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Teacher Learning Communities and Teaching Performance in Disaster-Prone Primary Schools: A Sequential Explanatory Mixed-Methods Study

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ABSTRACT

This study examined the implementation of teacher learning communities and their relationship with teaching performance in state primary schools in Sibolga City, a disaster-prone area. It also explored the processes and contextual factors shaping their implementation. A sequential explanatory mixed-methods design was employed, involving questionnaire data from 205 teachers selected from a population of 539 and qualitative data from 15 teacher learning community coordinators through interviews, observations, and documentation. The findings indicated that teacher learning communities achieved an average implementation score of 87.16%, while teaching performance averaged 85.8%. A positive and statistically significant relationship was identified between the two variables (r = 0.576; R2 = 0.332). Qualitative findings showed that needs-based planning, collaboration, active participation, reflection, and classroom follow-up were central to how learning communities functioned. School leadership, teacher engagement, collaborative culture, time, and resources supported implementation, whereas workload, limited facilities, and disaster-related disruptions constrained sustainability. These findings highlight the importance of strengthening collaborative professional learning through context-responsive planning, reflective practice, and systematic follow-up to help sustain teaching quality and learning continuity in disaster-prone schools.

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■ INTRODUCTION

Primary education provides a foundation for students' academic and social development and their ability to respond to changing learning conditions. Maintaining educational quality is especially challenging in disaster-prone areas, where damage to facilities, limited accessibility, disrupted attendance, and interruptions to teaching may occur. A safe, supportive school environment supports students' character development and learning (Prasetia et al., 2021b; Schipper et al., 2017). Research on disaster risk reduction stresses school-community readiness and disaster-responsive education (Kurniawati et al., 2025). Teachers must therefore adapt instruction to uncertainty and maintain learning continuity, requiring adaptive competencies and sustained professional learning (Septikasari et al., 2024; Suarmika et al., 2022).

These challenges are relevant to Sibolga City, on the west coast of North Sumatra, where floods and landslides may affect facilities, teacher mobility, and learning conditions. An imbalance between teacher availability and student numbers may increase workloads and limit professional support. Strengthening teachers' capacity requires collaborative, sustainable learning and effective educational administration and resource management. Teacher empowerment is also associated with school effectiveness, highlighting the importance of supportive working conditions and teachers' contributions to improvement (Prasetia & Akrim, 2024). Professional development is more meaningful when it responds to classroom needs and occurs in collaborative environments (Rahmi & Rassanjani, 2025; Vangrieken et al., 2015). Teachers also need assessment competencies to evaluate learning using well-constructed items (Kyaruzi & Kisamo, 2025).

Teacher learning communities offer one way to strengthen this professional capacity. They allow teachers to share experiences, discuss instructional problems, exchange practices,

reflect on teaching, and develop collective responses to classroom challenges. Research with Indonesian teachers highlights the relevance of professional learning communities to instructional needs and classroom practice (Bachtiar & Nirmala, 2023). Network-based communities support individual and collective learning (Denee, 2024), while cross-national research examines links between professional learning communities and teacher outcomes (Christensen & Jerrim, 2025). Digital transformation has also been explored as a way to support professional learning and sustainable education (Krabonja et al., 2024). Indonesian research has examined Lesson Study as a strategy for strengthening teachers' pedagogical quality (Prasetia et al., 2021a). In contrast, research on teacher mobilizers highlights teacher leadership in guiding learning and mobilizing communities for improvement (Prasetia et al., 2025). These findings align with research linking sustained, needs-based collaboration with pedagogical capacity and improved learning practices (Olmo-Extremera et al., 2025; Ventista & Brown, 2023).

Teacher learning communities may be especially important in disaster-prone settings, where professional learning must continue despite disruption. In more stable contexts, communities support planning, sharing practices, assessment, and reflection (Olmo-Extremera et al., 2025; Vangrieken et al., 2015). Disasters can damage facilities, restrict mobility, change school priorities, and increase teachers' emergency and recovery workloads, interrupting collaboration. Communities must therefore support pedagogical improvement while helping teachers adapt instruction, maintain learning continuity, and respond to students' academic and psychosocial needs. Research on preparedness and disaster-responsive education reinforces the importance of integrating readiness, instructional adaptation, and continuity into school practices (Kurniawati et al., 2025; Septikasari et al., 2024; Suarmika et al., 2022).

However, the contribution of teacher learning communities may vary across contexts. Their value depends on systematic organization, attention to learning problems, leadership support, and alignment with teachers' needs (Christensen & Jerrim, 2025; Olmo-Extremera et al., 2025; Vangrieken et al., 2015). In disaster-prone areas, these conditions may be complicated by limited resources, restricted mobility, heavy workloads, and interruptions to school routines. Preliminary observations and document reviews in Sibolga suggested that learning community activities were not always connected to students' learning needs, disaster preparedness, or educational continuity. They also indicated potential constraints involving coordination, participation, workload, and sustained collaboration. These indications warrant systematic investigation but do not establish that all learning communities are ineffective. Limited context-specific evidence from Sibolga further supports examining how these communities are implemented and how they relate to teaching performance in disaster-prone primary schools.

Accordingly, this study examines teacher learning community implementation, teachers' teaching performance, and the relationship between these variables in state primary schools in Sibolga City. The study integrates questionnaire data from 205 teachers with qualitative evidence from 15 teacher learning community coordinators, collected through interviews, observations, and documentation. The study also explores how communities support teaching performance, factors that facilitate or hinder implementation, and a context-sensitive approach to strengthening sustainability. It provides context-specific evidence on collaborative professional learning in disaster-prone primary schools. The study addresses six questions: (1) What is the level of teacher learning community implementation? (2) What is the level of teachers' teaching performance? (3) Is implementation significantly related to teaching performance? (4) How do communities support teaching performance? (5) What factors support or hinder their implementation? Furthermore, (6) What contextual and sustainable approach could strengthen teacher learning communities in Sibolga City?.

