
Research paper**Student Reflections as Evidence in LOC-R-Based Lesson Study: See-Stage Interpretation for Revising Population Geography Instruction**

Hernita Pasongli¹ , Enok Maryani^{1*} , Mamat Ruhimat¹ , Bagja Waluya¹ ,
Joseph Ozigis Akomodi² , Andi Kaharuddin³ 

¹ *Indonesia University of Education*, INDONESIA

² *Long Island University*, UNITED STATES

³ *Universitas Lakidende Unaaba*, INDONESIA

***Corresponding Author:** enokmaryani@upi.edu

Citation: Pasongli, H., Maryani, E., Ruhimat, M., Waluya, B., Akomodi, J. O., & Kaharuddin, A. (2026). Student reflections as evidence in LOC-R-based lesson study: See-stage interpretation for revising population geography instruction. *European Journal of STEM Education*. <https://doi.org/10.20897/ejsteme/19493>

Published: October 6, 2026

ABSTRACT

This study examines how undergraduate students' written reflections function as learner-generated pedagogical evidence in LOC-R-based Lesson Study to improve Population Geography instruction. A qualitative classroom action research design was integrated with two Lesson Study cycles involving 28 students, one model lecturer, and seven observers. The corpus comprised 56 written reflections, supported by consolidated observer records and written see-stage minutes. Data were examined through qualitative content analysis and cross-cycle evidence-chain analysis. Cycle 1 reflections disclosed positive engagement alongside fatigue, uneven participation, and difficulty with map-based country classification. These findings informed clearer instructions, stronger visual support, adjusted pacing, structured group roles, and more focused participation in Cycle 2. However, Cycle 2 also introduced different sustainability content, activities, and sharper reflection prompts. Consequently, SDG-oriented statements were classified as prompt-dependent awareness or sustainability valuation rather than evidence of individual development in critical socio-spatial reasoning. No retained reflection met the minimum threshold for relational socio-spatial explanation or critical questioning. The study therefore distinguishes pedagogical improvement from changed content exposure and elicitation conditions. Its principal contribution is a transparent, auditable mechanism linking learner-reported experience, observational context, collective see-stage interpretation, and documented lesson-revision decisions, while demonstrating the importance of maintaining cautious inferential boundaries in non-equivalent classroom cycles.

Keywords: lesson study, student reflection, pedagogical evidence, LOC-R, lesson revision, population geography

Higher education is increasingly expected to cultivate students who can interpret information, question assumptions, collaborate, and connect disciplinary knowledge with complex social and environmental realities. In geography education, this means moving beyond memorizing places, terms, or spatial patterns toward reading relationships among population, space, environment, development, and sustainability. Students need opportunities to interpret spatial representations, demographic data, and human-environment relationships as interconnected phenomena rather than as isolated content. Higher education research similarly emphasizes the importance of

critical thinking and reflective engagement in evaluating information and using knowledge responsibly (Rothinam et al., 2025).

Population Geography provides a relevant context for this pedagogical demand. Students encounter population growth, distribution, migration, urbanization, regional inequality, environmental pressure, demographic transition, and sustainable development. These topics require more than conceptual recognition: students need to understand population phenomena as socio-spatial problems that are unevenly distributed across places and connected with material conditions such as settlement, resource use, mobility, environmental pressure, and regional development. Geography education research has highlighted the importance of geo-literacy, spatial thinking, maps, GIS, Web-GIS, and other spatial representations in strengthening geographical understanding (Berendsen et al., 2023; Meechandee & Meekaew, 2025; Wijaya et al., 2026).

Such learning is important because population patterns are not only social categories; they also have spatial and environmental consequences. Uneven urban growth, migration flows, land-use pressure, disaster vulnerability, and sustainability challenges require students to connect demographic evidence with material conditions. Population Geography is therefore a productive setting for examining whether student reflection can disclose how learners interpret spatial representations and where lesson design requires revision.

Within this context, critical geographical literacy provides an interpretive orientation rather than a measured outcome. It refers to progressively more demanding forms of response: recognizing Population Geography concepts, interpreting spatial representations, valuing sustainability concerns, and explicitly explaining or questioning relationships among population, inequality, environment, and development. The distinction is important because mentioning the SDGs or describing them as important indicates awareness or valuation, not by itself causal, relational, or critical socio-spatial reasoning.

