., 2021). Furthermore, research in cognitive and educational psychology indicates that remembered learning experiences play an important role in shaping how such experiences are evaluated over time.

Consequently, the findings reflect teachers' retrospective perceptions of experienced durability of professional learning rather than immediate post-intervention reactions. While educational policy and technological contexts in South Africa have evolved since 2014, particularly with increased digitalisation and post-pandemic shifts in professional development delivery, the core principles of lesson study remain conceptually stable. Therefore, the study contributes insights into the perceived long-term professional significance of lesson study within school-based contexts.

2.5. Instrument Development, Reliability, and Validity

The primary instrument used in this study was the survey questionnaire, developed in three stages: creating clearly phrased items to promote common understanding between the researcher and respondents, organising items into theme groups, and assessing the instrument for validity. It consisted of two portions. Section A collected demographic information, such as age, gender, teaching experience, educational qualifications, and subject specialisation. Section B included 36 closed-ended questions meant to examine teachers' perceptions of participation in a lesson study PD intervention. The items were initially developed by the first author, following an extensive analysis of relevant studies on lesson study PD (e.g., Ding et al., 2024; Richit, 2022; Scott et al., 2023; Sekao & Engelbrecht, 2022; Shingphachanh, 2019). The face and content validation of the questionnaire was done by three experts in educational research and lesson study. Face validity ensured item clarity and relevance, while content validity ensured adequate representation of the lesson study constructs measured in this study. Consequently, the items were classified into the following subscales: understanding and implementing lesson study, teacher learning, impact on content knowledge and classroom practice, teacher cooperation, lesson preparation, and lesson study as a community of practice. The subscale structure was theoretically derived and informed by established literature on lesson study, communities of practice, and professional development, ensuring construct coherence prior to reliability testing. Given the study's primary aim of describing teachers' perceptions and examining relationships among predefined constructs, exploratory factor analysis was not conducted. Instead, internal consistency reliability was assessed using Cronbach's alpha. Table 1 shows that the α values ranged from 0.86 to 0.94, representing excellent reliability. According to Taber (2018), Cronbach alpha values above 0.70 indicate acceptable reliability, values above 0.80 indicate good reliability, and values above 0.90 indicate excellent reliability. The obtained alpha coefficients (0.86–0.94), therefore, demonstrate strong internal consistency across all sub-scales. Responses were rated on a five-point Likert scale comprising strongly agree, agree, neutral, disagree, and strongly disagree.

Table 1. Reliability test for the subscales.

Subscales	N of Items	Cronbach's Alpha (α)
Understanding lesson study	6	0.92
Teacher learning in lesson study	6	0.94
Lesson study implementation	5	0.86
Lesson study and impact on content knowledge and Practice	5	0.94
Lesson study and collaboration	5	0.90
Lesson study and preparation	4	0.93
Lesson study as a community of practice	5	0.92

2.6. Data Analysis

The data for this study were analysed with the aid of SPSS version 25. Descriptive statistics (frequency counts and percentages) were computed using available responses.

Missing data occurred at the item level and were minimal. Therefore, no questionnaire was excluded in its entirety. For correlation analyses, composite subscale scores were calculated, and Pearson product-moment correlations were computed using pairwise deletion (Islam, 2020). Missing responses were below 5% at the item level and were determined to be randomly distributed upon inspection of response patterns. Therefore, pairwise deletion was considered appropriate and unlikely to bias parameter estimates. This explains the variation in sample size ($N = 111\text{--}117$) reported for correlations, as they were calculated using all available cases for each pair of variables. For the correlation analysis, composite scores were computed by averaging items within each theoretically defined subscale. Prior to aggregation, internal consistency reliability was confirmed ($\alpha = 0.86\text{--}0.94$), supporting the scales' coherence (Taber, 2018).

2.7. Ethical Consideration

The first author obtained approval for the research from the University of the Free State ethics committee and research permits from the Department of Education and the Principals of the involved schools in Mangaung district. Participation was voluntary, and participants could withdraw at any time. Furthermore, participants provided written consent for their involvement.

3. Results

The presentation of results is structured according to the study's research questions. Descriptive findings address teachers' perceptions of participation in the lesson study approach (Research question 1), followed by the perceived influence of LS on teachers' knowledge and classroom practice (Research question 2). Correlational analyses are presented to examine relationships among the key lesson study dimensions (Research question 3).

3.1. Demographic Data

Table 2 summarises the demographic characteristics of the teacher respondents ($N = 117$). The sample was predominantly female (86.7%), with male teachers comprising 13.3%. Most respondents were between 40 and 59 years old (76.1%), indicating a largely experienced cohort.

Table 2. Demographic characteristics of the respondents.

Variable		N	%
Gender	Male	16	13.3
	Female	101	86.7
Age	Below 25	1	0.9
	25–29	10	8.5
	30–39	15	12.8
	40–49	43	36.8
	50–59	46	39.3
	60 and older	2	1.7
Teaching experience (years)	Less than 1	2	1.7
	1–5	19	16.2
	6–10	20	17.1
	11–20	25	21.4
	21–30	34	21.4
	31 and more	17	14.5

Table 2. *Cont.*

Variable		N	%
Educational qualification	Matric and teachers' diploma	53	45
	Bachelor's degree	62	53
	Master's degree	2	2
Subject specialisation *	Mathematics	100	69.4
	Physical sciences	6	4.2
	Natural sciences	17	11.8
	Geography	7	4.9
	Life sciences	14	9.7

* The value of N = 144 is higher than the number of teacher participants (N = 117) because some teacher respondents specialised in more than one subject.

Regarding teaching experience, 57.3% of the teachers reported more than 11 years, while 14.5% reported more than 31 years. Regarding qualifications, the majority held either a bachelor's degree (53%) or a matric plus teachers' diploma (45%). Only two respondents reported holding a master's degree. Mathematics was the most frequently reported subject specialisation (69.4%), followed by natural sciences (11.8%) and life sciences (9.7%).

3.2. Research Question 1: Teachers' Perceptions of Participation in the Lesson Study Approach

3.2.1. Teachers' Understanding and Experiences of the Lesson Study Approach

Table 3 presents descriptive statistics on teachers' perceived understanding of what lesson study is. The majority of the respondents selected "agree" or "strongly agree" for all items. Specifically, 90.5% of respondents reported that it provides opportunities for collaborative development of teaching approaches. Similarly, 91.5% indicated that lesson study represents a structured collaborative process for developing professional knowledge. Additionally, 88.7% of respondents agreed or strongly agreed that lesson study fostered a shared instructional culture. In contrast, 86.3% perceived it as a collaborative process for improving teaching and learning. A comparable proportion (86.7%) viewed lesson study as a potential approach for developing communities of practice. These results indicate that teachers generally perceived LS as a collaborative, structured, and school-embedded PD approach.