■ METHOD

Research Design

This study used a sequential explanatory mixed-methods design, in which the quantitative phase came first, followed by a qualitative phase to explain and elaborate on the quantitative findings (Tashakkori & Teddlie, 2010; Fàbregues & Guetterman, 2025). The quantitative phase measured the implementation of teacher learning communities and teachers' teaching performance in state primary schools in Sibolga City. The subsequent qualitative phase explored how learning communities supported teaching performance and helped explain the quantitative results. Integrating quantitative and qualitative findings provided a more comprehensive understanding of the research questions and the contextual factors influencing the implementation of teacher learning communities (Onwuegbuzie et al., 2023; Zhou et al., 2024). The procedure for sequential explanatory research is illustrated in Figure 1 below:

1. Preliminary Study. A phase aimed at obtaining an initial overview of the research context, involving an initial assessment of the conditions within the learning community and the teaching performance of teachers at state primary schools in Sibolga City through field observations and document analysis.
2. Quantitative Stage. This stage involves measuring the effectiveness of learning communities on teachers' teaching performance. The procedures carried out at this stage are: (1) formulating a quantitative research question; (2) defining the research variables and hypotheses; (3) developing the research instrument and pilot-testing it on a sample outside the research sample; (4) defining the research population and sample; (5) distributing the research instrument to the research sample; (6) collecting and analysing data using statistical techniques.
3. Identification of Results and Follow-up. This stage involves determining the quantitative results (critically analysing the quantitative results). Explaining and interpreting the results of hypothesis testing and quantitative findings as a basis for developing qualitative instruments.
4. Qualitative Design Stage. At this stage, the aim is to determine the direction of further investigation based on the quantitative results, and to explain why and how learning communities influence teachers' teaching performance. The procedures carried out were: (1) formulating the research questions and following up on the quantitative findings; (2) selecting participants for in-depth interviews; (3) preparing the interview protocol; (4) conducting interviews with selected teachers based on the quantitative results; (5) carrying out observations and collecting supporting documentation of learning community activities, (6) transcribing and verifying data, and analysing the data.
5. Integration of Quantitative and Qualitative Findings. This stage involves integrating or linking quantitative and qualitative findings. Qualitative findings are linked to reinforce the quantitative findings, thereby providing a comprehensive understanding of the quantitative findings.

Participants

In the quantitative phase, the study involved 205 teachers selected from a population of 539 teachers at state primary schools in Sibolga City. The sample size was determined using the method described by Isaac and Michael (as cited in Sugiyono, 2021). Proportionate stratified random sampling was employed, with each state primary school treated as a stratum. The sample allocation for each school was proportional to its share of the total teacher population. Within each school, participating teachers were randomly selected from the available teacher lists. This procedure was intended to ensure proportional representation of teachers across the participating schools. In the qualitative phase, 15 teacher learning community coordinators were purposively selected based on their roles in coordinating learning community activities at their respective schools.

Data Collection

Quantitative data were collected using questionnaires measuring teacher learning community implementation and teachers' teaching performance. The teacher learning community questionnaire covered six indicators: activity planning, collaboration and sharing of good practices, participation and engagement, focus on learning issues, reflection and evaluation, and implementation and follow-up. The teaching performance questionnaire covered lesson planning, lesson delivery, classroom management, the use of teaching media and technology, assessment and evaluation, and reflection and professional development. Both instruments were pilot-tested with 25 teachers who were not included in the main research sample. Item validity was examined using Pearson product-moment correlations. The item-total correlation coefficients for the teacher learning community instrument ranged from r = 0.412 to r = 0.786, with a Cronbach's alpha coefficient of 0.82. For the teaching performance instrument, the coefficients ranged from r = 0.405 to r = 0.811, with a Cronbach's alpha coefficient of 0.82. All item-total correlations exceeded the specified critical value of 0.390, and both instruments demonstrated acceptable internal consistency.

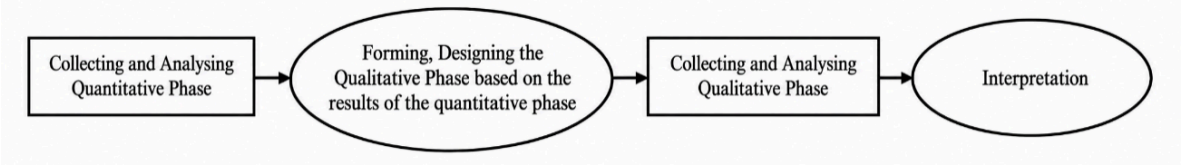


Figure 1. The sequential explanatory stages are as follows:

Qualitative data was collected through interviews, documentation and field observations. In-depth interviews were conducted with the aim of gathering comprehensive information on the implementation of learning communities, teachers' experiences and involvement, and the impact of these on improving teachers' teaching performance. A literature review was conducted to collect, examine and analyse various documents relevant to the research focus, with a view to obtaining data or evidence that could corroborate the findings from interviews and observations. Observations, meanwhile, were carried out to obtain factual data regarding the processes and practices of the learning community within the natural context of the school.

Qualitative Interview and Observation Focus

Interviews with 15 teacher learning community coordinators explored six themes related to the implementation of teacher learning communities. The matrix clarifies the interview questions and observation foci used to guide qualitative data collection, while relevant documentation was used to corroborate the findings.

Table 1. Qualitative interview and observation instrument

Focus	Guiding Interview Questions	Observation Focus
Activity planning	How are activities planned according to teachers' needs?	Planning discussions and identification of learning needs.
Collaboration and sharing of good practices	How do teachers exchange teaching experiences and good practices?	Professional discussions, sharing practices, and collaborative problem-solving.
Teacher participation	How do teachers participate in learning community activities?	Teacher engagement and participation in discussions.
Focus on learning issues	How are instructional problems and students' learning needs identified?	Discussions of instructional problems and proposed solutions.
Reflection and evaluation	How do teachers reflect on activities and evaluate their outcomes?	Reflective discussions, feedback, and evaluation of activities.
Implementation and follow-up	How are agreed strategies applied in classroom practice?	Follow-up planning and classroom application, where observable.