The LOC-R model, consisting of Literacy, Orientation, Collaboration, and Reflection, was used as a structured learning flow. LOC-R developed from work on map-literacy learning and was subsequently articulated as a four-stage model for sociocultural literacy (Segara et al., 2018; Segara et al., 2022). Later studies have implemented the sequence in science and Population Geography settings (Iskandar, 2024; Pasongli et al., 2025). Its empirical base remains largely Indonesian and context-specific; accordingly, the present study treats LOC-R as a locally developed instructional sequence related to social-constructivist, collaborative, and reflective learning, not as an internationally established general theory.

However, a learning syntax alone is not sufficient. Teaching also needs to be planned, observed, evaluated, and revised on the basis of classroom evidence. Lesson Study provides such a mechanism through the cyclical stages of plan, do, and see. In higher education, Lesson Study allows the model lecturer and observers to examine the learning process collectively, discuss student responses, and refine the pedagogical design. Studies on Lesson Study, action learning, and pedagogical inquiry show that collaborative observation and reflective dialogue can help educators improve teaching based on actual learning experiences rather than assumptions alone (Fouché, 2024; İleritürk, 2026).

Student reflection is especially important in this process. Reflection does not merely record students' feelings; it can reveal the learning atmosphere, clarity of instruction, quality of interaction, conceptual difficulty, and meanings students construct during learning. Reflective learning literature suggests that written reflection can deepen understanding, support learner autonomy, and provide feedback on instructional design (Fuertes-Camacho et al., 2021; Xega et al., 2024). In Lesson Study, student reflections can therefore serve as pedagogical data that complement observer notes and see-stage discussions.

Existing research provides three partly connected bodies of knowledge. Lesson Study research has examined collaborative planning, teacher learning, and instructional improvement, yet learner-generated evidence is often supplementary rather than central to see-stage interpretation. Higher education studies increasingly recognize students' voices in Lesson Study (Salmon et al., 2022; Tamura & Uesugi, 2020), while geography education emphasizes geo-literacy, spatial thinking, and sustainability-oriented learning. Pasongli et al. (2025) previously reported the implementation process, general learning activity, and descriptive observer findings from the same LOC-R Lesson Study project. The present article addresses a distinct analytic question by examining the complete written-reflection corpus as evidence connecting student experience, see-stage interpretation, and specific lesson-revision decisions.

The novelty of this study does not lie in LOC-R, Lesson Study, student reflection, or the SDGs as separate elements. Its contribution is the evidence mechanism through which reflections are coded, compared with cycle-level observational records, interpreted during the see stage, and translated into documented revisions. The article does not claim that non-equivalent cycles demonstrate individual cognitive development. Instead, it distinguishes pedagogical improvement, changed content exposure, and prompt-dependent SDG awareness and sustainability valuation.

This study aims to analyze undergraduate students' written reflections as pedagogical evidence for understanding and improving Population Geography instruction. It addresses three questions: (1) What learning

conditions, participation gaps, and conceptual obstacles were disclosed by the reflections? (2) How did Cycle 1 evidence inform see-stage interpretation and Cycle 2 lesson revision? (3) What forms of SDG awareness and sustainability valuation were articulated in Cycle 2, and what inferential limits arise because the instructional emphasis and reflection prompts changed?

CONCEPTUAL FRAMEWORK

LOC-R as a structured learning model

LOC-R is positioned here as a locally developed instructional sequence rather than a stand-alone theory of learning. Its map-literacy precursor emphasized spatial media, scaffolding, social interaction, and the teacher's supporting role (Segara et al., 2018). The later LOC-R formulation organized activity into literacy, orientation, collaboration, and reflection and linked the sequence to social constructivism (Segara et al., 2022). Literacy provides access to concepts and representations; orientation establishes the problem and its relevance; collaboration enables peer-supported meaning-making; and reflection allows learners to articulate experience, uncertainty, and understanding. Evidence for LOC-R remains emerging and context-bound, including science education and Population Geography applications (Iskandar, 2024; Pasongli et al., 2025).

This sequence is relevant to the present study because it creates identifiable points at which students encounter information, contextualize it, negotiate meaning, and reflect. Lesson Study supplies a separate inquiry structure for examining and revising those points. LOC-R is therefore the instructional sequence, whereas plan-do-see is the collaborative mechanism through which the lesson is observed and improved.

Lesson study as collaborative pedagogical inquiry

Lesson Study is used as a collaborative pedagogical inquiry consisting of plan, do, and see. The plan stage involves designing the lesson, selecting learning activities, preparing media, and determining the focus of observation. The do stage is the classroom implementation conducted by the model lecturer while observers document student responses and classroom dynamics. The see stage is a collective reflection forum where the model lecturer, observers, and research team interpret evidence from the lesson and determine improvements for the next cycle.

