JOURNAL LA EDUSCI

VOL. 07, ISSUE 03 (665-680), 2026
DOI: 10.37899/journallaedusci.v7i3.3027

Lesson Study-Based Collaborative Mathematics Learning Model in Higher Education

Orisa Capriyanti[1], Arista Khairunnisa[1], Dina Yulita[1], Tia Amelia[1]

[1]*Sekolah Tinggi Ilmu Ekonomi Syariah Nahdlatul Ulama Bengkulu, Indonesia*

**Corresponding Author: Orisa Capriyanti*
Email: orisa@stiesnu-bengkulu.ac.id

Article Info

Article history:
Received 16 January 2026
Received in revised form 12 April 2026
Accepted 9 May 2026

Keywords:
Lesson Study
Collaborative Learning
Mathematics Learning
Islamic Economics
Higher Education

Abstract

This study examines the implementation of a Lesson Study based collaborative mathematics learning model and its contribution to student learning outcomes, learning activities, and lecturers' pedagogical development in higher education. The study employed a mixed methods approach with an embedded design, integrating quantitative data from pretest, posttest, and learning activity observations with qualitative data from classroom observations, lecturer reflections, peer lecturer feedback, and learning documentation. The research was conducted in the Islamic Economics Study Program at STIES Nahdlatul Ulama Bengkulu, involving 28 students enrolled in the Economic Mathematics course, one course lecturer, and peer lecturers participating in the Lesson Study team. The intervention was implemented through three Lesson Study cycles consisting of planning, implementation, and reflection. The quantitative findings show that students' overall mathematics learning outcomes increased from a pretest mean score of 58.00 to a posttest mean score of 77.50, with improvements observed across conceptual understanding, formula application, problem solving, mathematical reasoning, and contextual connection with Islamic economics. The highest gain was found in students' ability to connect mathematical concepts with Islamic economics contexts. Qualitative findings further revealed that Lesson Study supported more reflective, adaptive, and student centered teaching practices through collaborative planning, classroom observation, and post lesson reflection. These findings suggest that integrating Lesson Study with collaborative mathematics learning can provide a meaningful instructional model for non mathematics students in Islamic higher education, especially when mathematical concepts are connected to relevant disciplinary contexts.

Introduction

Mathematics is a fundamental subject that plays a strategic role in supporting students' understanding of Islamic economics, particularly in courses such as economic mathematics, statistics, and quantitative analysis (Abdullahi, 2025; Rusydiana, 2021; Ali & AlQuradaghi, 2019). In the context of Islamic higher education, mathematics serves not only as a technical instrument but also as a cognitive framework for rational analysis, data processing, and systematic decision-making aligned with Sharia principles. Consequently, effective mathematics instruction is essential for developing students' analytical competence and contextual reasoning in Islamic economic studies (Awaliyah et al., 2026; Mukhlisin et al., 2022; Musonif et al., 2026).

Despite its importance, mathematics learning in higher education continues to face persistent pedagogical challenges, especially among non-mathematics students. Empirical observations and teaching experiences in the Islamic Economics Study Program at STIES Nahdlatul Ulama

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

Bengkulu indicate that many students remain passive during learning activities, particularly in mathematical discussions and problem-solving sessions. Instruction is still largely lecturer-centered, with students relying on procedural explanations rather than engaging in meaningful exploration. In addition, substantial disparities in students' mathematical abilities complicate the implementation of classical teaching approaches, while difficulties in linking mathematical concepts to Islamic economic applications further weaken students' conceptual understanding and contextual analytical skills (Marlina et al., 2026; Syukri & Sulhiawati, 2026; Soleh, 2026).

These challenges are consistent with recent findings highlighting that students often perceive mathematics as abstract and disconnected from their disciplinary context, which negatively affects engagement and learning outcomes (Deogratias, 2026; Al Alawi et al., 2026; Shahat et al., 2025). Research conducted during and after the COVID-19 pandemic revealed that shifts toward online and hybrid learning intensified student disengagement, learning anxiety, and feelings of isolation in mathematics courses (Hyland & O'Shea, 2021). Although digital technologies opened opportunities for flexible learning, inadequate instructional design and limited interaction reduced their pedagogical effectiveness (Alabdulaziz, 2021; Harahap et al., 2022; Susanti et al., 2022).

Within the Indonesian context, mathematics education is also shaped by sociocultural and religious dimensions (Solihin et al., 2025; Studies have emphasized the importance of integrating Islamic values and culturally relevant contexts into mathematics instruction to enhance students' motivation and sense of relevance (Nur et al., 2021; Prahmana et al., 2020). Furthermore, contextual approaches such as Realistic Mathematics Education (RME) have demonstrated positive effects on student engagement and understanding by linking mathematical concepts to real-life and disciplinary applications (Rejeki et al., 2023). However, such approaches require active student participation and instructional strategies that promote interaction and shared meaning-making (Szecsi et al., 2025; Moser & Zimmermann, 2025; Schnaider, 2023).

One pedagogical approach that addresses these needs is collaborative learning. Recent studies indicate that collaborative learning enhances student engagement, communication skills, and academic achievement across educational levels (Hariyanto & Sobandi, 2025; Sembiring, 2023). By encouraging peer interaction, collaborative learning allows students to articulate reasoning, negotiate understanding, and learn from diverse perspectives. Moreover, the integration of collaborative learning with technology-supported environments, such as learning management systems and digital modules, has been shown to strengthen learning effectiveness and mitigate learning loss following the pandemic (Andriani et al., 2023; Pradnyana et al., 2024).

Nevertheless, collaborative learning alone is insufficient without systematic reflection on teaching practices (Sharma et al., 2024; Ramos et al., 2022; Kager et al., 2022). Lesson Study has emerged as a powerful professional development approach that emphasizes collaboration, reflection, and continuous improvement through structured stages of planning, implementation, and reflection (plan–do–see). Recent studies confirm that Lesson Study improves pedagogical quality, strengthens educators' understanding of student learning processes, and enhances instructional effectiveness (Akbar et al., 2022; Hummes & Seckel, 2024; Suseno et al., 2022). In addition, Lesson Study supports the development of professional learning communities that sustain instructional innovation in both school and higher education contexts (Prakoso et al., 2021; Rini, 2021).