The interview and observation data were analysed thematically, with relevant documentation used to corroborate the findings and provide contextual insights into the implementation of teacher learning communities.

Data Analysis

Percentage achievement scores were calculated by dividing the observed score by the maximum possible score and multiplying by 100. The resulting percentages were interpreted using a five-category classification adapted from Riduwan and Sunarto (2014): very poor (0–20%), poor (21–40%), fair (41–60%), good (61–80%), and very good (81–100%). These five categories provide descriptive benchmarks for interpreting the achievement levels of teacher learning community implementation and teachers' teaching performance. The classification was applied consistently to the percentage results presented in Figures 2 and 3. The categories were used for descriptive interpretation and were distinguished from the inferential analysis used to examine the relationship between the two variables.

Quantitative data analysis was conducted using SPSS and SmartPLS for complementary analytical purposes. SPSS was used to calculate descriptive statistics, percentage achievement scores, and Pearson's bivariate correlation to examine the relationship between teacher learning community implementation and teachers' teaching performance. SmartPLS was used to evaluate the reflective measurement model through indicator outer loadings, Average Variance Extracted (AVE), and Composite Reliability (CR). The measurement model was evaluated using outer loadings of at least 0.708,

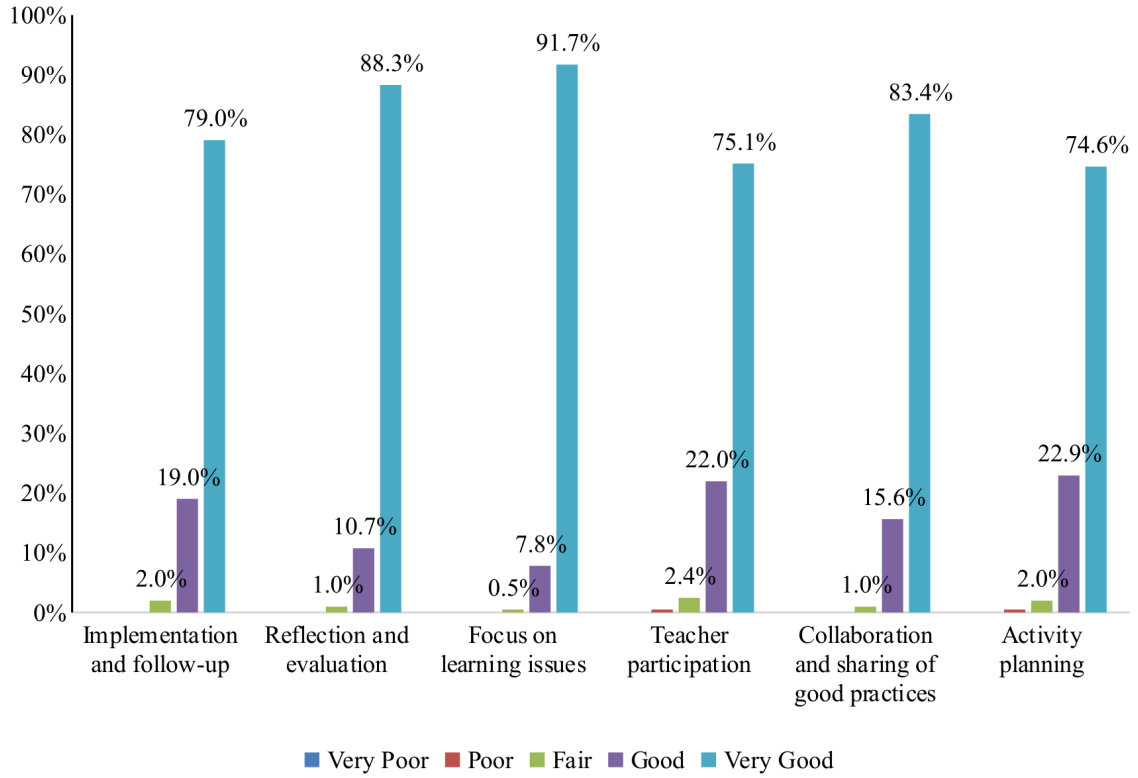


Figure 2. Distribution of teachers by category across teacher learning community indicators

AVE of at least 0.50, and CR of at least 0.70. The structural model was assessed using the relevant SmartPLS output to examine the relationship between the two constructs. Quantitative findings were interpreted according to the respective purposes of the descriptive, correlational, and PLS-SEM analyses.

Qualitative data from interviews, observations, and documentation were analysed thematically through data familiarisation, initial coding, theme development, theme review, theme definition and naming, and interpretation. The qualitative analysis identified patterns and themes concerning the implementation of teacher learning communities and their contribution to teaching performance. The quantitative and qualitative findings were then integrated to provide a more comprehensive understanding of the research results.

Data trustworthiness

The trustworthiness of the data was strengthened through instrument testing and the use of multiple qualitative data sources. The questionnaire was pilot-tested with 25 teachers outside the research sample, followed by validity and reliability testing before the main data collection. For the qualitative phase, interviews, field observations, and documentation were compared to corroborate the information obtained from each source. The qualitative findings were subsequently integrated with the quantitative results to provide a more comprehensive and contextually grounded interpretation of teacher learning communities and teaching performance.

Ethical considerations

The study was conducted with due consideration for the privacy and confidentiality of the participating teachers. The data collected through questionnaires, interviews, observations, and documentation were used solely for research purposes and were reported in relation to the objectives of the study. Participant identities and personal information were protected throughout the data collection, analysis, and reporting processes.