In this article, Lesson Study is not treated merely as a professional development activity for lecturers. It is also treated as an inquiry structure that enables evidence-based interpretation of student learning. By combining student reflections, observer notes, and reflective discussion, Lesson Study offers a systematic way to examine how LOC-R is experienced by students and how the learning design can be revised.

In this configuration, LOC-R provides the instructional sequence through which students read, contextualize, collaborate, and reflect, whereas Lesson Study provides the inquiry structure for observing, interpreting, and revising that sequence. This distinction is important because Lesson Study should not be confused with the learning model itself. Following Ko's (2019) emphasis on the salient features of Lesson Study and Learning Study, the present study treats the object of learning, evidence of student learning, and lesson revision as analytically connected components of pedagogical inquiry.

Student reflection as pedagogical evidence

Student reflection functions as a bridge between learning experience and pedagogical improvement. Through reflection, students articulate what they understood, what they found difficult, how they interacted with peers, and how the lesson connected with real issues. In this study, reflection is treated as learner-generated pedagogical evidence: a student-produced data source that can diagnose learning conditions, identify conceptual obstacles, and inform revision in the see stage of Lesson Study. This position extends student-voice-oriented Lesson Study by shifting attention from student voice as general feedback toward student reflection as evidence for interpretation and planning (Warwick et al., 2019; Salmon et al., 2022).

This position is analytically different from treating reflection as a routine closing activity. Reflection becomes evidence when student statements are systematically coded, compared with observer notes, discussed in the Lesson Study forum, and translated into concrete instructional revisions. Students in this study were not positioned as co-designers or co-researchers in the full Lesson Study cycle. Their involvement was located at the level of learner-generated evidence: they produced written reflections that informed the research team's interpretation of classroom learning during the see stage. This cautious positioning follows work on student involvement in Lesson Study while avoiding an overclaim that students participated in all phases of lesson design (Tamura & Uesugi, 2020).

Critical geographical literacy and object of learning

Critical geographical literacy refers to students' capacity to understand, interpret and question geographical phenomena in relation to space, society, environment, development and sustainability. In Population Geography, this literacy involves more than identifying population data or naming regional categories. It requires students to interpret demographic patterns, read maps and spatial representations, connect population phenomena with inequality, migration, development and environmental pressure and reflect on the social and ecological consequences of these relationships.

Because this study is qualitative, critical geographical literacy was not measured through a standardized test. The analysis used four study-specific evidential levels: conceptual recognition, spatial representation, sustainability awareness or valuation, and relational or critical explanation. These were operational analytic categories developed for the present secondary analysis, not a standardized or externally validated measure of reasoning. The final level required an explicit relationship, causal account, comparison, or critical question connecting population patterns with inequality, development, environment, or sustainability. Mere use of terms such as 'SDGs,' 'future,' or 'sustainability' was coded as awareness or valuation and was not treated as critical reasoning.

The object of learning was the interpretation of country-development classifications and population patterns through maps, demographic representations, and sustainability contexts. No external binary classification system was adopted as an analytic standard. The labels 'developed' and 'developing' followed the course materials and were used only as an initial pedagogical starting point. The United Nations Statistics Division (2026) notes that the United Nations system has no established definition of these categories. Classroom questioning connected the labels with within-country inequality, income, environmental pressure, and multidimensional development; however, students' critical interrogation of the binary was not assessed systematically. Accordingly, this study does not treat correct reproduction of the labels as critical geographical literacy.

METHOD

Research design

This study employed qualitative classroom action research integrated with two Lesson Study cycles. The design examined how student-produced reflective evidence informed instructional revision; it was not a controlled experiment and did not use equivalent cycle tasks as a developmental measure.

Relationship to the prior publication and analytic originality

The classroom implementation examined here is the same project reported by Pasongli et al. (2025), and the 56 written reflections were generated during those two cycles. Accordingly, the course setting, participants, two Lesson Study cycles, LOC-R sequence, six-group arrangement, map and population-pyramid activities, observer involvement, and see-stage process are shared study context rather than a new intervention or newly collected corpus.

The earlier article described the implementation process and broad descriptive findings concerning student activity and literacy, including difficulty interpreting population-pyramid data and identifying countries on maps, collaborative participation, observer feedback, and general instructional improvement. The present article cites those elements as previously reported context and does not present them as newly discovered empirical findings. Where both articles address map difficulty, participation, or collaboration, the present analysis asks a different question: how reflection evidence was classified, interpreted in the see stage, and linked to revision decisions.