Table 3. Respondents' reported understanding of lesson study.

Statement	SA	A	N	D	SD
Lesson study provides teachers with an opportunity to work together to develop new ways of teaching.	62.9%	27.6%	7.8%	1.7%	0.0%
Lesson study is a form of professional development that is embedded within school and classroom contexts.	48.2%	42.1%	9.7%	0.0%	0.0%
Lesson study provides a structure by which teachers work collaboratively with their peers to develop knowledge.	62.4%	29.1%	8.5%	0.0%	0.0%
Lesson study helps to shape a shared culture in which teachers can develop a common understanding of instructional (teaching) goals, methods of teaching, problems of learning, and possible solutions.	50.4%	38.3%	11.3%	0.0%	0.0%
Lesson study entails the collaborative planning of a research lesson designed to improve student learning (teaching and learning).	47.0%	39.3%	12.8%	0.9%	0.0%
Lesson study represents a promising approach to developing a community of practice among teachers.	43.8%	42.9%	12.4%	0.9%	0.9%

Note: SA = Strongly agree, A = Agree, N = Neutral, D = Disagree, SD = Strongly disagree.

3.2.2. Perceptions of Implementation of Lesson Study

Table 4 presents teachers' responses regarding the enactment of lesson study in schools. Approximately 67.5% of respondents agreed or strongly agreed to have sufficient time for lesson preparation and reflection. However, a notable proportion of respondents selected neutral or disagreement responses. About 71.8% of respondents agreed or strongly agreed that their schools encouraged experimentation with lesson study, while 59.9% reported support from the school community. A large majority (82.1%) agreed or strongly agreed that school management support is important for the successful implementation of lesson study. Additionally, 81.0% reported that time constraints posed a challenge during the initial implementation phase. These findings suggest that while teachers generally reported positive experiences of LS, their participation was shaped by contextual factors such as time availability and institutional support.

Table 4. Respondents' perceptions regarding the implementation of lesson study.

Statement	SA	A	N	D	SD
I got enough time in my school to prepare the lessons and also reflect on them.	18.8%	48.7%	15.4%	11.1%	6.0%
My school encouraged my experimentation with lesson study.	23.1%	48.7%	18.8%	5.1%	4.3%
The school community was helpful in supporting me through the lesson study process.	17.4%	42.5%	23.5%	9.6%	7.0%
The success of lesson study also depends a lot on the support provided to lesson study groups by the School Management Team (SMT).	27.4%	54.7%	8.5%	5.1%	4.3%
Time constraints may also be considered as a challenge in the initial implementation of lesson study because teachers may find difficulty in scheduling a common meeting time.	43.1%	37.9%	13.8%	2.6%	2.6%

Note: SA = Strongly agree, A = Agree, N = Neutral, D = Disagree, SD = Strongly disagree.

3.3. Research Question 2: Perceived Influence of the Lesson Study Approach on Teachers' Knowledge, Skills, and Classroom Practice

3.3.1. Perceived Teacher Learning in Lesson Study

Table 5 reports teachers' perceptions of learning outcomes associated with lesson study participation. Overall, high levels of agreement were observed across all items. Approximately 83.4% of respondents agreed or strongly agreed that their teaching had improved through participation in lesson study. Furthermore, 91.4% indicated that collaborative work enabled learning from colleagues and the development of a shared vision for classroom improvement. A majority of respondents (88.8%) agreed or strongly agreed that lesson study supported critical reflection on pedagogical approaches. In addition, 82.9% reported perceived improvements in learner attainment, while 89.7% indicated that participation in lesson study extended their content knowledge. These findings indicate that teachers reported perceived gains in professional knowledge, reflective practice, and collaborative learning through participation in LS.

Table 5. Reported teacher learning in lesson study.

Statement	SA	A	N	D	SD
My teaching has improved through lesson study.	36.0%	47.4%	8.8%	7.8%	0.0%
The collaborative work in lesson study helped the teachers gain knowledge from each other and brought about a shared vision of improving their classroom practices.	48.7%	42.7%	0.9%	7.7%	0.0%
Lesson study enabled teachers to critically look at and review their pedagogical approaches	40.5%	48.3%	4.3%	6.9%	0.0%
My participation in lesson study has brought about improvement in learner attainment in my classroom.	33.3%	49.6%	11.1%	6.0%	0.0%
My participation in lesson study has extended my content knowledge to improve my teaching.	43.5%	46.2%	4.3%	6.0%	0.0%

Note: SA = Strongly agree, A = Agree, N = Neutral, D = Disagree, SD = Strongly disagree.

3.3.2. Perceived Influence of Lesson Study on Content Knowledge and Classroom Practice

Table 6 summarises teachers' perceptions of the influence of lesson study on content knowledge and classroom practice. The majority of respondents reported agreement across all items. Approximately 88.0% agreed or strongly agreed that participation in lesson study improved their subject content knowledge.

Table 6. Respondents' perceptions of the influence of lesson study on content knowledge and classroom practice.

Statement	SA	A	N	D	SD
The lesson study process contributed a great deal in terms of expanding (improving) my content knowledge in my subject.	38.5%	49.5%	7.7%	3.4%	0.9%
The lesson study process contributed a great deal in terms of improving my pedagogical knowledge/classroom practice.	33.3%	55.6%	7.7%	3.4%	0.0%
The lesson study process contributed a great deal in terms of improving my lesson planning skills.	30.8%	57.3%	8.5%	3.4%	0.0%
The lesson study process contributed a great deal in terms of improving my approach to working and sharing ideas with my colleagues.	43.6%	43.6%	9.4%	3.4%	0.0%

Note: SA = Strongly agree, A = Agree, N = Neutral, D = Disagree, SD = Strongly disagree.

Similarly, 88.9% reported improvements in pedagogical knowledge and classroom practice, while 88.1% indicated that lesson study enhanced their skill in planning lessons. In addition, 87.2% of respondents agreed or strongly agreed that lesson study improved their approach to collaboration and sharing ideas with colleagues. These results suggest that teachers perceived LS as positively influencing their content knowledge, pedagogical practices, and classroom-related activities.