■ RESULT AND DISCUSSION

Implementation of Teacher Learning Communities

The quantitative findings indicate that teacher learning communities in state primary schools in Sibolga City were implemented at a generally high level, with an average achievement score of 87.16%, classified as very good. As shown in Figure 2, the Very Good category accounted for the largest proportion of teachers across all six indicators, particularly

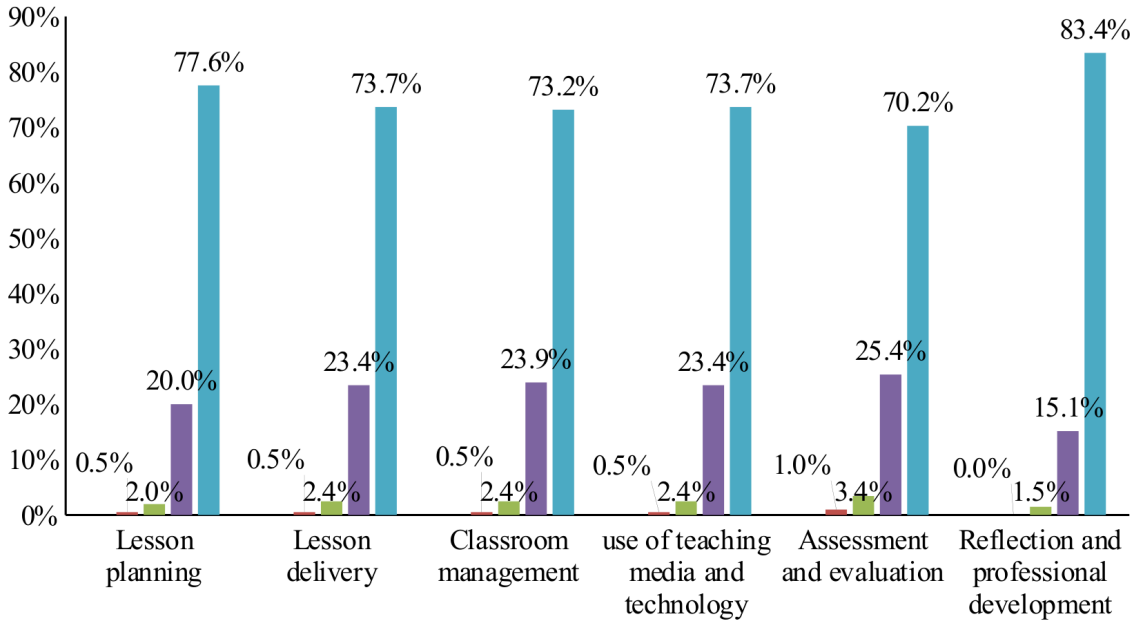


Figure 3. Teaching performance of teachers at state primary schools in Sibolga city

the focus on learning issues (91.7%), reflection and evaluation (88.3%), and collaboration and sharing of good practices (83.4%). In contrast, activity planning (74.6%) and teacher participation (75.1%) had comparatively lower proportions in the Very Good category, indicating areas that may require further strengthening. Overall, these findings suggest that teacher learning communities function as spaces for collaborative professional learning through instructional discussion, reflection, and the exchange of good practices rather than merely administrative activities.

The strong representation of the Very Good category in the focus on learning issues suggests that collaborative activities were closely connected to teachers' instructional challenges. Through collaborative discussion, teachers can exchange teaching strategies, reflect on classroom experiences, and transform individual knowledge into shared professional resources. These findings align with previous research showing that professional learning communities are positively associated with teacher resilience. Zhang et al. (2024), in a study involving 2,815 primary and secondary school teachers in eastern China, found that professional learning communities predicted teacher resilience, with teacher identity playing a mediating role. Although their study examined resilience rather than teaching performance, it provides complementary evidence of the potential contribution of collaborative professional environments to teachers' sustained professional development. The comparatively lower proportions for activity planning and teacher participation in the present study also highlight the importance of systematic planning and sustained engagement to ensure that collaborative activities lead to meaningful classroom follow-up.

These findings are particularly relevant in disaster-prone educational settings, where disruptions to school facilities, resources, routines, and students' learning conditions may require teachers to adapt instruction and coordinate their responses. Parrott et al. (2025), who interviewed 40 teachers from three schools in disaster-affected Central Sulawesi, Indonesia, found that teachers contributed to community resilience through psychoeducational and practical support, including promoting students' well-being, educational continuity, and disaster risk reduction. This evidence broadens the interpretation of the Sibolga findings by highlighting the importance of teachers' adaptive roles in disaster-affected communities. Teacher learning communities may provide opportunities to exchange context-responsive teaching strategies, reflect on emerging challenges, and coordinate support for students. Accordingly, strengthening activity planning, teacher participation, and reflective collaboration may help sustain professional learning and teaching quality under changing school conditions. However, because the present study did not directly measure teacher resilience, its role should be understood as a relevant contextual perspective rather than

a demonstrated mechanism underlying the observed findings.

Teaching Performance of Teachers

Teachers' teaching performance was predominantly classified as very good across all six dimensions. The proportion of teachers in the very good category ranged from 70.2% to 83.4%. Reflection and professional development recorded the highest proportion (83.4%), followed by lesson planning (77.6%). In contrast, assessment and evaluation recorded the lowest proportion (70.2%), with 25.4% classified as good, 3.4% as fair, and 1.0% as poor. These findings suggest that, although teaching performance was generally strong, assessment and evaluation should receive particular attention for further improvement.

The relatively strong performance in reflection and lesson planning suggests that teachers perceived themselves as capable of organising instruction and reviewing their teaching practices. This pattern is consistent with Garet et al. (2001), who identified active learning, content focus, coherence, collective participation, and sustained engagement as important features of effective professional development. Similarly, Kraft et al. (2018), in a meta-analysis of 60 causal studies, found that teacher coaching improved instructional practice and student achievement. These studies support the value of sustained, practice-focused professional learning, although coaching interventions differ from the learning communities examined in this study. Moreover, the descriptive findings alone do not establish a causal relationship between learning communities and teaching performance.