The original contribution of the present article is the systematic secondary qualitative analysis of the complete 56-reflection corpus. It introduces the operational framework in Table 3, the reflection-level category distribution in Table 5, the cross-cycle evidence-chain reconstruction, the distinction between sustainability valuation and relational explanation, and the explicit finding that no retained reflection met the threshold for relational explanation or critical questioning. None of Tables 1-5 or Figures 1-2 is reproduced from the earlier publication. The student-coded quotations and analytic summaries identified as S1-C1 to S20-C2 were not published in that article; its quoted qualitative material consisted of observer comments rather than these student-coded reflection excerpts. Thus, the data source is shared, but the coding, tabulation, evidence-chain analysis, selection of reflection evidence, and inferential interpretation reported here are original to this article.

The class functioned as a site of iterative pedagogical inquiry in which each cycle was planned, implemented, observed, discussed, and revised. The analytic procedure is described as cross-cycle evidence-chain analysis: it links Cycle 1 reflection or observation evidence to a documented diagnosis, a Cycle 2 design decision, and the evidence subsequently elicited. This label replaces 'process tracing,' because the study did not conduct formal causal-process testing or systematically test rival causal mechanisms.

Context and participants

The study was conducted in one undergraduate Geography Education class at a public university in eastern Indonesia. The same 28 students participated in both cycles, yielding 56 reflections. Population Geography required engagement with maps, demographic patterns, development, inequality, mobility, environmental pressure, and sustainability. The analytic unit was the meaning unit within each reflection, not an individual change score. Although student codes preserved source identity across cycles, the non-equivalent prompts and tasks did not provide an appropriate paired measure. A paired developmental table was therefore deliberately not constructed.

The Lesson Study process involved one model lecturer and seven observers: five lecturers from Geography Education and two from Biology Education. They participated in planning, observation, and the see-stage discussion. Their different disciplinary perspectives broadened the discussion, but their involvement in the intervention means that their records are contextual sources rather than independent corroboration.

The model lecturer implemented the LOC-R lesson during the do stage. Observers O1–O6 were each assigned to Groups 1–6, respectively, while O7 documented whole-class conditions, including lecturer instructions, media use, pacing, and transitions between LOC-R stages. All observers used a shared protocol covering participation, group interaction, conceptual difficulty, instructional clarity, media use, and classroom atmosphere. Individual notes were discussed during the see stage and consolidated into cycle-level records. The discussion was retained as written minutes rather than an audio transcript. For auditability, this article uses issue-specific consolidated identifiers: ON-C1-AFF (attention/atmosphere), ON-C1-PART (participation), ON-C1-MAP (map difficulty), ON-C2-PACE (pacing), and MIN-C1-REV (Cycle 1 revision decision).

Implementation of LOC-R-based lesson study

Initial coordination clarified the Population Geography focus, LOC-R sequence, observation foci, and reflection format. Each Lesson Study cycle was implemented during a 100-minute regular course meeting, with Cycle 2 conducted seven days after Cycle 1. The same 28 students remained in six groups of four to five, and the see-stage discussion lasted approximately 45 minutes after each implementation. Cycle 1 used informal task division, whereas Cycle 2 introduced facilitator, map/data analyst, note-taker, and presenter roles. Cycle 1 used a learning video, demographic information and population pyramids, country-identification maps, blind-map shading, information searches, group discussion, and presentation. During Cycle 2, each group selected a country case and used maps, demographic information, and population-pyramid representations to connect population patterns with inequality, environmental pressure, and relevant SDGs before presenting its interpretation. This activity was not equivalent to the Cycle 1 map-classification task and was not used as evidence of developmental change.

In Cycle 1, the plan stage prepared the lesson, media, group tasks, observation focus, and narrative reflection. During the do stage, the lecturer facilitated literacy, orientation, collaboration, and reflection while observers recorded participation and conceptual difficulty. The see stage compared student reflections with the consolidated observation record to identify strengths, obstacles, and revision needs.

The Cycle 1 see-stage discussion informed clearer instructions, more concrete examples, stronger visual support, better pacing, and wider participation in Cycle 2. Cycle 2 also increased attention to SDGs and sharpened the reflection prompts. This final change improved the ability of the data collection to elicit sustainability-related language, but it also reduced direct comparability. Cross-cycle differences were therefore interpreted as evidence about what the revised lesson and prompts made visible, not as proof that the same students advanced from one reasoning level to another ([Table 1](#)).