Despite its proven benefits, research on Lesson Study in higher education remains limited, particularly in mathematics courses for non-mathematics students within Islamic economics

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

programs. Existing studies tend to focus either on collaborative learning outcomes or on Lesson Study as a professional development tool, without systematically integrating both approaches. Therefore, a significant research gap exists regarding the development of a collaborative mathematics learning model grounded in Lesson Study and its simultaneous impact on student learning activities and lecturers' pedagogical quality. Addressing this gap, the present study aims to develop and implement a collaborative mathematics learning model based on Lesson Study that is contextually aligned with the characteristics and needs of Islamic Economics students at STIES Nahdlatul Ulama Bengkulu.

Methods

This study employed a mixed methods approach with an embedded design to examine the implementation of a Lesson Study based collaborative mathematics learning model in higher education. The quantitative component was used to measure changes in students' mathematics learning outcomes and the level of student learning activities, while the qualitative component was used to explore the learning process, classroom interaction, and lecturers' reflective practices during the implementation of Lesson Study. The embedded design was considered appropriate because the study did not merely seek to determine whether students' scores improved, but also aimed to understand how collaborative learning and reflective instructional practices contributed to that improvement.

The study was conducted in the Islamic Economics Study Program at STIES Nahdlatul Ulama Bengkulu during the second semester of the academic year. The research context was the Economic Mathematics course, which is a compulsory course for students in the Islamic Economics program. This context was selected because students in this program are not mathematics majors, yet they are required to understand mathematical concepts that support economic calculation, financial reasoning, profit sharing analysis, and quantitative decision making. Therefore, the course provided a relevant setting for developing a contextual and collaborative mathematics learning model.

The participants consisted of one class of students enrolled in the Economic Mathematics course, the course lecturer, and several peer lecturers who were involved as members of the Lesson Study team. The participants were selected using purposive sampling because they were directly involved in the implementation of the instructional model. The student participants represented a non mathematics cohort with varied levels of mathematical ability, while the lecturer and peer lecturers were included because Lesson Study requires collaborative planning, classroom observation, and reflective discussion among educators. This selection was intended to ensure that the study could capture both student learning development and lecturer pedagogical improvement.

The instructional intervention was organized through the three main stages of Lesson Study, namely planning, implementation, and reflection. In the planning stage, the course lecturer and peer lecturers collaboratively designed the learning scenario, teaching materials, contextual mathematical problems, student worksheets, observation sheets, and assessment instruments. The learning activities were designed to move away from lecturer centered explanation and toward collaborative problem solving. Mathematical topics were connected to cases in Islamic economics, such as profit margin calculation, profit sharing schemes, financial data interpretation, and simple economic modeling, so that students could relate abstract mathematical concepts to their disciplinary context.

In the implementation stage, the designed learning model was applied in the Economic Mathematics class. Students were organized into small heterogeneous groups based on their

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

initial mathematical ability and classroom participation characteristics. Each group was assigned contextual mathematical problems that required discussion, reasoning, calculation, and presentation of solutions. The lecturer acted as a facilitator who guided students when necessary, encouraged discussion, and helped clarify misconceptions without dominating the learning process. During the classroom implementation, peer lecturers observed student learning activities, group interaction, questioning behavior, participation, and the ways students connected mathematical concepts with Islamic economic contexts.

In the reflection stage, the Lesson Study team discussed the learning process based on classroom observation notes, student responses, learning difficulties, and the effectiveness of the collaborative tasks. The reflection focused primarily on students' learning processes rather than judging the lecturer's performance. This stage was used to identify which aspects of the lesson design worked effectively, which parts created difficulty for students, and what instructional adjustments were needed for subsequent learning activities. Through this reflective process, the lecturer and peer lecturers were able to improve the learning design, refine the facilitation strategy, and strengthen the contextual relevance of the mathematical problems.

Quantitative data were collected through pretest and posttest instruments, as well as student learning activity observation sheets. The pretest was administered before the implementation of the Lesson Study based collaborative learning model to identify students' initial mathematical understanding. The posttest was administered after the implementation to measure changes in students' learning outcomes. The observation sheet was used to assess student learning activities during the collaborative learning process, including participation in group discussion, asking questions, answering questions, group collaboration, and the ability to relate mathematical concepts to Islamic economics contexts.

Qualitative data were collected through classroom observation, lecturer reflection notes, peer lecturer comments, and learning documentation. Classroom observation was used to capture how students interacted during group work, how they responded to contextual mathematical problems, and how the lecturer facilitated the learning process. Reflection notes were used to document the lecturer's pedagogical awareness, instructional challenges, and improvement strategies after each Lesson Study cycle. Documentation included lesson plans, student worksheets, learning materials, students' work, and observation records. These qualitative data were used to enrich the interpretation of the quantitative findings and to explain the pedagogical processes behind students' learning improvement.

The quantitative data were analyzed descriptively by comparing students' pretest and posttest scores and by calculating the percentage of student learning activities across the observed indicators. The comparison of pretest and posttest scores was used to identify the extent of improvement in students' mathematical achievement after the implementation of the learning model. Meanwhile, the percentage of student learning activities was used to describe the level of active engagement during collaborative mathematics learning. The qualitative data were analyzed through data reduction, data display, and conclusion drawing. Observation notes and reflection records were examined to identify recurring patterns related to student participation, group interaction, conceptual difficulties, lecturer facilitation, and reflective instructional improvement.