Assessment and evaluation represent a particularly important area for further development. Schildkamp et al. (2020) found that effective formative assessment depends on teachers' assessment and data literacy, pedagogical knowledge, and opportunities for collaboration. Hattie and Timperley (2007) also showed that feedback can substantially influence learning, although its effectiveness depends on its form and delivery. More recently, von Hagen et al. (2025) highlighted the diversity of approaches and outcomes in professional development focused on formative assessment, underscoring the importance of practical learning activities. In disaster-prone schools, teacher learning communities could provide a collaborative space to examine assessment evidence, exchange strategies, and adapt instruction to changing student needs and school conditions. This is a potential contribution that should be interpreted alongside the study's inferential and qualitative findings.

Measurement Model Evaluation

The reflective measurement model was evaluated for indicator reliability, convergent validity, and internal consistency reliability. Table 2 presents the outer loading values for each indicator, together with the Average Variance Extracted (AVE) and Composite Reliability (CR) values for each construct. The evaluation criteria were outer loadings of at least 0.708, AVE of at least 0.50, and CR of at least 0.70.

Table 2. Outer model evaluation results

Construct	Indicator	Outer Loading	AVE	CR
Teacher Learning Communities (KB)	KB1	0.782	0.577	0.875
	KB2	0.754	-	-
	KB3	0.718	-	-
	KB4	0.801	-	-
	KB5	0.763	-	-
	KB6	0.729	-	-
Teaching Performance (KM)	KM1	0.787	0.597	0.899
	KM2	0.832	-	-
	KM3	0.814	-	-
	KM4	0.756	-	-

Construct	Indicator	Outer Loading	AVE	CR
	KM5	0.731	-	-
	KM6	0.708	-	-

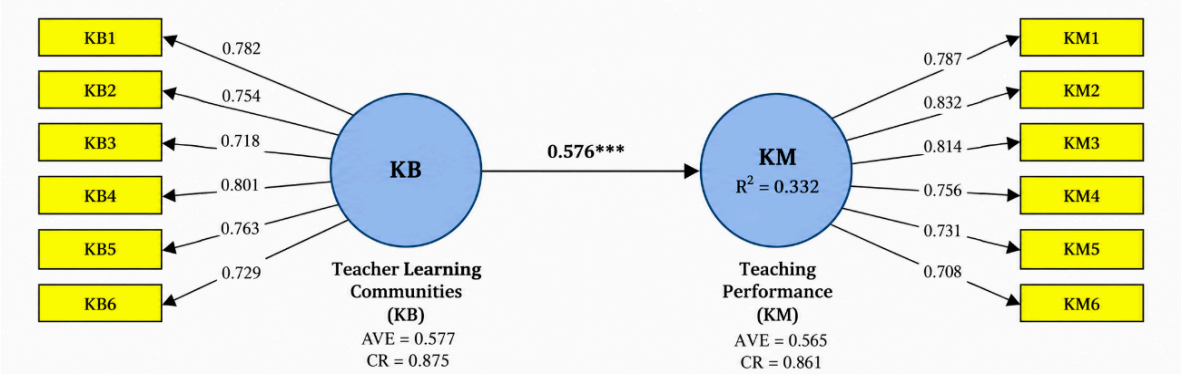


Figure 4. Model of the relationship between learning communities and teaching performance

The outer loadings ranged from 0.718 to 0.801 for teacher learning communities and from 0.708 to 0.832 for teaching performance. All indicators met the minimum outer loading criterion of 0.708. The AVE values were 0.577 for teacher learning communities and 0.597 for teaching performance, exceeding the minimum criterion of 0.50. The CR values were 0.875 and 0.899, respectively, exceeding the minimum criterion of 0.70. These results indicate that both constructs met the specified criteria for indicator reliability, convergent validity, and internal consistency reliability.

Structural Model Assessment

After assessing the reflective measurement model, the structural model was evaluated to examine the relationship between teacher learning communities and teachers' teaching performance. The assessment focused on the structural path coefficients, their bootstrapped statistical significance, the coefficient of determination, and relevant model fit indices. These analyses examined the direction and significance of the relationship, the explanatory power, and the discrepancy between the matrices.

Table 3. Structural model assessment results

Criteria	Path/Construct	Value
Structural Path Coefficient (β)	Teacher Learning Communities → Teaching Performance	0.576
Collinearity (VIF)	Teacher Learning Communities → Teaching Performance	1.000
Explanatory Power (R^2)	Teaching Performance	0.332
Effect Size (f^2)	Teacher Learning Communities → Teaching Performance	0.497
Model Fit (SRMR)	Estimated model	0.061
Model Fit (NFI)	Estimated model	0.901
Bootstrapping (t-statistic)	Teacher Learning Communities → Teaching Performance	9.870
Significance (p-value)	Teacher Learning Communities → Teaching Performance	0.000

As shown in Table 3, the structural model reports a path coefficient of 0.576 for the relationship between teacher learning communities and teaching performance, subject to verification against the original SmartPLS output. The coefficient of determination (R^2) is reported as 0.332, indicating that the model accounts for 33.2% of the variance in teaching performance. Interpret the statistical significance of the structural relationship using the bootstrapping results, including the t-statistic, p-value, and confidence interval. These results provide the basis for determining whether the proposed structural relationship is statistically supported.

Figure 4 illustrates the structural relationship between teacher learning communities and teaching performance, together with the indicator loadings and construct-level statistics. Interpret the model alongside the structural model results in Table 3, which show a positive path coefficient ($\beta = 0.576$) between teacher learning communities and teaching performance. The bootstrapping results indicate that this relationship is statistically significant ($t = 9.870$, $p < .001$). The coefficient of determination ($R^2 = 0.332$) indicates that the model explains 33.2% of the variance in teaching performance. The effect size ($f^2 = 0.497$) indicates a substantial contribution of teacher learning communities to the structural model. The variance inflation factor (VIF = 1.000) indicates no apparent collinearity concern for the predictor. Regarding model fit, the SRMR value of 0.061 is below the commonly used threshold of 0.08, while the NFI value of 0.901 exceeds the commonly cited benchmark of 0.90. Taken together, these results indicate a positive and statistically significant structural relationship, with acceptable values for the reported model fit indices.