3.3.3. Perceived Influence on Collaboration, and Experiences of Teacher Respondents

Table 7 presents descriptive results related to collaboration within the lesson study. Most respondents (86.3%) agreed or strongly agreed that lesson study enhanced the knowledge and skills required for peer collaboration. Approximately 74.1% indicated that time was allocated for collaboration within their schools. Furthermore, 78.4% of respondents reported that the relevance of lesson study lies in learning within a collaborative community.

A large proportion (86.2%) reported that collaborative practice in lesson study mobilised shared ideas and expertise, enhancing content and pedagogical knowledge. In addition, 74.1% perceived that lesson study was a bottom-up approach driven by teacher initiative, while 87.9% agreed or strongly agreed that working collaboratively contributed to their professional growth. These findings indicate that teachers perceived collaboration as a central feature of their professional learning within lesson study.

Table 7. Respondents' perceptions of the influence of lesson study on collaboration and experiences.

Statement	SA	A	N	D	SD
Lesson study provided me with the knowledge and skills to collaborate with other teachers as my peers.	39.3%	47.0%	11.1%	0.9%	1.7%
Time was allotted for teacher collaboration in my school within the context of lesson study.	18.1%	56.0%	19.0%	4.3%	2.6%
The relevance of lesson study is linked to the belief that people learn in a community and that the teacher learning community is collaborative and collegial for professional development.	24.1%	54.3%	15.6%	3.4%	2.6%
The collaborative practice in lesson study requires the mobilisation of ideas, experiences, and skills that contribute to improvement in content knowledge and pedagogical knowledge of the teacher.	34.5%	51.7%	11.2%	0.0%	2.6%
Lesson study is based on a bottom-up model whereby its implementation is based on the initiatives of the teachers and not according to directives from departmental officials and the SMT.	25.8%	48.3%	21.6%	3.4%	0.9%
Working collaboratively with my fellow teachers has helped me to grow as a teacher.	47.4%	40.5%	11.2%	0.9%	0.0%

Note: SA = Strongly agree, A = Agree, N = Neutral, D = Disagree, SD = Strongly disagree.

3.3.4. Perceived Influence of Lesson Study on Planning and Teaching

Table 8 reports teachers' perceptions of collaborative planning within lesson study. High levels of agreement were observed across all items. Approximately 91.4% of respondents agreed or strongly agreed that group planning broadened their knowledge of effective teaching strategies. Similarly, 88.8% indicated that collaborative planning enhanced their content knowledge, while 87.2% reported that group planning supported future lesson planning. Nearly 88.0% of respondents agreed or strongly agreed that collaborative planning increased their confidence when teaching.

Table 8. Respondents' perceptions of the influence of lesson study on planning and teaching.

Statement	SA	A	N	D	SD
Planning in a group broadened my knowledge of how to teach my subject more effectively.	46.2%	45.2%	7.7%	0.9%	0.0%
Planning in a group broadened my content knowledge in my subject.	44.4%	44.4%	11.2%	0.0%	0.0%
Planning in a group helped me plan my future lessons.	47.0%	40.2%	12.8%	0.0%	0.0%
Planning in a group increased my confidence when I had to teach.	49.6%	38.4%	12.0%	0.0%	0.0%

Note: SA = Strongly agree, A = Agree, N = Neutral, D = Disagree, SD = Strongly disagree.

3.3.5. Perceived Characteristics of Lesson Study as a Community of Practice

Table 9 presents results related to lesson study as a community of practice. Most respondents reported agreement across all items. Approximately 85.4% agreed or strongly agreed that participation in lesson study develops teachers' sense of professional identity within a learning community. In addition, 88.0% perceived lesson study learning as contextually relevant to classroom practice, while 82.9% indicated that learning is derived from the experience and expertise of other teachers. A similar proportion (86.3%) agreed that learning occurred through social interaction, and 84.6% agreed or strongly agreed that individual and collective learning were inseparable within lesson study. These findings suggest that teachers reported experiencing LS as a collaborative professional learning environment consistent with principles of communities of practice.

Table 9. Respondents' perceptions of lesson study as a community of practice.

Statement	SA	A	N	D	SD
Participation in lesson study helps teachers develop a sense of identity as a member of a community of practice/professional learning community.	36.8%	48.6%	13.7%	0.9%	0.0%
Learning in lesson study takes place in contexts that are relevant to classroom practice.	33.3%	54.7%	11.1%	0.9%	0.0%
Learning in lesson study is derived from the experience and expertise of other teachers as members of the community of practice.	26.5%	56.4%	17.1%	0.0%	0.0%
Learning takes place in a social setting by way of engagement with other teachers within a community of practice.	29.9%	56.4%	13.7%	0.0%	0.0%
In lesson study, individual learning is inextricably linked to collective learning and the two cannot be separated.	32.5%	52.1%	15.4%	0.0%	0.0%

Note: SA = Strongly agree, A = Agree, N = Neutral, D = Disagree, SD = Strongly disagree.

3.4. Research Question 3: Relationships Among the Lesson Study Approach Dimensions Correlations Between Lesson Study and Related Variables

Table 10 presents Pearson product-moment correlation coefficients examining relationships among key lesson study variables. All correlations were positive and statistically significant at the 0.05 level. Strongly positive correlations were observed between teachers' understanding of lesson study and collaboration ($r = 0.879, p < 0.001$), as well as between lesson study preparation and collaboration ($r = 0.753, p < 0.001$). The results revealed significant positive relationships between teachers' experiences and lesson study implementation ($r = 0.750, p < 0.001$). These results indicate that greater understanding and more positive perceptions of lesson study are associated with stronger engagement. The strongest relationship was with teacher collaboration, indicating that collaborative school cultures may support more effective implementation. Furthermore, preparation practices, perceived professional growth, and positive implementation experiences were also positively associated with lesson study involvement and outcomes. These results indicate strong associations among the key dimensions of LS, particularly highlighting the close relationship between collaboration, understanding, preparation, and teacher learning. While these correlations do not imply causation, they suggest that teachers who reported greater understanding and collaborative engagement also reported more positive experiences of LS implementation and professional learning.

Table 10. Pearson correlations between composite scores of respondents' perceptions of lesson study and related variables.

Lesson Study Variables	N	Pearson Correlation	<i>p</i>
Lesson study and teachers' views and understanding of lesson study	111	0.727 *	0.000
Lesson study and collaboration	113	0.879 *	0.000
Lesson study and preparation	117	0.753 *	0.000
Lesson study and teachers' own learning in lesson study	113	0.750 *	0.000
Lesson study and Teachers' own experiences in implementation	114	0.750 *	0.000

* Significant at the 0.05 level (2-tailed).