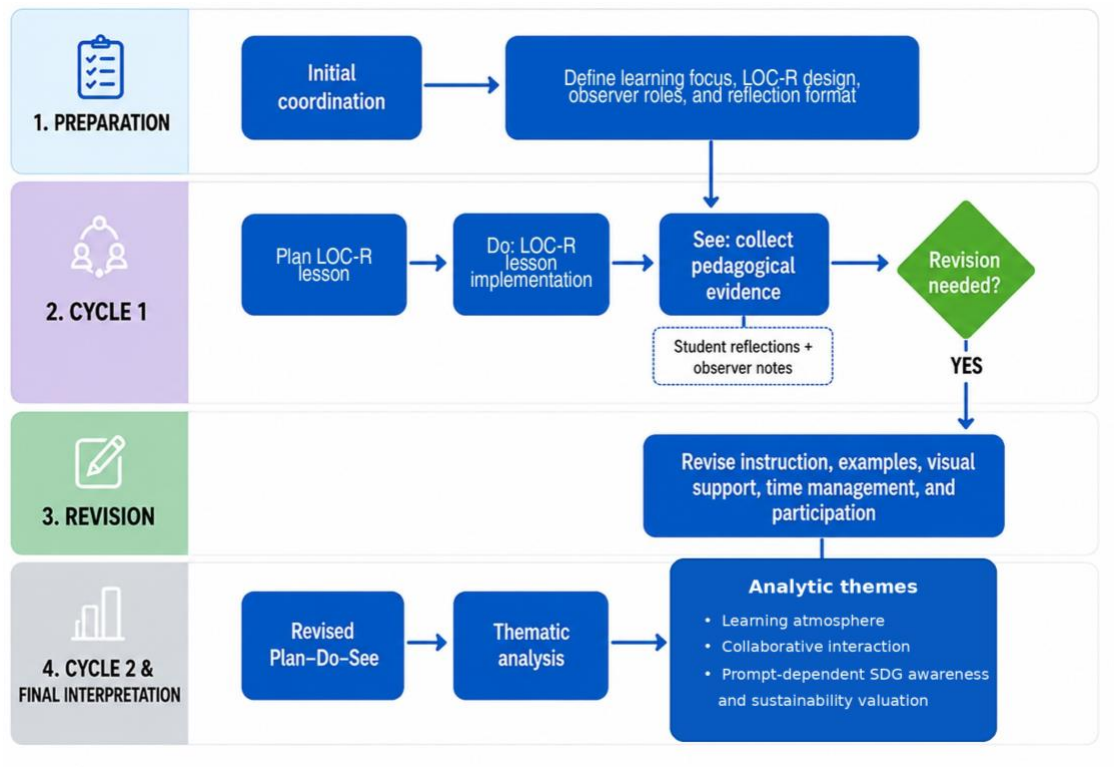
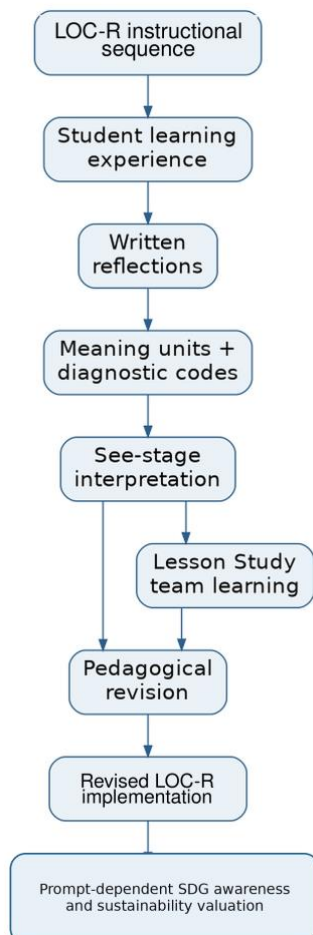
[Figure 1](#) shows the pedagogical evidence chain. The accompanying interpretation applies an explicit boundary of inference. Cycle 1 evidence supported specific revision decisions, and Cycle 2 generated evidence about the revised lesson. Because instructional emphasis and prompts changed together, the analysis separates defensible pedagogical conclusions from alternative explanations for richer Cycle 2 language.

[Figure 2](#) conceptualizes reflection as an evidence mechanism. Written reflections were segmented into meaning units and diagnostic codes, interpreted with cycle-level records, and translated into lesson revision. The endpoint is prompt-dependent SDG awareness and sustainability valuation rather than a causal claim that LOC-R produced individual development in socio-spatial reasoning.

Table 1.