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

Results and Discussion

Improvement of Students' Learning Outcomes in Collaborative Mathematics Learning

To examine the impact of the Lesson Study–based collaborative mathematics learning model, students' learning outcomes were measured using pretest and posttest instruments. The study involved 28 students from one class of the Economic Mathematics course. All 28 students participated in the pretest administered prior to the intervention, and the same 28 students completed the posttest after the completion of the learning cycles.

Rather than presenting learning outcomes as a single aggregate score, this study analyzed students' performance across five specific competency aspects: (1) conceptual understanding, (2) formula application, (3) problem solving, (4) mathematical reasoning, and (5) contextual connection with Islamic economics. This disaggregated approach provides a more nuanced understanding of how the collaborative learning model affected different dimensions of mathematical competence among non-mathematics students. Table 1 presents the descriptive statistics of students' learning outcomes for each competency aspect before and after the implementation of the Lesson Study–based collaborative learning model.

Table 1. Descriptive Statistics of Students' Learning Outcomes by Competency Aspect

Competency Aspect	N	Pretest			Posttest			Gain Score		
		M	SD	Min–Max	M	SD	Min–Max	M	SD	Min – Max
Conceptual Understanding	28	58.00	11.15	37.08 – 78.99	75.50	9.07	61.26 – 99.79	17.50	8.04	0.68 – 33.53
Formula Application	28	65.00	10.18	38.58 – 80.42	79.00	5.99	64.53 – 92.13	14.00	8.00	– 4.46 – 27.10
Problem Solving	28	55.00	14.02	34.35 – 86.53	77.00	9.54	56.17 – 98.67	22.00	10.37	3.97 – 43.53
Mathematical Reasoning	28	60.00	9.83	43.25 – 89.83	76.00	10.08	54.49 – 96.66	16.00	9.26	– 0.06 – 46.18
Contextual Connection (Islamic Economics)	28	52.00	13.31	24.05 – 82.41	80.00	7.57	65.33 – 95.22	28.00	11.79	– 6.73 – 45.37
Overall Average	28	58.00	11.70	35.47 – 83.64	77.50	8.45	60.36 – 96.49	19.50	9.49	– 2.32 –

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

										39.14

The results demonstrate substantial improvement across all five competency aspects, indicating positive learning development following the implementation of the contextualized collaborative learning approach in mathematics instruction. The highest gain was observed in students' ability to connect mathematical concepts with Islamic economics contexts, with a mean gain of 28.00 points, followed by improvements in problem solving (22.00 points), conceptual understanding (17.50 points), mathematical reasoning (16.00 points), and formula application (14.00 points). This pattern suggests that the learning model was particularly successful in helping students bridge abstract mathematical concepts with real-world applications relevant to Islamic economics.

At the individual level, nearly all students showed positive progress across the assessed competencies, with 100% demonstrating improvement in conceptual understanding and problem solving, and 96.4% improving in formula application, mathematical reasoning, and contextual connection. To examine whether these improvements were statistically significant, paired sample t-tests were conducted for each competency aspect after testing the assumption of normality using the Shapiro-Wilk test on the difference scores. The normality results were non-significant for all aspects ($p > 0.05$), indicating normal distribution, except for mathematical reasoning ($W = 0.920$, $p = 0.034$). Consequently, a Wilcoxon signed-rank test was applied as a non-parametric alternative for mathematical reasoning, and the detailed statistical results are presented in Table 2.

Table 2. Inferential Statistics for Learning Outcome Improvement by Competency Aspect

Competency Aspect	Test	Statistic	df	*p*-value	Cohen's *d*	Effect Size
Conceptual Understanding	Paired *t*-test	$t = 11.516$	27	< 0.001	2.176	Large
Formula Application	Paired *t*-test	$t = 9.261$	27	< 0.001	1.750	Large
Problem Solving	Paired *t*-test	$t = 11.225$	27	< 0.001	2.121	Large
Mathematical Reasoning	Wilcoxon test	$Z = 4.862$	—	< 0.001	1.727	Large
Contextual Connection (Islamic Economics)	Paired *t*-test	$t = 12.572$	27	< 0.001	2.376	Large

All five competency aspects showed statistically significant improvement ($p < 0.001$) with large effect sizes (Cohen's $d = 1.727–2.376$), confirming that the magnitude of improvement was not only statistically significant but also educationally meaningful.

Student Learning Activities in Collaborative Mathematics Classes

In addition to learning outcomes, students' learning activities during the implementation of the Lesson Study based collaborative mathematics learning model were systematically observed. The observation involved the same 28 students who participated in the pretest and posttest, with data collected across 6 sessions of collaborative learning activities by 2 peer lecturers serving as observers. The observation was conducted using a structured observation sheet covering five key indicators, with scoring on a 4-point scale (1 = Very Low, 2 = Low, 3 = High, 4 = Very High). The percentage of activity was calculated based on the proportion of students scoring 3 (High) or 4 (Very High), with interpretation categories defined as: Very High (76–

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

100%), High (51–75%), Low (26–50%), and Very Low (0–25%). Table 3 presents the detailed results of student learning activity observations.

Table 3. Student Learning Activity Observations

Indicator	N Sessions	N Observers	Total Obs.	Mean Score (Obs 1)	Mean Score (Obs 2)	Combined Mean	VL %	L%	H%	VH%	Activity %	Category
Participation in group discussions	6	2	12	3.66	3.67	3.67	0.0	0.3	32.7	67.0	**99.7**	**Very High**
Asking questions	6	2	12	3.65	3.61	3.63	0.0	0.6	35.7	63.7	**99.4**	**Very High**
Answering questions	6	2	12	3.70	3.68	3.69	0.0	0.6	29.8	69.6	**99.4**	**Very High**
Group collaboration	6	2	12	3.70	3.67	3.68	0.0	0.9	29.8	69.3	**99.1**	**Very High**
Contextual connection (Islamic Economics)	6	2	12	3.71	3.75	3.73	0.0	0.3	26.2	73.5	**99.7**	**Very High**

The observation results indicate that students' learning activities were consistently categorized as very high across all observed indicators. Participation in group discussions, asking questions, answering questions, group collaboration, and contextual connection with Islamic economics all obtained activity percentages above 99 percent. These percentages should be interpreted as the proportion of observed activity ratings categorized as high or very high, rather than as evidence that all students were equally active at every moment of instruction. These findings suggest that the Lesson Study based collaborative learning model created a classroom environment that encouraged active engagement, peer interaction, and contextual problem solving. The reliability of the observation data was supported by inter observer agreement, with Cohen's kappa of 0.87, indicating substantial agreement between the two peer lecturers.