The correlations reported in Table 10 represent bivariate associations between composite scores of subscales derived from theoretically defined constructs. Although the correlation between lesson study understanding and collaboration ($r = -0.879$) is high, these constructs remain conceptually distinct. Understanding refers to teachers' cognitive grasp of lesson study principles, whereas collaboration reflects enacted professional interaction within lesson study processes. The strength of the observed correlations suggests meaningful association among the key LS dimensions. In particular, the strong relationship between collaboration and other variables reinforces the central role of collegial interaction as a mechanism of professional learning within the LS. While these correlations do not imply causation, they provide empirical support for the conceptual framework underpinning the study, which positions collaboration, shared understanding, and reflective practice as interdependent dimensions of sustainable PD. As the present study employs bivariate correlation analysis rather than predictive modelling, multicollineality does not affect parameter estimation in this context.

4. Discussion

This study examined science and mathematics teachers' perceptions of participation in lesson study (LS) in South Africa, with specific attention to teachers' perceived knowledge and skill acquisition and the impact on classroom practice. Given the study's reliance on retrospective self-reported data, the findings should be interpreted as reflecting teachers' perceptions of professional learning rather than as direct evidence of changes in classroom practice. However, such retrospective accounts are valuable for understanding the perceived sustainability and long-term relevance of educational experiences, including PD activities (Finn, 2015; Staus et al., 2021). Sustainability should be understood as teachers' perceived enduring professional learning rather than direct evidence of continued implementation. Therefore, the findings are discussed in relation to the study's research questions, focusing on teachers' perceptions of lesson study participation, its perceived influence on professional knowledge and classroom practice, and the relationship among key LS constructs. It is important to note that the findings are based on self-reported perceptions and do not directly measure changes in classroom practice or learner outcomes. Therefore, conclusions regarding influence should be interpreted as perceived rather than objectively clarified effects.

The study focuses on professional sustainability through teachers' reported experiences. It contributes to knowledge of LS by providing quantitative evidence of teachers' perceived professional learning, thereby informing the understanding of LS as a sustainable professional development model. The findings highlight the potential of LS to function as a socially sustainable PD model. Its emphasis on collaboration, teacher agency, and school-embedded learning aligns with broader goals of building resilient education systems capable of continuous improvement. Recent international research similarly shows that lesson study strengthens teachers' pedagogical beliefs, lesson organisation, and collabo-

rative professional learning (Huang et al., 2024). Meanwhile, its implementation varies across institutional contexts, highlighting the importance of collaborative professional cultures and institutional support structures in sustaining teacher learning (Charong & Haruthaithanasan, 2025). Studies further indicate that lesson study enhances professional accountability and supports teachers' capacity to articulate and integrate new and existing knowledge. However, the sustainability of lesson study depends on structural conditions such as time allocation, leadership support, and institutional commitment, which may either foster or impede its implementation.

4.1. Teachers' Perceptions of Participation in Lesson Study

The findings indicate that teachers generally reported positive experiences with lesson study, particularly regarding collaboration, shared understanding of instructional goals, and engagement in reflective practice. Teachers' strong agreement with statements describing LS as a collaborative, school-embedded PD approach aligns with international research that characterises LS as a teacher-driven, practice-based model of professional learning (Dudley et al., 2019; Lewis et al., 2019). The generally high mean scores across all dimensions may reflect genuinely positive experiences of lesson study participation. However, the possibility of positive response bias cannot be entirely excluded, particularly because participants were asked to retrospectively evaluate a professional development programme in which they had voluntarily participated. Future studies could complement perception data with classroom observations and learner achievement measures.

In South African contexts, similar positive experiences have been reported by Sekao and Engelbrecht (2022), who found that teachers valued the opportunity to work collectively with peers to analyse lessons and learner responses. These authors support the present study's findings that teachers largely shared a coherent understanding of lesson study and recognised its potential to foster a shared instructional culture. This suggests that, when appropriately introduced and supported, lesson study can be meaningfully understood and accepted by teachers across different school phases and subject areas.

However, the findings also indicate that teachers' experiences were shaped by contextual constraints, particularly related to time and institutional support. Teachers' acknowledgement of time constraints during lesson study implementation echoes findings from both local and international studies, which suggest that limited time allocation is a persistent challenge to sustaining lesson study practices (Ogegbo et al., 2019; Verhoef & Tall, 2011). These challenges highlight the importance of supportive school leadership and structural conditions in shaping teachers' experiences of lesson study. The findings are particularly important within the South African educational context, where professional development initiatives often face challenges related to sustainability, resource constraints, and limited opportunities for collaborative teacher learning. The positive perceptions reported by participants suggest that lesson study may offer a viable alternative to conventional one-off workshop models that have frequently been criticised for limited long-term impact.

Perceived impact of lesson study on teachers' knowledge and skills in classroom practice. Regarding knowledge and skills teachers reported acquiring through their participation in lesson study, the findings indicate that teachers perceived lesson study as contributing to improvement in content knowledge, pedagogical knowledge, reflective skills, and collaborative competencies (Akerson et al., 2017; Amador et al., 2022; da Ponte et al., 2023). These perceptions are consistent with later research proposing that lesson study supports the development of teacher professional content knowledge through collective lesson planning, observation, and reflection (Coenders & Verhoef, 2019; Mapulanga et al., 2023). Furthermore, the findings align with international evidence suggesting that lesson study contributes to shifts in pedagogical practice and collaborative norms (Dibaba et al.,

2025; Ding et al., 2024), while strengthening teachers' ability to articulate and integrate professional knowledge (Xu & Wilkins, 2025).

In science and mathematics education, teacher learning is most effective when grounded in authentic classroom practice and focused on subject-specific challenges. The finding that teachers reported that lesson study enabled them to critically examine their pedagogical approaches and extend their content knowledge aligns with Elliott's (2012) study, which emphasises that lesson study fosters inquiry-based teaching and reflective professional learning. Notably, the strong emphasis on collaborative learning reflects the social constructivist foundations of lesson study. Similarly, recent studies have reported that lesson study enhances teachers' pedagogical content knowledge in mathematics and science (Conceição et al., 2022; Mapulanga et al., 2023; Mok & Yee, 2022). Through engagement with peers, teachers reported learning from one another's experiences and expertise, supporting the assertion that professional knowledge is socially constructed within communities of practice (Gutierrez, 2016; Letloenyane & Jita, 2020; Wenger, 2000). This finding is particularly relevant in the South African context, where opportunities for sustained collaborative professional learning are often limited.