Relationship between Teacher Learning Communities and Teaching Performance

The quantitative analysis examined the relationship between teacher learning community implementation and teachers' teaching performance. The results indicated a positive correlation coefficient of ($r = 0.576$), exceeding the critical value of approximately 0.137 at the 5% significance level ($n = 205$; $df = 203$). The relationship was statistically significant ($p < .001$). The coefficient of determination ($R^2 = 0.332$) indicated that 33.2% of the variance in teaching performance was statistically associated with teacher learning community implementation in the bivariate linear relationship.

Table 4. Relationship between teacher learning communities and teaching performance

		Teacher Learning Communities	**Teaching Performance**
Teacher Learning Communities	Pearson Correlation	1.000	.576
	Sig. (2-tailed)	.	.000
	N	205	205
Teaching Performance	Pearson Correlation	.576	1.000
	Sig. (2-tailed)	.000	.
	N	205	205

***. Correlation is significant at the 0.01 level (2-tailed).*

The Pearson bivariate correlation analysis revealed a positive and statistically significant relationship between teacher learning community implementation and teachers' teaching performance ($r = 0.576$, $p < .001$, $N = 205$). This finding indicates that higher levels of teacher learning community implementation were associated with higher teaching performance. The coefficient of determination, calculated by squaring the Pearson correlation coefficient ($R^2 = 0.576^2 \approx 0.332$), indicates that the bivariate linear relationship accounted for 33.2% of the variance in teaching performance. The remaining 66.8% was not accounted for by this relationship and may reflect other individual, organizational, contextual, and random factors. However, the contributions of these factors were not examined separately in the present study. Therefore, teacher learning communities should be considered an important component of teachers' professional development rather than the sole determinant of teaching performance.

This finding is consistent with Vescio et al. (2008), whose review of research on professional learning communities identified positive contributions to teaching practices and student learning, while also noting limitations in the available empirical evidence. Similarly, Ronfeldt et al. (2015), in a study involving more than 9,000 teachers across 336 public schools, found that higher-quality teacher collaboration was associated with greater student achievement gains in mathematics and reading. Although student achievement and teachers' teaching performance are distinct outcomes, these findings support the relevance of collaborative professional learning. In addition, Kraft et al. (2018), through a meta-analysis of 60 causal studies, reported positive effects of teacher coaching on instructional practice and student achievement. Although coaching differs from teacher learning communities, these findings provide complementary evidence of the potential value of structured, practice-focused professional development.

Taken together, the present findings and previous research highlight the importance of sustained collaboration, professional reflection, instructional feedback, and applying shared knowledge to classroom practice. In disaster-prone primary schools, teacher learning communities may provide an organized space for teachers to discuss instructional challenges, exchange adaptive strategies, and reflect on students' changing learning needs. This function is particularly relevant when disruptions to facilities, resources, mobility, and school routines create additional demands on teachers. However, the relationship between teacher learning communities and teaching performance should also be interpreted in light of the qualitative findings concerning school leadership, teacher participation, workload, available resources, and disaster-related disruptions. Because the Pearson correlation analysis establishes association rather than causation, the findings do not show that teacher learning communities alone improve teaching performance.

How Teacher Learning Communities Support Teaching Performance

The qualitative findings explain how teacher learning communities were associated with teaching performance through six interconnected mechanisms: needs-based planning, collaboration and sharing of good practices, active participation, a focus on learning issues, reflection and evaluation, and classroom implementation and follow-up. These themes emerged from interviews with learning community coordinators and were considered alongside observation and documentation findings.

First, needs-based activity planning guided professional learning. Activities were organized around teachers' competency needs and instructional challenges. One coordinator explained:

> *"A key factor in the success of a learning community is that it is implemented through clear and sustainable programs and plans… such as meetings held regularly every week, with an agenda drawn up collaboratively by the headteacher and the community coordinator in line with the needs for skills development and learning issues" (Interview G1).*

This account highlights the importance of regular meetings and collaboratively established agendas in connecting professional learning with teachers' actual needs.

Second, collaboration and sharing of good practices enabled teachers to exchange knowledge and respond collectively to classroom and resource constraints. A coordinator described the value of inter-school collaboration:

> *"We collaborate within an inter-school learning community, because in this community we support one another by sharing knowledge and skills despite our schools' limitations… particularly in the aftermath of a disaster, when our school infrastructure has been damaged… we need the community's support to overcome learning challenges" (Interview G11).*

This account illustrates how collaboration can provide professional support when individual schools face resource limitations and disaster-related disruption.

Third, active teacher participation helped transform meetings from routine activities into opportunities for professional learning. One coordinator described the structure and participation of community members:

> *"Involvement and an active role in the learning community are important… we have got used to following the learning community's schedule, which takes place every two weeks. The activities are structured; they usually begin with sharing best practice, followed by discussion and problem-solving…" (Interview G3).*

This experience suggests that regular participation, structured discussion, and

problem-solving can support the exchange and development of teaching practices.

Fourth, a focus on learning issues helped the community respond to students' actual learning challenges. In the post-disaster context, one coordinator noted:

> *"The impact of the disaster some time ago has now left challenges in terms of learning; although the school buildings were not affected, it will take time to restore the students' enthusiasm for learning… this has become the focus of the inter-school learning community's work" (Interview G12).*

This statement shows that learning challenges after a disaster may extend beyond physical damage to schools and include students' motivation and engagement. Addressing these challenges requires discussion and instructional responses that reflect students' changing needs.

Fifth, reflection and evaluation enabled teachers to review their practices and prepare for subsequent lessons. As one coordinator explained:

> *"The learning community activities have helped me understand the importance of reflection after teaching… the impact on my teaching practice is that learning challenges can be overcome, which makes me better prepared for the next lesson" (Interview G7).*

This account links post-lesson reflection to identifying instructional challenges and preparing for subsequent teaching.