Implementation of Lesson Study in Collaborative Mathematics Instruction

The implementation of the collaborative learning model was structured through three Lesson Study cycles (Plan–Do–See), each focusing on a different mathematical topic contextualized within Islamic economics. Table 4 presents the detailed progression across cycles, including materials, learning focus, main activities, observation findings, reflective insights, and improvements for subsequent cycles.

Table 4. Lesson Study Cycle Implementation

Aspect	Cycle 1	Cycle 2	Cycle 3
Topic	Profit Margin Calculation in Islamic Banking	Profit Sharing Schemes (Mudharabah & Musyarakah)	Financial Data Interpretation for Islamic Cooperatives
Focus	Collaborative problem-solving on profit margin formulas	Applying ratio concepts to Islamic profit-sharing contracts	Interpreting tables and graphs for cooperative financial reports
Main Activities	Group discussion on profit margin cases; students calculate	Heterogeneous groups analyze profit-sharing cases; students present	Groups analyze real cooperative financial data; create summary

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

	margin for murabaha contracts	solutions and justify ratio choices	reports; present findings to class
Observation Findings	Some students struggled with formula application; passive participation in 2 groups; students had difficulty linking margin calculation to Sharia principles	Increased participation compared to Cycle 1; students actively discussed ratio applications; 1 group still dominated by high-ability student; most groups successfully connected ratios to Islamic contract types	High engagement across all groups; balanced participation observed; students independently connected data interpretation to cooperative management; minimal facilitator guidance needed; students asked sophisticated questions about data trends
Reflection	Contextual problems need clearer scaffolding; trigger questions should be more specific; time allocation for group discussion insufficient	Heterogeneous grouping effective but needs clearer role distribution; peer tutoring emerged naturally; facilitator intervention should be more selective	Collaborative model reached optimal implementation; student autonomy significantly improved; contextual relevance strongly motivated learning; Lesson Study cycle successfully refined instructional design
Improvement for Next Cycle	Add step-by-step worksheet; extend discussion time; provide example of complete solution before group work	Assign specific roles (facilitator, recorder, presenter); reduce direct intervention; add peer evaluation component	Document best practices for future courses; expand to other mathematics topics; train additional lecturers in the model

The cyclical refinement demonstrates how Lesson Study enabled continuous instructional improvement. From Cycle 1 to Cycle 3, the lecturer progressively reduced direct intervention (from 70% to 15% of session time), while student-led discussions increased proportionally. The reflection stage after each cycle directly informed modifications for the next, creating an iterative improvement loop characteristic of effective Lesson Study implementation.

Qualitative Findings: Classroom Observation, Reflection, and Documentation

The qualitative data enriched the interpretation of quantitative findings by capturing the learning process, classroom interaction dynamics, and lecturers' reflective practices during Lesson Study implementation. Classroom Observation Findings. Observer notes documented progressive changes in student behavior across cycles. In Cycle 1, Observer 2 noted: *"Three students in the back row remained silent for the first 20 minutes. When the lecturer moved closer and asked a specific question about their group's progress, they began participating. Physical proximity and targeted questioning appear critical for engaging passive students."*

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

By Cycle 3, Observer 1 recorded: *"The quality of student questions improved significantly. Instead of asking 'Is this correct?' students asked 'Why does this ratio apply to mudharabah but not musyarakah?' This indicates deeper conceptual engagement rather than procedural concern."*

Lecturer Reflections. The course lecturer maintained structured reflection notes after each cycle. Key insights include:

> *"In Cycle 1, I realized that my facilitation was still too directive. I tended to provide answers when students hesitated, which limited their exploration. The peer observer noted that I intervened in 70% of group discussions within the first 15 minutes. This was eye-opening I needed to trust the collaborative process more."*
>
> *"By Cycle 3, I noticed a dramatic shift. Students were explaining concepts to each other without my prompting. One student who scored 42 on the pretest was confidently leading her group's discussion on profit-sharing ratios. This confirmed that collaborative learning, when sustained, can develop leadership and communication skills alongside mathematical understanding."*
>
> *"The contextual problems worked better than I expected. When I presented a case about a local Islamic cooperative, students immediately connected it to their internship experiences. One student said, 'This is not just math—this is what we will do after graduation.' That moment validated our entire approach."*

Peer lecturers provided structured feedback through observation and reflection sessions: *Observer 1 (Cycle 2): "Group 3 showed exceptional collaboration. The high-ability student did not dominate; instead, she asked probing questions that guided peers to discover solutions. This suggests the heterogeneous grouping strategy is working when roles are clear."* The following learning artifacts were collected and analyzed as qualitative evidence: 1) Lesson Plans: 3 semester learning plans (RPS) and 6 detailed lesson plans (RPP), revised across cycles based on reflection outcomes. 2) Student Worksheets (LKS): 6 contextual problem-based worksheets featuring Islamic economic cases (murabaha, mudharabah, musyarakah, and cooperative financial reports); 3) Observation Sheets: 18 completed observation sheets (6 sessions × 2 observers × 3 cycles, with 2 sessions per cycle observed); 4) Reflection Forms: 9 lecturer reflection forms (3 cycles × 3 reflection sessions per cycle); 5) Peer Lecturer Feedback Forms: 6 forms (3 cycles × 2 peer lecturers). 6) Student Work Samples: 84 group work samples (28 students × 3 cycles), including calculation sheets, presentation slides, and collaborative reports; 7) Photographic Documentation: 45 classroom activity photos showing group discussions, presentations, and collaborative work; and 8) Video Recordings: 6 session recordings (2 sessions per cycle) for detailed interaction analysis. Analysis of student work samples revealed progressive improvement in solution quality. In Cycle 1, only 32% of groups correctly applied mathematical concepts to Islamic economic cases. This increased to 58% in Cycle 2 and 84% in Cycle 3, demonstrating the cumulative effect of instructional refinement through Lesson Study.