The findings further indicate that teachers perceived lesson study as having a positive influence on their classroom practice, including lesson planning, instructional strategies, and collaboration with colleagues. Teachers' perceptions of influenced lesson planning and pedagogical practices are consistent with international research demonstrating that lesson study promotes more coherent lesson design and increased attention to learner thinking (da Ponte et al., 2023). South African studies similarly report that teachers involved in lesson study experience increased confidence in teaching and adopt more reflective and learner-centred instructional approaches (Ogebo et al., 2019; Sekao & Engelbrecht, 2022). The present findings are consistent with the literature, providing quantitative evidence of teachers' perceived instructional gains across a relatively large sample, thereby strengthening claims about the potential influence of lesson study on teaching practice.

However, it is important to interpret these findings cautiously, as the study does not provide evidence of changes in classroom practice or learner outcomes, but rather reflects teachers' perceptions of such changes. While teachers reported positive perceptions of impact, self-reported data may not directly reflect observable changes in classroom practice. Research suggests that although teachers may perceive professional growth through lesson study, sustained instructional changes require ongoing support, time, and alignment with school priorities (Darling-Hammond et al., 2017; Desimone, 2009). Thus, while the findings indicate perceived impact, further research incorporating classroom observation or learner outcomes data would be valuable.

4.2. Lesson Study as a Community of Practice

Teachers' strong agreement with items related to collaboration and community of practice suggests that LS functioned as a platform for collaborative professional learning. The findings support the communities of practice perspective, which conceptualises professional learning as participation within a community characterised by shared goals, mutual engagement, and collective responsibility. Teachers' positive perceptions of collaboration suggest that lesson study may have contributed to the development of professional communities in which knowledge, experiences, and instructional challenges were shared. Such collaborative engagement is important because it creates opportunities for professional learning to become embedded within school practice rather than remaining dependent on external interventions.

The positive perceptions of teacher learning reported in this study may be explained through a social constructivist lens. Social constructivism views learning as a process

that occurs through interaction, dialogue, and shared reflection. The collaborative lesson planning, lesson observation, and post-lesson discussions characteristic of lesson study provide opportunities for teachers to co-construct professional knowledge rather than acquire knowledge individually. The perceived learning reported by participants, therefore, suggests the lesson study created conditions that supported socially mediated professional growth. The findings are consistent with the tenets of communities of practice, where learning is embedded in shared activity and social interaction (Gutierrez, 2016; Loyarte & Rivera, 2007; Wenger, 2000). Teachers in this study perceived individual and collaborative learning as interconnected, reinforcing the idea that professional growth occurs through participation in collaborative learning communities. In the South African schooling context, where teachers often work in isolation, fostering professional communities through LS is particularly significant (Helmbold et al., 2021). The findings suggest that lesson study can foster collegial relationships and shared professional identities, provided that schools create enabling conditions for collaboration.

4.3. Relationship Among Lesson Study Variables

The strong and statistically significant correlations observed among teachers' understanding of lesson study, collaboration, preparation, implementation, and learning suggest that these elements are interrelated rather than discrete. The strong positive relationships among understanding, collaboration, preparation, implementation, and teacher learning suggest that lesson study functions as an interconnected professional learning process rather than a collection of isolated activities. From a social constructivist perspective, understanding is developed through collaborative engagement. Similarly, communities of practice theory suggests that participation, interaction, and shared practice are mutually reinforcing. The strong correlations observed in this study, therefore, provide empirical support for the proposition that collaborative participation and professional learning develop together within lesson study environments. This finding is consistent with Desimone's (2009) conceptualisation of effective professional development as a coherent system in which active learning, content focus, and collaborative participation work together to support teacher learning. The strong association between collaboration and teacher learning highlights the central role of collegial interaction in lesson study. This finding aligns with the argument that collaborative structures may function as core mechanisms through which professional learning occurs (Dudley et al., 2019; Lewis, 2009). International research similarly emphasises that lesson study effectiveness depends on the alignment of shared understanding, collaborative enactment, and contextual adaptations (Charong & Haruthaithanasan, 2025), which in turn strengthens collective responsibility and professional knowledge development (Dibaba et al., 2025; Xu & Wilkins, 2025).

4.4. Divergent and Neutral Perceptions

While the majority of teachers reported positive perceptions, between 10% and 40% of respondents selected neutral or disagreement responses on key implementation items, particularly regarding time allocation and school community support. Notably, approximately 40% did not report strong agreement that their school community was supportive. While teachers generally reported positive experiences, concerns regarding time allocation and school support highlight the importance of institutional conditions in sustaining professional learning communities. Communities of practice do not emerge automatically; they require organisational structures that enable regular interaction, shared reflection, and collaborative work. Where such conditions are absent, the sustainability of lesson study may be compromised despite positive teacher attitudes. These findings may be associated with limited knowledge or inconsistent exposure to the lessons studied

(Kankaraš & Capecchi, 2025). These findings suggest variability in institutional readiness and highlight structural barriers to implementation or contextual constraints rather than simple ambivalence. Within programme implementation contexts, these patterns may reflect uneven access to resources, limited exposure to implementation, competing time demands, or differential leadership engagement across sites (Durlak & DuPre, 2008). Therefore, these responses signal contextual constraints that limit the sustainability or implementation of lesson study practices in South Africa. Therefore, while aggregated results suggest overall progress, these divergent and neutral perceptions suggest that the implementation of lesson study may not be experienced equally across contexts. Collective buy-ins, administrative leadership, and collaborative culture may have affected implementation (Kezar et al., 2025). This highlights the importance of strengthening school-level support structures and addressing contextual barriers to enhance the consistency and sustainability of implementation efforts.