Documented instructional features and implications for cross-cycle comparison

Feature	Cycle 1 implementation	Cycle 2 revision	Comparability implication
Lesson focus	Characteristics of developed/developing countries; demographic information and population pyramids.	Stronger SDG, sustainability, and inequality contextualization.	Content exposure changed across cycles.
Groups and tasks	Six groups of 4–5 students; informal task division; information search, blind-map shading, discussion, and presentation.	Same six groups; explicit facilitator, map/data analyst, note-taker, and presenter roles.	Participation conditions changed; role effects were not independently tested.
Visual support	Learning video, demographic representations, maps, and student devices for information search.	More concrete examples, guided interpretation, and stronger visual support.	Any difference may reflect revised scaffolding.
Pacing	A 100-minute regular course meeting; see-stage discussion approximately 45 minutes.	A 100-minute meeting seven days after Cycle 1; see-stage discussion approximately 45 minutes.	Nominal lesson duration was equivalent; pacing and transitions were revised.
Reflection	Common prompts on learning, discussion, and difficulties.	Common prompts plus sharper questions on patterns, causes, and sustainability.	Richer SDG language may be prompt-dependent.
SDG-related activity	No equivalent explicit SDG analytical task was documented.	Each group selected a country case and used maps, demographic information, and population pyramids to connect population patterns with inequality, environmental pressure, and relevant SDGs, then presented its interpretation.	The Cycle 2 SDG activity was not equivalent to the Cycle 1 map-classification task.
Observation record	O1–O6 assigned to Groups 1–6; O7 documented whole-class instruction, media, pacing, and transitions.	Same assignment structure and shared protocol; written see-stage minutes, not audio transcripts.	Records contextualize reflections but do not independently corroborate them.

Figure 1*Analytical flow of LOC-R-based lesson study***Figure 2***Reflection-informed pedagogical evidence mechanism in LOC-R-based Lesson Study.*

Data sources and reflection prompts

The main data consisted of 56 written reflections produced by the same 28 students after the two cycles. The reflections addressed learning atmosphere, participation, conceptual understanding, obstacles, and meanings related to geography, the SDGs, and sustainability. Coding was conducted on the Indonesian originals. English excerpts were produced through forward translation and line-by-line comparison with the source wording for semantic equivalence; formal back-translation was not used. Quotation marks identify translated verbatim wording retained in the source, whereas unquoted student-coded descriptions are concise analytic paraphrases. No student's wording was expanded to create a longer or more relational statement.

Across both cycles, common prompts asked students what they learned, how the activities and group discussion affected their understanding, and what difficulties they experienced. Cycle 2 added or sharpened prompts asking about spatial patterns, possible social causes, and sustainability implications. [Table 2](#) separates the common and non-equivalent components. Common-prompt material was used only to compare pedagogical experiences; material elicited by the sharper Cycle 2 prompts was classified as prompt-dependent evidence. It was not used to infer individual development.

Table 2

Reflection-prompt structure and permitted analytic use

Prompt domain	Cycle 1	Cycle 2	Permitted interpretation
Learning gained	What did you learn?	What did you learn?	Comparable as learner-reported understanding, not measured competence.
Activity and discussion	How did the activities and group discussion affect your understanding?	Same common area, with clearer task directions.	Comparable for pedagogical experience, with caution about revised instruction.
Difficulty	What difficulties did you experience?	What difficulties did you experience?	Comparable as diagnostic self-report.
Analytical extension	No equivalent explicit request reported.	Explain spatial patterns, possible social causes, and sustainability implications.	Prompt-dependent evidence only; not evidence of individual development.

Supporting data consisted of consolidated observer notes and written see-stage minutes. The notes documented participation, group interaction, instructional clarity, media use, and visible responses; the minutes recorded the agreed diagnostic issues and revisions. These records contextualized student reflections but were not treated as independent corroboration because the lecturer and observers participated in the intervention. Issue-specific source labels identify the relevant consolidated record rather than implying a verbatim quotation from a single observer.

Data analysis

The data were analyzed using qualitative content analysis and cross-cycle evidence-chain analysis (Graneheim et al., 2017). Content analysis identified meaning units within all 56 reflections. Evidence-chain analysis linked a Cycle 1 meaning unit or observation item to the team's diagnosis, the corresponding revision decision, and the evidence elicited after revision. It reconstructs a documented pedagogical sequence; it neither estimates a causal effect nor tests individual developmental gain.