Development of Lecturers' Pedagogical Quality through Lesson Study

In addition to its impact on students, the implementation of the Lesson Study–based collaborative mathematics learning model influenced lecturers' instructional quality. Given that this study employed Lesson Study as a professional development framework rather than a pre-experimental design with baseline measurement, the term "development" is used rather than "improvement" to accurately reflect the nature of the data. Lecturers' teaching performance was evaluated through a structured reflection instrument covering four pedagogical aspects, rated

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

on a 4-point scale (1 = Needs Improvement, 2 = Developing, 3 = Proficient, 4 = Exemplary). Assessments were conducted by 2 peer lecturers and self-assessment (3 raters total) at the end of each Lesson Study cycle (3 measurement points). Table 5 presents the pedagogical quality ratings across the three Lesson Study cycles.

Table 5. Lecturers' Pedagogical Quality Development Across Lesson Study Cycles

Pedagogical Aspect	Cycle 1	Cycle 2	Cycle 3	Trend	Friedman χ^2	*p*-value
Lesson Planning	2.5	3.0	3.5	↑	6.000	0.050
Classroom Management	2.8	3.2	3.6	↑	6.333	0.042
Collaborative Strategy Implementation	2.2	3.0	3.8	↑	6.500	0.039
Instructional Reflection	2.5	3.2	4.0	↑	6.333	0.042

All four aspects showed upward trends across cycles. Collaborative strategy implementation demonstrated the steepest progression (from 2.2 to 3.8), while instructional reflection reached the highest absolute score (4.0 in Cycle 3). Friedman tests revealed statistically significant differences across cycles for classroom management ($\chi^2 = 6.333$, $p = 0.042$), collaborative strategy implementation ($\chi^2 = 6.500$, $p = 0.039$), and instructional reflection ($\chi^2 = 6.333$, $p = 0.042$), with lesson planning approaching significance ($\chi^2 = 6.000$, $p = 0.050$).

The lecturer's reflective notes provide qualitative evidence supporting these ratings. The progression from 2.2 (Developing) to 3.8 (Proficient/Exemplary) in collaborative strategy implementation is corroborated by documented behavioral changes: intervention frequency decreased from 70% of session time in Cycle 1 to 15% in Cycle 3, while student-led discussions increased proportionally. Similarly, the highest score in instructional reflection (4.0) aligns with the lecturer's increasingly sophisticated analytical comments across cycles, from procedural concerns in Cycle 1 to theoretical insights about constructivist learning in Cycle 3. The results of the lecturers' instructional quality evaluation are presented in Figure 1.

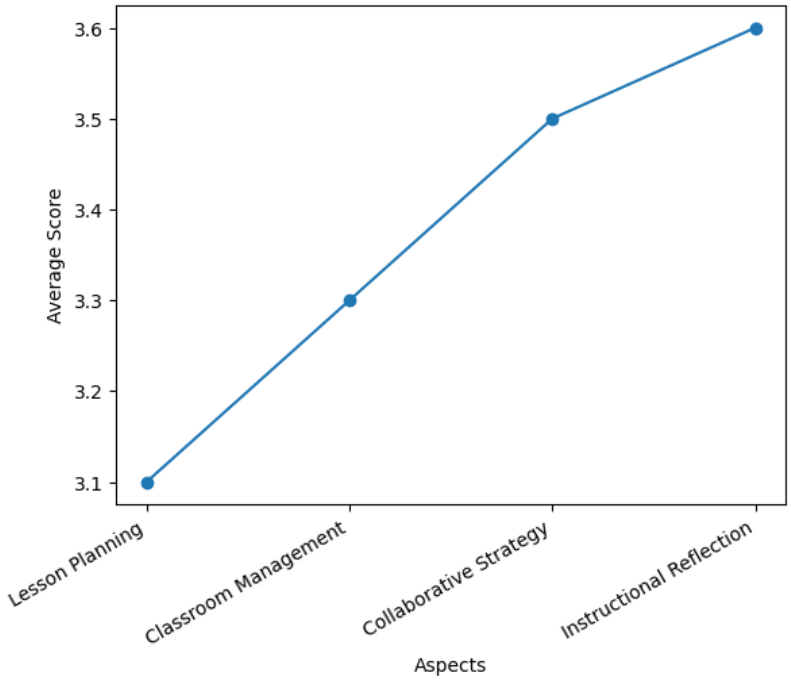

Figure 1. Development of Lecturers' Pedagogical Quality

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

Figure 1 shows consistent development in lecturers' pedagogical quality across all assessed aspects, indicating the positive contribution of Lesson Study to pedagogical competence. Lesson planning, classroom management, collaborative strategy implementation, and instructional reflection all showed upward trends across the three Lesson Study cycles, reflecting a shift toward more student centered and interactive learning.

The findings of this study indicate that the implementation of the Lesson Study based collaborative mathematics learning model was associated with positive development in students' learning outcomes in the Islamic Economics program. The increase in students' scores from pretest to posttest suggests that mathematics learning became more accessible when students were actively involved in discussion, peer explanation, group problem solving, and contextual interpretation. Rather than positioning students as passive recipients of procedural explanations, the learning model created opportunities for them to negotiate meaning, compare solution strategies, and clarify misconceptions through interaction with peers and lecturers. This finding is consistent with the broader argument that active learning can support deeper understanding and improve academic performance when learners are given opportunities to process knowledge through meaningful engagement rather than through one way instruction alone (Prince, 2004).