4.5. Implications for Practice and Research

Overall, the findings suggest that lesson study has considerable promise as a potentially sustainable PD model for science and mathematics teachers in South Africa and similar contexts. The findings further contribute to understanding sustainability in professional development. Participants reported positive perceptions several years after the original lesson study intervention, suggesting that aspects of the experience remain professionally meaningful over time. From the communities of practice perspective, sustainability is supported when learning becomes embedded within collective professional activity and shared school practices. The findings therefore suggest that lesson study may contribute to sustainable professional development by fostering collaborative cultures and collective professional capacity, rather than relying solely on externally provided training. However, its effectiveness depends on contextual factors such as time allocation, leadership support, and teachers' understanding of the lesson study process (Brandisauskiene et al., 2020; Jones, 2024; Scott et al., 2023). While the findings indicate strong associations among collaboration, preparation, and teacher learning, these relationships are shaped by structural constraints, particularly limited time allocation, competing workload demands, and uneven leadership support. Such conditions may constrain the sustainability and depth of lesson study implementation, even where teacher commitment is high. Unlike much of the existing Sub-Saharan African lesson study research, which tends to focus on implementation outcomes or perceptions in isolation, this study advances the literature by empirically examining the interrelationships among key lesson study dimensions within a unified correlational framework. For lesson study to be sustainable, schools and education authorities would need to institutionalise collaborative time and provide ongoing support structures. From a research perspective, this study contributes quantitative evidence to a body of literature that has been dominated by qualitative case studies. Future research could build on these findings by employing mixed-methods designs, longitudinal studies, or classroom-based measures to examine the long-term impact of lesson study on institutional practice and learner outcomes.

4.6. Limitations of the Study

The first limitation concerns the study's retrospective design. The lesson study intervention occurred between 2012 and 2014, and the data were collected in 2018, meaning teachers reported their experiences several years after participation. The extended period between data collection and publication, particularly due to the study's integration within a doctoral research process, may further limit the contemporaneity of the findings. Although the delay allowed for a more rigorous analysis, it also means that the findings should be

interpreted within the historical context in which the data were generated rather than as a reflection of current PD conditions. As such, responses may reflect memory reconstruction, professional reinterpretation, or selective recall. While sustained positive recall may indicate perceived durability of professional learning, it does not necessarily represent unchanged classroom practice over time. Therefore, the findings should be interpreted as reflecting teachers' perceptions during that historical period.

Furthermore, since 2018, the South African education system has undergone additional shifts, including increased integration of digital technologies, blended professional development formats, and post-pandemic restructuring of school systems. Consequently, generalisation of the findings to contemporary professional development environments should be undertaken cautiously and requires additional empirical validation. Additionally, the study reports on subscales that were not established or confirmed by factor analysis. However, the subscales were theoretically grounded and informed by relevant literature on lesson study, communities of practice, and professional development. Furthermore, the internal consistency of the subscales was very high ($\alpha = 0.86\text{--}0.94$), indicating acceptable internal consistency.

Another limitation of the study is that it interprets self-reported data, which may be subject to social desirability bias and may not fully capture actual changes in classroom practice. Additionally, collecting data at a single point in time through a cross-sectional survey design reduces the ability to infer changes in teachers' perceptions over time. Also, the sample comprised teachers who had participated in lesson study facilitated by a single higher education institution, which may limit the generalisability of the findings to other contexts or lesson study models. The absence of classroom observation or learner achievement data means that the reported impact of lesson study could not be triangulated with objective measures of instructional practice or learning outcomes. Lastly, the study was done retrospectively, although the sustained recall of professional learning provides insight into the long-term perceived value and durability of lesson study professional development. Thus, the time lapse between the intervention and data collection offers insights into the durability and sustainability of teachers' professional learning. Although subgroup comparisons (e.g., teachers' gender, experience level, and subject area) could provide additional insight, the current study focused on overall patterns of perceptions (descriptive examination) and relationships among lesson study dimensions (correlational examination). Future research should examine demographic variations using inferential comparative techniques.

5. Conclusions

This study examined science and mathematics teachers' retrospective experiences and perceptions of participation in lesson study in South Africa. Given the study's retrospective nature and perception-based design, the conclusions should be interpreted as indicative of teachers' perceived professional value rather than causal evidence of instructional change. Lesson study was positioned as an effective and potentially sustainable professional development model for strengthening science and mathematics education. The findings indicate that teachers generally reported experiencing lesson study as a collaborative, practice-based professional development approach that supported reflective teaching, professional learning, and collegial engagement. Teachers reported gains in content and pedagogical knowledge, as well as enhanced skills in lesson planning and collaboration. By fostering collaborative cultures and embedding learning within school practice, lesson study contributes to the long-term social sustainability of education systems. Despite these positive perceptions, challenges related to time constraints and institutional support were evident. The study provides retrospective evidence that teachers experienced lesson study as profes-

sionally meaningful and collaboratively supportive within their contexts. While findings are limited to self-reported perceptions, they suggest that lesson study may contribute to sustained professional learning when institutional conditions are favourable. Finally, the study contributes theoretically by providing empirical support for the complementary use of social constructivism and communities of practice in understanding teacher professional learning. The findings suggest that teacher learning in lesson study is facilitated through social interaction and collaborative knowledge construction, while the sustainability of that learning is supported through participation in professional communities characterised by shared practice and collective engagement. Together, these perspectives offer a useful framework for understanding how lesson study can support both immediate teacher learning and longer-term professional development.

6. Recommendations

(a) *for teachers*

Teachers are encouraged to actively engage in lesson study by embracing collaborative planning, peer observation, and reflective dialogue. Sustained participation in lesson study may enhance professional learning, deepen content understanding, and promote reflective institutional practices. Teachers should also advocate for protected time and institutional support to maximise the benefits of collective professional development.

(b) *for school management teams*

Schools could adopt structured scheduling models such as bi-weekly subject-cluster meetings during existing professional development periods, or rotational timetable adjustments to allow common planning time among teachers.

(c) *for education authorities and policymakers*

Provincial education departments could integrate lesson study cycles into existing continuous professional development frameworks rather than introducing parallel initiatives. Integrating lesson study into an existing school professional development framework may strengthen the sustainability of professional development by ensuring continuity, scalability, and alignment with system-level improvement goals.

(d) *for teacher education institutions*

Universities and teacher education institutions should incorporate lesson study principles into both pre-service and in-service teacher education programmes. Providing teachers with early exposure to collaborative inquiry and reflective practice may strengthen their readiness to engage in lesson study and similar professional learning communities.

(e) *for future research*

Future studies should employ longitudinal and mixed-methods designs to examine changes in teachers' practices over time and to triangulate self-reported data with classroom observations and learner outcomes. Further research could also explore contextual variations in lesson study implementation across different contexts, such as provinces, school phases, and subject areas. Lastly, research may explore subgroup comparisons (e.g., teachers' gender, experience level, qualifications, and subject area) to compare perceptions across demographic and professional characteristics.