The first stage involved repeated reading of all 56 Indonesian reflections. Words, phrases, sentences, or short passages concerning classroom atmosphere, collaboration, engagement, conceptual understanding, confusion, criticism, SDGs, or sustainability were marked as meaning units. A preliminary operational framework was developed after familiarization with ten reflections, five from each cycle, by combining concepts from the study framework with distinctions emerging from the data. It was finalized before formal full-corpus coding and then applied to all 56 reflections. Table 3 therefore records a study-specific analytical framework developed through familiarization with the corpus; it is not an externally validated measure of student reasoning.

The second stage applied diagnostic codes. Statements about attention, enjoyment, fatigue, or timing were coded as affective-cognitive engagement or pedagogical strain. Statements about discussion, cooperation, contribution, regional experience, or uneven participation were coded as collaborative participation. Geography statements were separated into conceptual recognition/spatial representation, SDG awareness/sustainability

valuation, and relational or critical socio-spatial explanation. This separation prevented an SDG keyword or positive evaluation from being coded as reasoning.

The third stage clustered the codes into four themes: affective engagement and pedagogical strain; collaboration and participation gaps; prompt-dependent SDG awareness and sustainability valuation; and reflection as see-stage pedagogical evidence. Three researchers participated in the formal coding process. Researcher 1 coded the complete corpus of 56 reflections. No analytic category was added or removed after the operational framework was finalized. The ten reflections used during familiarization remained in the corpus and were recoded using the same final operational definitions applied to the other 46 reflections.

Researcher 2 independently cross-checked 28 reflections (14 from each cycle, representing 50% of the corpus). Researcher 3 reviewed seven meaning units for which the initial coding decisions differed. Disagreements were resolved through consensus by returning to the Indonesian source statements and the minimum-evidence criteria in [Table 3](#). Because the procedure emphasized interpretive consensus, no inter-coder coefficient was calculated. The Lesson Study forum supplied classroom context but was analytically separated from this formal review.

Table 3

Analytically developed operational framework for coding student reflections

Analytic category	Minimum evidence	What does not qualify	Interpretive label
Affective-cognitive engagement	Attention, enjoyment, fatigue, pacing, or concentration.	A general positive evaluation without a learning condition.	Positive affect; fatigue; pacing; pedagogical strain.
Collaborative participation	Peer discussion, contribution, unequal participation, or exchange of experience.	A generic claim that group work occurred.	Cooperation; participation gap; contextual exchange.
Conceptual recognition and spatial representation	Identification of concepts, maps, spatial patterns, or classification difficulty.	Enjoyment of media without conceptual reference.	Recognition; spatial representation; confusion.
SDG awareness and sustainability valuation	Recognition of SDGs or explicit statement of relevance, importance, inspiration, or future value.	Use of an SDG term alone as evidence of causal or relational reasoning.	Awareness; positive valuation; future relevance.
Relational or critical socio-spatial explanation	Explicit relationship, cause, consequence, comparison, or critical question linking population with inequality, development, environment, or sustainability.	Keywords such as SDGs, future, poverty, or sustainability without explanation.	Relational explanation; causal reasoning; critical questioning.

Trustworthiness and ethical considerations

Trustworthiness was supported through source comparison, negative-case analysis, an audit trail, translation checks, and explicit inference limits. Reflections were compared with issue-specific consolidated observation records and see-stage minutes to clarify classroom context. Because these sources were produced by participants in the intervention, convergence was not treated as independent corroboration. The audit trail instead documented the sequence from a reflection or observation item to diagnosis, revision decision, and subsequent evidence.

The Lesson Study forum served a pedagogical function: the model lecturer and observers discussed strengths, obstacles, and revisions. Formal analytic review remained the responsibility of the authorial research team. Negative cases—including fatigue, confusion, unequal participation, and Cycle 2 statements that named SDGs or future relevance without explaining relationships—were retained to counter confirmation bias. Researcher involvement in lesson design and interpretation is reported as a limitation, not as an independent credibility check.

Student reflections were part of routine learning, but research inclusion was handled separately. A research-team member who was not responsible for grading administered written consent seven days before Cycle 1. Consent forms were stored separately from the coded reflection corpus. The model lecturer could use reflection content for pedagogical feedback but did not receive the individual consent list and did not use consent decisions for grading. Had a student declined, the reflection would have remained a learning record but would have been

excluded before coding. All 28 students consented, yielding 56 consenting reflections. Approval was granted under Letter No. 1627/UN40.A2/PT.01.01/2026.