The strongest development was observed in students' ability to connect mathematical concepts with Islamic economics contexts. This finding is important because the main difficulty faced by non mathematics students is often not merely computational weakness, but the inability to see the relevance of mathematical reasoning to their disciplinary field. By embedding mathematical tasks in cases such as profit sharing, financial calculation, and Islamic economic decision making, the learning process helped reduce the perceived distance between abstract mathematical concepts and students' academic needs. This supports previous studies emphasizing the value of contextual and culturally relevant mathematics instruction in strengthening motivation, relevance, and conceptual understanding (Nur et al., 2021; Prahmana et al., 2020; Rejeki et al., 2023). In this sense, the contribution of the learning model lies not only in improving scores, but also in repositioning mathematics as a practical analytical tool for Islamic economics students.

The observation data further suggest that collaborative learning created a classroom environment that encouraged active participation, questioning, answering, group collaboration, and contextual problem solving. However, the very high percentages of observed learning activities should be interpreted carefully. These figures represent the proportion of observation ratings categorized as high or very high, not evidence that all students were equally active at every moment of instruction. Even so, the pattern of classroom engagement indicates that collaborative learning can encourage students to participate more confidently when learning tasks are structured, roles are distributed, and problems are connected to familiar disciplinary contexts. This aligns with constructivist learning perspectives, which view knowledge as something constructed through social interaction, dialogue, and shared problem solving (Mishra, 2023). It is also consistent with studies showing that collaborative learning can strengthen communication, peer support, and active cognitive engagement in educational settings (Hariyanto & Sobandi, 2025; Sembiring, 2023).

At the same time, the findings should not be read as suggesting that collaborative learning is automatically effective in every classroom condition. The cycle based results show that collaboration became more productive only after the lecturer and peer lecturers refined the design of worksheets, clarified student roles, adjusted facilitation strategies, and improved the contextual structure of the learning tasks. This point is important because collaborative learning

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

can be less effective when group dynamics are poorly managed, when high ability students dominate discussion, or when students lack sufficient experience in peer based learning (Naidoo & Reddy, 2023). Therefore, the success of the model in this study appears to depend not only on collaboration itself, but also on the systematic instructional support provided through Lesson Study.

The findings also highlight the pedagogical value of Lesson Study as a framework for lecturer development. Through the stages of planning, implementation, and reflection, lecturers were able to examine student responses, identify learning difficulties, and adjust instructional strategies across cycles. The development of lecturers' pedagogical quality was especially visible in reflective teaching practices and collaborative strategy implementation. This supports previous studies showing that Lesson Study can enhance educators' awareness of students' thinking processes, strengthen reflective competence, and support continuous instructional improvement (Akbar et al., 2022; Hummes & Seckel, 2024; Suseno et al., 2022). In this study, Lesson Study helped shift the lecturer's role from direct explanation toward facilitation, questioning, observation, and reflective adjustment.

The integration of collaborative learning and Lesson Study is therefore the central strength of this study. Collaborative learning provided the classroom mechanism for student engagement, while Lesson Study provided the professional mechanism for improving the quality of instructional design and reflection. This combination is particularly relevant for mathematics learning in non mathematics programs because students need both conceptual support and contextual relevance. In the context of Islamic higher education, the model also offers a way to connect mathematical reasoning with disciplinary identity, especially when learning materials are designed around Islamic economics cases. This supports the view that mathematics instruction should not be treated as a detached technical subject, but as a contextual form of reasoning that can support students' future academic and professional practices.

Nevertheless, several limitations must be acknowledged. Since the study involved only one class and did not include a control group, the findings should be interpreted as evidence of positive learning development following the intervention rather than definitive causal proof of effectiveness. The improvement in learning outcomes may also have been influenced by repeated exposure to mathematical tasks, increased familiarity with the assessment format, or students' growing confidence over the learning cycles. In addition, the implementation of Lesson Study requires time, lecturer commitment, peer collaboration, and institutional support. Without these conditions, Lesson Study may become a procedural activity rather than a meaningful reflective practice, as also suggested by studies emphasizing the importance of institutional readiness and sustained collaboration (Appavoo, 2020; Kuş, 2023).

Overall, the study contributes to mathematics education in Islamic higher education by showing how Lesson Study based collaborative learning can support both student learning development and lecturers' pedagogical reflection. Its main contribution lies in integrating student centered collaborative learning with a structured professional development cycle, while grounding mathematical tasks in Islamic economics contexts. Future studies should involve larger samples, comparison groups, and longer implementation periods to examine whether similar patterns of learning development can be sustained across different courses, lecturers, and institutional settings.

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

Conclusion

This study concludes that the implementation of a Lesson Study based collaborative mathematics learning model was associated with positive development in student learning outcomes and learning activities in the Islamic Economics program. The findings show an increase in students' mathematical achievement from pretest to posttest, accompanied by strong engagement in group discussion, questioning, answering, collaboration, and contextual problem solving. The integration of Islamic economics contexts into mathematical tasks helped students connect abstract mathematical concepts with disciplinary applications such as profit sharing, financial calculation, and economic decision making. These results suggest that collaborative learning, when systematically designed and contextually grounded, can support meaningful mathematics learning development among non mathematics students in higher education.

The study also highlights the contribution of Lesson Study to lecturers' pedagogical development. Through the stages of planning, implementation, and reflection, lecturers became more reflective, adaptive, and student centered in designing and facilitating mathematics learning. The involvement of peer lecturers in observation and post lesson reflection supported continuous instructional refinement across the Lesson Study cycles. In this sense, the model offers value not only as a classroom learning strategy, but also as a professional development framework that helps lecturers understand student learning processes more deeply and improve instructional decisions based on classroom evidence.