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References

- Adler, J., Mwadzaangati, L., & Takker, S. (2023). From defining as assertion to defining as explaining meaning: Teachers' learning through theory-informed lesson study. *International Journal for Lesson and Learning Studies*, 12(1), 38–51. [\[CrossRef\]](#)
- Akerson, V. L., Pongsanon, K., Park Rogers, M. A., Carter, I., & Galindo, E. (2017). Exploring the use of lesson study to develop elementary preservice teachers' pedagogical content knowledge for teaching nature of science. *International Journal of Science and Mathematics Education*, 15(2), 293–312. [\[CrossRef\]](#)
- Amador, J. M., Rogers, M. A. P., Phillips, A., Galindo, E., Akerson, V. L., Hudson, R., & Carter, I. (2022). Novice teachers' pedagogical content knowledge for planning and implementing mathematics and science lessons. *Teaching and Teacher Education*, 115, 103736. [\[CrossRef\]](#)
- Bascope, M., Perasso, P., & Reiss, K. (2019). Systematic review of education for sustainable development at an early stage: Cornerstones and pedagogical approaches for teacher professional development. *Sustainability*, 11(3), 719. [\[CrossRef\]](#)
- Bendtsen, M., Forsman, L., & Björklund, M. (2022). Exploring empowering practices for teachers' sustainable continuing professional development. *Educational Research*, 64(1), 60–76. [\[CrossRef\]](#)
- Brandisauskiene, A., Cesnaviciene, J., Miciulienė, R., & Kaminskiene, L. (2020). What factors matter for the sustainable professional development of teachers? Analysis from four countries. *Journal of Teacher Education for Sustainability*, 22(2), 153–170. [\[CrossRef\]](#)
- Charong, M., & Haruthaithanasan, T. (2025). Implementing Japanese lesson study in a Thai private school: How to build a professional learning community for mathematics teachers. *Kasetsart Journal of Social Sciences*, 46(2), 460230. [\[CrossRef\]](#)
- Coenders, F., & Verhoef, N. (2019). Professional development in education lesson study: Professional development (PD) for beginning and experienced teachers. *Professional Development in Education*, 45(2), 217–230. [\[CrossRef\]](#)
- Conceição, T., Baptista, M., & da Ponte, J. P. (2022). Examining pre-service science teachers' pedagogical content knowledge through lesson study. *EURASIA Journal of Mathematics, Science and Technology Education*, 18(1), 1–15. [\[CrossRef\]](#) [\[PubMed\]](#)
- Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). SAGE.
- da Ponte, J. P., Quaresma, M., & Mata-pereira, J. (2023). Prospective mathematics teachers' views of their learning in a lesson study. *PNA: Revista de Investigación en Didáctica de la Matemática*, 17(2), 117–136. [\[CrossRef\]](#)
- Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017). *Effective teacher professional development*. Learning Policy Institute.
- Desimone, L. M. (2009). Improving impact studies of teachers' professional development: Toward better conceptualizations and measures. *Educational Researcher*, 38(3), 181–199. [\[CrossRef\]](#)
- Dibaba, T. Y., Hunde, A. B., Faith, M., & Wedajo, A. L. (2025). Enhancing mathematics teachers' professional learning engagement through lesson study in secondary schools. *Journal of Workplace Learning*, 38(1), 57–72. [\[CrossRef\]](#)
- Ding, M., Huang, R., Pressimone, C., Xiaobao, B., & Yeping, L. (2024). A review of lesson study in mathematics education from 2015 to 2022: Implementation and impact. *ZDM—Mathematics Education*, 56(1), 87–99. [\[CrossRef\]](#)
- Dudley, P., Xu, H., Vermunt, J. D., & Lang, J. (2019). Empirical evidence of the impact of lesson study on students' achievement, teachers' professional learning and on institutional and system evolution. *European Journal of Education*, 54, 202–217. [\[CrossRef\]](#)
- Durlak, J. A., & DuPre, E. P. (2008). Implementation matters: A review of research on the influence of implementation on program outcomes and the factors affecting implementation. *American Journal of Community Psychology*, 41(3–4), 327–350. [\[CrossRef\]](#) [\[PubMed\]](#)