Sixth, classroom implementation and follow-up helped translate discussions into practical improvements. One coordinator emphasized that each activity should lead to an actionable outcome:

> *"We emphasize that learning community activities are not merely a formality… every teacher must participate and play an active role in every activity… every activity must result in a follow-up plan in the form of improvements to learning administration or classroom teaching strategies…" (Interview G2).*

This statement highlights the importance of follow-up plans in ensuring that professional discussions lead to changes in classroom practice rather than remaining isolated meeting activities.

Table 5. Learning community themes and teaching performance

Theme	Implementation of learning community	Contribution to teaching performance
Activity planning	Planning based on teachers' needs and students' learning challenges	Improves lesson objectives, content, methods, resources, and assessment
Collaboration and sharing of good practices	Exchange of experiences, strategies, media, resources, innovations, and feedback	Supports lesson planning, delivery, problem-solving, and reflection
Teacher participation	Active involvement in discussions, sharing, feedback, and collaborative problem-solving	Supports planning, teaching, evaluation, innovation, and reflective practice
Focus on learning issues	Activities address actual instructional problems and students' learning needs	Strengthens planning, classroom management, problem-solving, and instructional adaptation
Reflection and evaluation	Review of learning processes, outcomes, strengths, weaknesses, and learning gaps	Supports the use of assessment information and continuous teaching improvement
Implementation and follow-up	Application and monitoring of agreed improvements in classroom practice	Promotes consistency, professional growth, innovation, and continuous improvement

The six themes form a continuous cycle of collaborative professional learning: teachers identify needs, plan activities, exchange practices, address learning problems, reflect on outcomes, and apply agreed improvements in the classroom. The observations further supported this interpretation, documenting instructional discussions, sharing of practices, classroom application, reflection, and additional assistance for students experiencing learning difficulties. In the post-disaster context, teachers also adapted their interactions to address students' learning engagement and psychosocial needs. Taken together, the interview, observation, and documentation findings suggest that teacher learning communities can support teaching performance by connecting collaborative professional learning with practical classroom responses to changing educational conditions.

Supporting and Hindering Factors

The effectiveness of teacher learning communities was supported by principal leadership, teacher engagement, collaborative school culture, and the availability of time and resources. Principals facilitated professional learning by providing direction and support, while active participation and open communication enabled teachers to share knowledge, discuss instructional challenges, and develop collaborative solutions.

However, scheduling interruptions, limited facilities, accessibility difficulties, increased workloads during emergency and recovery periods, insufficient integration of disaster management, and psychosocial pressures constrained implementation. These explain why assessment recorded the lowest average score among the teaching performance indicators.

Table 6. Supporting and hindering factors in teacher learning communities

Dimension	Findings	Implication
School leadership	Guidance, motivation, resources, and facilitation from principals	Strengthens legitimacy and sustainability
Teacher participation	Active collaboration, sharing, feedback, and problem-solving	Supports collective professional learning
School culture	Open communication and collaborative relationships	Facilitates reflection and knowledge sharing
Time and scheduling	Regular scheduling supports continuity, while emergencies may disrupt activities.	Requires flexible but consistent scheduling
Facilities and infrastructure	Damage or limitations may restrict professional learning activities	Requires alternative arrangements
Accessibility and mobility	Disaster-related damage may make inter-school activities difficult	Requires adaptive coordination
Teacher workload	Emergency and recovery responsibilities increase teachers' demands	Professional learning must consider changing workloads
Disaster-management integration	Disaster preparedness is not yet fully integrated into learning community activities.	Disaster-related professional learning should be strengthened.
Psychosocial conditions	Teachers and students may require additional psychosocial support after disasters.	Professional learning should be context-sensitive.