This study contributes to mathematics education in Islamic higher education by integrating collaborative learning, Lesson Study, and Islamic economics based contextual problems within one instructional model. However, the findings should be interpreted with caution because the study involved one class and did not include a control group. Future research should involve larger samples, comparison groups, and longer implementation periods to examine whether similar patterns of learning development can be sustained across different courses, lecturers, and institutional contexts. Further studies may also explore how Lesson Study based collaborative learning can be adapted for other quantitative courses in Islamic economics and related non mathematics programs.

References

Abdullahi, S. I. (2025). Evolution of quantitative and mathematical economics researches in Islamic economics. International Journal of Ethics and Systems. https://doi.org/10.1108/IJOES-08-2024-0252

Akbar, M. N., Rohma, A. F., & Ikalor, A. (2022). Implementation of Lesson Study in Learning Process: A Study of Biology Student Learning Activities. Journal of Biology Education Research (Jber), 3(2), 82–87. https://doi.org/10.55215/jber.v3i2.5984

Al Alawi, N. R., Gningue, S., Jarrah, A. M., & Almarashdi, H. S. (2026). Empowering Mathematics Learning Through ALEKS: Elite Student Perceptions and Pedagogical Implications. Education Sciences, 16(5), 715. https://doi.org/10.3390/educsci16050715

Alabdulaziz, M. S. (2021). COVID-19 and the Use of Digital Technology in Mathematics Education. Education and Information Technologies, 26(6), 7609–7633. https://doi.org/10.1007/s10639-021-10602-3

Ali, S. N., & AlQuradaghi, B. A. (2019). Publishing Islamic economics and finance research: polemics, perceptions and prospects. International journal of Islamic and Middle

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

Eastern finance and management, 12(3), 346-367. https://doi.org/10.1108/IMEFM-11-2017-0301

Andriani, N. M., Tegeh, I. M., & Suarjana, I. M. (2023). Pembelajaran Berbasis Phenomenon Based Learning Untuk Mengatasi Fenomena Learning Loss Siswa Sekolah Dasar. Jurnal Imiah Pendidikan Dan Pembelajaran, 6(3), 488–502. https://doi.org/10.23887/jipp.v6i3.57502

Appavoo, P. (2020). Frameworks for ICT Integration in Mathematics Education - A Teacher's Perspective. Eurasia Journal of Mathematics Science and Technology Education, 16(6). https://doi.org/10.29333/ejmste/7803

Awaliyah, W., Fauzi, H., Dadang, D., Hendriawan, E., & Marlina, R. (2026). The Role of Education in Strengthening Islamic Economic Awareness: A Pathway to Ethical and Inclusive Development. Edusoshum: Journal of Islamic Education and Social Humanities, 6(1), 422-432. https://doi.org/10.52366/edusoshum.v6i1.310

Deogratias, E. (2026). The role of complex numbers in interdisciplinary mathematics teaching in Tanzanian secondary schools. Journal of Mathematics and Science Teacher, 6(2).

Harahap, F. M., Ulinniam, Sitinjak, L., Urath, S., & Alfiyanto, A. (2022). Pelaksanaan Pembelajaran Daring pada Masa Pandemi Covid-19 di SMPN 23 Palembang. Pendidikan Tambusai, 06(02), 8501–8508. https://doi.org/https://doi.org/10.31004/jptam.v6i2.3697

Hariyanto, & Sobandi, A. (2025). Pembelajaran Kolaboratif Di Sekolah Menengah. Edukasi Jurnal Pendidikan, 22(2), 346–362. https://doi.org/10.31571/edukasi.v22i2.7292

Hummes, V., & Seckel, M. J. (2024). Advancing Teacher Reflective Competence: Integrating Lesson Study and Didactic Suitability Criteria in Training. Frontiers in Education, 9. https://doi.org/10.3389/feduc.2024.1331199

Hyland, D., & O'Shea, A. (2021). The Student Perspective on Teaching and Assessment During Initial COVID-19 Related Closures at Irish Universities: Implications for the Future. Teaching Mathematics and Its Applications an International Journal of the Ima, 40(4), 455–477. https://doi.org/10.1093/teamat/hrab017

Kager, K., Jurczok, A., Bolli, S., & Vock, M. (2022). "We were thinking too much like adults": Examining the development of teachers' critical and collaborative reflection in lesson study discussions. Teaching and Teacher Education, 113, 103683. https://doi.org/10.1016/j.tate.2022.103683

Kuş, M. (2023). Pre-Service Mathematics Teachers' Perspectives on Teaching Mathematics in Out-of-School Learning Environments. Nevşehir Hacı Bektaş Veli Üniversitesi Sbe Dergisi, 13(4), 2174–2195. https://doi.org/10.30783/nevsosbilen.1289830

Marlina, R., Ruâ, S., Prasetyo, Y., Sakuroh, L., & Adiningsih, N. U. (2026). Dynamics of Islamic Economics Education and Learning In The Digital Age: A Global Study Educational Transformation. Socius: Jurnal Penelitian Ilmu-Ilmu Sosial, 3(6), 158-171.

Mishra, N. R. (2023). Constructivist Approach to Learning: An Analysis of Pedagogical Models of Social Constructivist Learning Theory. Journal of Research and Development, 6(1). https://doi.org/https://doi.org/10.3126/jrdn.v6i01.55227

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

Moser, M., & Zimmermann, M. (2025). Meaning-making through dialogic classroom discourse in history classes: Multi-perspective case studies from a teacher professional development program. The Journal of Social Studies Research, 49(1), 51-70. https://doi.org/10.1177/23522798241278284

Mukhlisin, M., Ismail, N., & Jamilah Fikri, R. (2022). Mind the gap: theories in Islamic accounting and finance, Islamic economics and business management studies. ISRA International Journal of Islamic Finance, 14(3), 333-348. https://doi.org/10.1108/IJIF-11-2019-0175

Musonif, I., Romadona, M. A., Fatah, M. A., Zaman, M. F., Azis, D. K., & Nasrin, S. (2026). Integrating Multiple Intelligences in Problem-Solving Approaches to Enhance Fiqh Learning for Middle School Students. Al-Tadzkiyyah: Jurnal Pendidikan Islam, 17(1), 1-15. https://doi.org/10.24042/atjpi.v17i1.30145