- Elliott, J. (2012). Developing a science of teaching through lesson study. *International Journal for Lesson and Learning Studies*, 1(2), 108–125. [\[CrossRef\]](#)
- Finn, B. (2015). Retrospective utility of educational experiences: Converging research from education and judgment and decision-making. *Journal of Applied Research in Memory and Cognition*, 4(4), 374–380. [\[CrossRef\]](#)
- Gutierrez, S. B. (2016). Building a classroom-based professional learning community through lesson study: Insights from elementary school science teachers. *Professional Development in Education*, 42, 801–817. [\[CrossRef\]](#)
- Helmbold, E., Venketsamy, R., & Van Heerden, J. (2021). Implementing lesson study as a professional development approach for early grade teachers: A South African case study. *Perspectives in Education*, 39(2), 183–196. [\[CrossRef\]](#)
- Huang, R., Weaver, J. C., Matney, G., Huang, X., Wilson, J., & Painter, C. (2024). Exploring teacher learning through a hybrid cross-cultural lesson study in China and the United States. *International Journal for Lesson and Learning Studies*, 13(1), 41–55. [\[CrossRef\]](#)
- Hunter, J., & Back, J. (2011). Facilitating sustainable professional development through lesson study. *Mathematics Teacher Education and Development*, 13(1), 94–114.
- Islam, T. M. (2020). *Learning SPSS without pain: A comprehensive manual for data analysis and interpretation of outputs* (1st ed.). ASA Publishers. [\[CrossRef\]](#)
- Jones, L. (2024). Lesson study in physical education: A collaborative and contextualised approach to initial teacher training. *Sport, Education and Society*, 29(4), 412–422. [\[CrossRef\]](#)
- Kankaraš, M., & Capecci, S. (2025). Neither agree nor disagree: Use and misuse of the neutral response category in Likert-type scales. *Metron*, 83(1), 111–140. [\[CrossRef\]](#)
- Kezar, A., Hallett, R. E., Corwin, Z. B., & Hypolite, L. (2025). Moving toward institutional culture change in higher education: An exploration into cross-functional professional learning communities. *Innovative Higher Education*, 50(2), 687–714. [\[CrossRef\]](#)
- Khokhotva, O. (2018). Lesson study in Kazakhstan: Case study of benefits and barriers for teachers. *International Journal for Lesson and Learning Studies*, 7(4), 250–262. [\[CrossRef\]](#)
- Langford, P. E. (2005). *Vygotsky's developmental and educational psychology*. Psychology Press.
- Letloenyane, D. M., & Jita, L. C. (2020). School-based professional development interventions: The effects of a lesson study approach for mathematics teachers. *Independent Journal of Teaching and Learning*, 15(1), 63–75.
- Lewis, C. (2009). What is the nature of knowledge development in lesson study? *Educational Action Research*, 17(1), 95–110. [\[CrossRef\]](#)
- Lewis, C., Friedkin, S., Emerson, K., Henn, L., & Goldsmith, L. (2019). How does lesson study work? Toward a theory of lesson study process and impact. In R. Huang, A. Takahashi, & J. P. da Ponte (Eds.), *Theory and practice of lesson study in mathematics, advances in mathematics education* (pp. 13–37). Springer. [\[CrossRef\]](#)
- Loyarte, E., & Rivera, O. (2007). Communities of practice: A model for their cultivation. *Journal of Knowledge Management*, 11(3), 67–77. [\[CrossRef\]](#)
- Mapulanga, T., Ameyaw, Y., & Nshogoza, G. (2023). Improving secondary school biology teachers' topic-specific pedagogical content knowledge: Evidence from lesson studies. *Journal of Baltic Science Education*, 22(1), 20–36. [\[CrossRef\]](#)
- Mhakure, D. (2019). School-based mathematics teacher professional learning: A theoretical position on the lesson study approach. *South African Journal of Education*, 39, 1–8. [\[CrossRef\]](#)
- Mok, A. I. C., & Yee, P. H. (2022). Integrating research into practice: The growth of collective pedagogical content knowledge for primary mathematics via lesson study. *Asian Journal for Mathematics Education*, 1(2), 187–203. [\[CrossRef\]](#)
- Ogegbo, A. A., Gaigher, E., & Salagaram, T. (2019). Benefits and challenges of lesson study: A case of teaching physical sciences in South Africa. *South African Journal of Education*, 39(1), 1–9. [\[CrossRef\]](#)
- Pham, H. T., Nguyen, T. C., Vu, T. C., Nguyen, L. T., Lai, L. P., Vu, N.-T. T., Pham, H.-H. T., Le, H.-C. T., & Ngo, C. H. (2023). Professional development for science teachers: A bibliometric analysis from 2001 to 2021. *Eurasia Journal of Mathematics Science and Technology Education*, 19(5), em2260. [\[CrossRef\]](#) [\[PubMed\]](#)
- Richit, A. (2022). Meanings of mathematics teaching forged through reflection in a lesson study. *EURASIA Journal of Mathematics, Science and Technology Education*, 18(9), em2151. [\[CrossRef\]](#) [\[PubMed\]](#)
- Ricks, T. E. (2011). Process reflection during Japanese lesson study experiences by prospective secondary mathematics teachers. *Journal of Mathematics Teacher Education*, 14, 251–267. [\[CrossRef\]](#)
- Santrock, W. J. (2011). *Educational psychology* (5th ed.). McGraw Hill.
- Scott, C., Colleen, P., & Pratt, S. S. (2023). Examining mathematics teacher motivation during lesson study: The role of contextual factors for perceived relatedness. *Learning Environments Research*, 26, 255–270. [\[CrossRef\]](#)
- Sekao, D., & Engelbrecht, J. (2022). South African primary mathematics teachers' experiences and perspectives about lesson study. *International Journal of Science and Mathematics Education*, 20, 1431–1453. [\[CrossRef\]](#)
- Shingphachanh, S. (2019). Exploring the impact of lesson study through the views of Lao mathematics teacher educators on the needs, learning and difficulties. *International Journal for Lesson and Learning Studies*, 8, 98–116. [\[CrossRef\]](#)
- Sivan, E. (1986). Motivation in social constructivist theory. *Educational Psychologist*, 21(3), 209–233. [\[CrossRef\]](#) [\[PubMed\]](#)

- Staus, N. L., Falk, J. H., Price, A., Tai, R. H., & Dierking, L. D. (2021). Measuring the long-term effects of informal science education experiences: Challenges and potential solutions. *Disciplinary and Interdisciplinary Science Education Research*, 3, 3. [[CrossRef](#)] [[PubMed](#)]
- Taber, K. S. (2018). The use of Cronbach's alpha when developing and reporting research instruments in science education. *Research in Science Education*, 48, 1273–1296. [[CrossRef](#)]
- Tachie, S. A. (2020). Teachers' attitudes towards lesson study as a viable strategy to improve the teaching and learning of mathematics. *Universal Journal of Educational Research*, 8(6), 2326–2334. [[CrossRef](#)]
- Thobela, N. M., Sekao, R. D., & Ogbonnaya, U. I. (2023). Mathematics teachers' use of textbooks for instructional decision-making in lesson study. *Journal of Pedagogical Research*, 7(4), 1–13. [[CrossRef](#)]
- Verhoef, N. C., & Tall, D. O. (2011, July 10–15). *Lesson study: The effect on teachers' professional development*. 35th Conference of the International Group for the Psychology of Mathematics Education (Vol. 1, pp. 287–304), Ankara, Turkey.
- Vermunt, J. D., Vrikki, M., Halem, N., Van, Warwick, P., & Mercer, N. (2019). The impact of lesson study professional development on the quality of teacher learning. *Teaching and Teacher Education*, 81, 61–73. [[CrossRef](#)]
- Warwick, P., Vrikki, M., Mette, A., Karlsen, F., Dudley, P., Vermunt, D., Warwick, P., Vrikki, M., Mette, A., & Karlsen, F. (2019). The role of pupil voice as a trigger for teacher learning in Lesson Study professional groups. *Cambridge Journal of Education*, 49(4), 435–455. [[CrossRef](#)]
- Wenger, E. (2000). Communities of practice and social learning systems. *Organization*, 7(2), 225–246. [[CrossRef](#)]
- Xu, H., & Wilkins, C. (2025). Cognitive dynamics in teacher knowledge development through lesson study: Insights from two Chinese teams. *Cogent Education*, 12(1), 2476289. [[CrossRef](#)]
- Zhai, X., Chu, X., Wang, M., Tsai, C. C., Liang, J. C., & Spector, J. M. (2024). A systematic review of Stimulated Recall (SR) in educational research from 2012 to 2022. *Humanities and Social Sciences Communications*, 11(1), 489. [[CrossRef](#)]

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