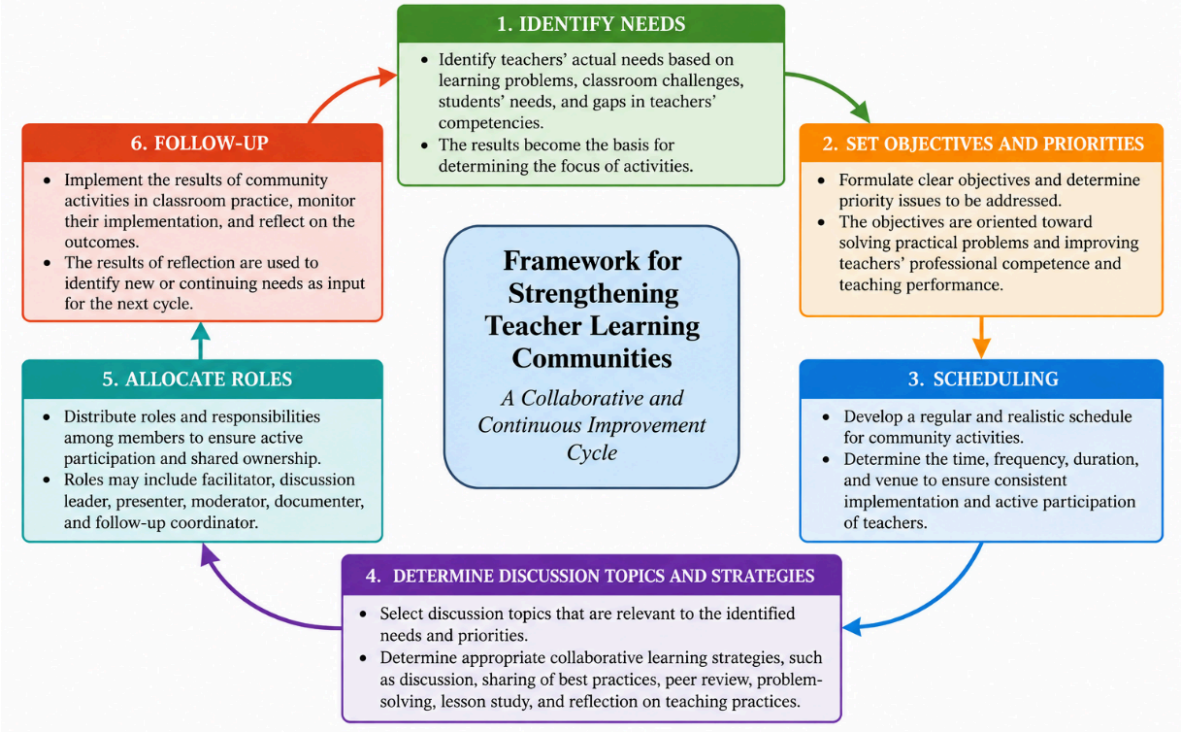


Figure 5. Continuous improvement cycle for teacher learning communities

Effective assessment requires teachers to design appropriate tasks, interpret evidence of student understanding, provide feedback, and adjust subsequent instruction. DeLuca et al. (2016) highlighted the multidimensional nature of teacher assessment literacy, while Schildkamp et al. (2020) emphasized the importance of assessment and data literacy, pedagogical knowledge, and collaboration in formative assessment. In post-disaster settings, disrupted schedules, inconsistent attendance, limited learning resources, and changing student needs may reduce opportunities to monitor learning progress and provide timely instructional follow-up. D'Ayala et al. (2025) similarly demonstrated how damage to school infrastructure and transport networks can disrupt educational services. Teacher learning communities could therefore help teachers collaboratively review learning evidence, identify learning gaps, exchange assessment strategies, and adapt evaluation practices to changing conditions. However, these contextual challenges should be considered plausible explanations rather than established causes of the lower assessment score, because their specific effects on assessment practices were not independently measured in this study.

Overall, teacher learning communities in disaster-prone schools need to combine pedagogical improvement with disaster preparedness, flexible assessment practices, educational continuity, and support for students' recovery. Strengthening collaboration around assessment and evaluation may help teachers make better-informed instructional decisions while sustaining professional learning under changing school conditions.

A Contextual and Sustainable Model for Strengthening Teacher Learning Communities

Integrating quantitative and qualitative findings produced a contextual and sustainable approach to strengthening teacher learning communities at state primary schools in Sibolga City. The model emphasizes a systematic, collaborative, reflective, and continuous professional learning cycle.

The first stage is identifying teachers' learning needs through observation, discussion, and reflection on classroom problems. The second stage is setting objectives and priorities collaboratively based on the identified needs. The third stage is scheduling activities regularly and by mutual agreement while remaining responsive to school conditions. The fourth stage involves selecting discussion topics and strategies directly relevant to teaching performance, including lesson planning, teaching methods, classroom management, and assessment. The fifth stage is defining roles and coordination, with the principal acting as a facilitator and teachers actively contributing to the process. The sixth

stage is developing follow-up plans to ensure that the outcomes of learning community activities are applied to classroom practice.

The six stages form a cyclical process rather than a linear sequence. The results of follow-up activities become the basis for subsequent reflection, which in turn helps teachers identify new learning needs. Figure 5 illustrates this continuous cycle and positions the learning community as a sustained professional learning ecosystem.

Figure 5 shows that strengthening teacher learning communities begins with teachers' actual professional and instructional needs and moves through collaborative planning, implementation, reflection, and follow-up. The model's cyclical nature allows professional learning to continue as new classroom challenges emerge. This characteristic is especially relevant to disaster-prone schools, where instructional needs and school conditions may change rapidly. The model therefore provides a contextual structure for sustaining teacher professional learning while allowing schools to respond to disruptions and recovery needs.

Table 7. Contextual and sustainable approach to strengthening teacher learning communities

Stage	Main activity	Expected outcome
Identify learning needs	Identify instructional problems and professional needs	Clearly defined learning and professional development needs
Set objectives and priorities	Establish objectives collaboratively	Shared professional learning priorities
Schedule activities	Establish regular and context-sensitive schedules	Consistent and sustainable implementation
Select topics and strategies	Select relevant topics and collaborative problem-solving strategies	Practical solutions to classroom challenges
Define roles and coordination	Establish responsibilities of principals and teachers	Effective and participatory coordination
Develop follow-up plans	Apply agreed improvements in classroom practice	Continuous improvement in teaching

Overall, the integrated findings demonstrate that teacher learning communities are positively associated with teachers' teaching performance at state primary schools in Sibolga City. The quantitative results provide empirical evidence of this relationship. At the same time, the qualitative findings explain that this is realized through needs-based planning, collaboration, active participation, learning-focused discussion, reflection, and classroom follow-up. The findings also show that the sustainability of learning communities depends on school leadership, teacher engagement, a collaborative school culture, time, resources, and schools' ability to adapt professional learning activities to disaster-related conditions.

The central implication is that teacher learning communities should be positioned not merely as administrative forums or routine professional meetings, but as sustained pedagogical mechanisms for collaborative professional learning and educational resilience. In disaster-prone primary schools, such communities can provide an organized space for teachers to collectively respond to instructional disruption, exchange adaptive practices, reflect on students' needs, and translate professional learning into classroom improvement. This positioning strengthens the study's educational significance and connects teacher professional development to the broader challenge of maintaining learning continuity in vulnerable educational contexts.

■ CONCLUSION

This study found that teacher learning communities in state primary schools in Sibolga City were implemented at a very good level (87.16%) and were positively associated with teaching performance (85.8%). The qualitative findings highlighted the importance of needs-based planning, collaboration, active participation, reflection, and classroom follow-up, supported by school leadership and a collaborative culture. However, limited time and resources, increased workloads,

and disaster-related disruptions challenged their sustainability. Methodologically, the study was limited to one city and relied partly on questionnaire data; therefore, the findings show an association rather than causation and may not generalize to other contexts. The local education authority should strengthen learning communities through protected meeting schedules, adequate resources, disaster-responsive professional learning, and collaborative assessment and follow-up practices. These measures could help sustain teaching quality and learning continuity in disaster-prone schools.

■ DISCLOSURE OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES

During manuscript preparation and revision, the authors used ChatGPT (OpenAI) to assist with language refinement, passage restructuring, and suggestions to improve clarity. The authors are responsible for critically reviewing the manuscript, verifying the accuracy of its claims and references, and ensuring the integrity of the final published content.

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