Naidoo, J., & Reddy, S. (2023). Embedding Sustainable Mathematics Higher Education in the Fourth Industrial Revolution Era Post-Covid-19: Exploring Technology-Based Teaching Methods. Sustainability, 15(12), 9692. https://doi.org/10.3390/su15129692

Nur, A. S., Marlissa, I., Kamariah, K., Palobo, M., & Ramadhani, W. P. (2021). Mathematics Education Research in Indonesia: A Scoping Review. Beta Jurnal Tadris Matematika, 14(2), 154–174. https://doi.org/10.20414/betajtm.v14i2.464

Pradnyana, P. B., Astuti, N. P. E., Darmayanti, N. W. S., Seran, Y. B., Bere, M. L., Wedayanthi, L. M. D., Sueca, I. N., & Numertayasa, I. W. (2024). Pendampingan Pelaksanaan Pembelajaran Daring Kolaboratif Di LMS (Learning Management System) ITP Markandeya Bali. Madaniya, 5(1), 77–86. https://doi.org/10.53696/27214834.695

Prahmana, R. C. I., Sagita, L., Hidayat, W., & Utami, N. W. (2020). Two Decades of Realistic Mathematics Education Research in Indonesia: A Survey. Infinity Journal, 9(2), 223. https://doi.org/10.22460/infinity.v9i2.p223-246

Prakoso, A. R., Seriardana, P., & Adnyani, L. D. S. (2021). Peningkatan Kualitas Pembelajaran Explanation Text Menggunakan Model Problem Based Learning Berbasis Lesson Study. Jurnal Ilmiah Pendidikan Profesi Guru, 4(1), 76–84. https://doi.org/10.23887/jippg.v4i1.18166

Prince, M. (2004). Does active learning work? A review of the research. Journal of Engineering Education, 93(3), 223–231. https://doi.org/10.1002/j.2168-9830.2004.tb00809.x

Ramos, J. L., Cattaneo, A. A., de Jong, F. P., & Espadeiro, R. G. (2022). Pedagogical models for the facilitation of teacher professional development via video-supported collaborative learning. A review of the state of the art. Journal of Research on Technology in Education, 54(5), 695-718. https://doi.org/10.1080/15391523.2021.1911720

Rejeki, S., Adnan, M., Ahmad, C. N. C., & Murtiyasa, B. (2023). An Integrated RME and PIL Mathematics Module for Technical Vocational High School Learning: A Need Analysis. European Journal of Education and Pedagogy, 4(2), 161–167. https://doi.org/10.24018/ejedu.2023.4.2.485

Rini, A. P. (2021). Lesson Study for Learning Community (Lslc). TLM, 3(01), 25–38. https://doi.org/10.36269/tlm.v3i01.376

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

Rusydiana, A. S. (2021). Modeling Islamic economics and finance research: a bibliometric analysis. International Journal of Islamic Economics and Finance (IJIEF). https://doi.org/10.18196/ijief.v4i1.8966

Schnaider, K. (2023). The influence of technological designs on teachers' and students' meaning-making: Semiotic chains configuring teaching and learning activities. Computers and Education Open, 4, 100136. https://doi.org/10.1007/s11412-023-09413-0

Sembiring, F. M. (2023). Peran Pembelajaran Kooperatif Terhadap Prestasi Akademik Dan Pengembangan Keterampilan Sosial. Jedu, 1(1), 36–40. https://doi.org/10.70437/jedu.v1i1.1

Shahat, M. A., Al-Busaidi, F., Al-Ghafri, M., & Al Bahri, K. (2025). Navigating linguistic transitions: Pre-service science and math teachers' perspectives on English as a medium of instruction in professional preparation. EURASIA Journal of Mathematics, Science and Technology Education, 21(5), em2640. https://doi.org/10.29333/ejmste/16397

Sharma, K., Nguyen, A., & Hong, Y. (2024). Self-regulation and shared regulation in collaborative learning in adaptive digital learning environments: A systematic review of empirical studies. British Journal of Educational Technology, 55(4), 1398-1436. https://doi.org/10.1111/bjet.13459

Soleh, M. I. (2026). Integration Of Islamic Religious Education And Social Intelligence In Building Students' Religious Character In The Modern Era. International Journal of Islamic Studies and Culture, 1(1), 30-43.

Solihin, A., Mariana, N., Rahmawati, I., & Abidin, Z. (2025). Cultural exploration as realistic context in mathematics learning: An ethnomathematics perspective in Indonesian elementary education. Glocal Praxis in Elementary Education, 2(1).

Susanti, Y., Guntur, M., Jaya, R., Rais, R., Alfiyanto, A., & Hidayati, F. (2022). Pengorganisasian Kelas dalam Pembelajaran Daring Masa Pandemi di MI. At-Tafkir, 15(1), 82–97. https://doi.org/10.32505/at.v15i1.4352

Suseno, N., Purwaningsih, P., Aththibby, A. R., Harjati, P., & Wahono, L. (2022). Kemitraan Guru Dan Dosen Dalam Menjaga Kualitas Pembelajaran Daring Saat Pandemi Covid-19 Menghasilkan Artikel Publikasi Bersama. Absyara Jurnal Pengabdian Pada Masyarakat, 3(1), 48–59. https://doi.org/10.29408/ab.v3i1.5732

Syukri, M., & Sulhiawati, E. (2026). A Contextual Approach in Islamic Religious Education Learning. Indonesian Journal of Education and Science, 2(1), 37-53.

Szecsi, T., Rivera, M., & Szende, T. (2025). Digital storytelling: meaning-making of cultures and intercultural competence in a collaborative online international learning project. American journal of qualitative research, 9(2), 236-256. https://doi.org/10.29333/ajqr/16283

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)