RESULTS

The results are presented as a cross-cycle pedagogical evidence chain rather than an individual developmental trajectory. The analysis asks what the reflections disclosed, how the evidence informed revision, and what the revised lesson and sharper prompts subsequently made visible. **Figures 1–2** and **Tables 1–5** distinguish pedagogical diagnosis and descriptive theme distribution from claims about student reasoning.

Cycle 1 disclosed positive affect, uneven participation, and difficulty with map-based classification. Cycle 2 followed changes in instruction, visual support, pacing, participation structure, SDG exposure, and reflection prompts. Because several conditions changed simultaneously, three explanations remain possible for richer Cycle 2 language: learning within the course, greater exposure to sustainability content, and the sharper elicitation prompts. The results do not isolate these explanations.

The reported excerpts are evidence markers within the complete corpus. Quoted passages are verbatim English translations; unquoted coded cases are paraphrases and are not presented as quotations. Brief mentions of the SDGs, sustainability, or the future are not treated as relational reasoning. Student codes identify source and cycle, but non-equivalent prompts rule out paired change scores. Theme distributions are reported descriptively at the reflection level. Because one reflection could contain more than one category, category totals were not expected to equal 28 within a cycle. The counts do not establish individual development or a causal effect.

Table 4 is the core evidence chain. It shows how Cycle 1 evidence informed concrete pedagogical decisions and what could reasonably be concluded after Cycle 2. The final column prevents lesson revision, changed content exposure, and changed prompts from being collapsed into a single developmental explanation.

Table 5 summarizes the reflection-level distribution of the operational categories. A reflection could receive more than one category when it contained distinct meaning units; therefore, the categories are not mutually exclusive.

Table 4

Cross-cycle evidence chain, defensible interpretations, and alternative explanations

Cycle 1 evidence	Cycle 2 design change	Cycle 2 evidence	Defensible interpretation and alternative explanation
Enjoyment coexisted with fatigue and timing concerns.	Pacing and transitions were adjusted.	Positive atmosphere continued; timing concerns remained.	Reflections diagnosed a persistent design issue; no causal learning claim is made.
Student confusion and ON-C1-MAP documented map-based classification and country-identification difficulty.	Examples, visual support, and guided interpretation were strengthened; SDG emphasis increased.	S18-C2–S20-C2 provided paraphrased evidence of SDG awareness or valuation, not a retained reasoning chain.	The revised lesson elicited different language; learning, changed content exposure, and changed prompts remain inseparable.
Collaboration occurred, but participation was uneven.	Participation opportunities and task structure were clarified.	Students described sharing stories and regional perspectives.	The revised design made contextual collaboration more visible; individual improvement was not tested.
Cycle 1 prompts were broad and largely experiential.	Cycle 2 added questions about patterns, causes, and sustainability.	Sustainability-oriented terms appeared under the expanded Cycle 2 prompts.	Changed elicitation conditions preclude a developmental interpretation.

Table 5

Descriptive distribution of analytic categories by cycle

Analytic category	Cycle 1 (n = 28)	Cycle 2 (n = 28)
Affective engagement or pedagogical strain	17 (60.7%)	19 (67.9%)

Analytic category	Cycle 1 (n = 28)	Cycle 2 (n = 28)
Collaborative participation or participation gaps	15 (53.6%)	17 (60.7%)
Conceptual recognition or spatial representation	14 (50.0%)	11 (39.3%)
SDG awareness or sustainability valuation	3 (10.7%)	16 (57.1%)
Relational socio-spatial explanation	0 (0.0%)	0 (0.0%)
Critical questioning	0 (0.0%)	0 (0.0%)

Affective engagement or pedagogical strain was identified in 17 Cycle 1 reflections (60.7%) and 19 Cycle 2 reflections (67.9%). Collaborative participation or participation gaps appeared in 15 (53.6%) and 17 (60.7%), respectively. Conceptual recognition or spatial representation appeared in 14 Cycle 1 reflections (50.0%) and 11 Cycle 2 reflections (39.3%). SDG awareness or sustainability valuation appeared in 3 Cycle 1 reflections (10.7%) and 16 Cycle 2 reflections (57.1%). No reflection in either cycle met the minimum threshold for relational socio-spatial explanation or critical questioning. These distributions are descriptive and cannot separate learning from changed content exposure or prompts.

Affective engagement and pedagogical strain in the learning atmosphere

The first analytic theme shows positive affect alongside pedagogical strain. In Cycle 1, the verbatim translated reflections included 'very enjoyable, easy to understand, and not sleepy' (S1-C1), 'an impressive learning experience' (S2-C1), and 'very pleasant' (S3-C1). These statements evidence perceived classroom atmosphere and clarity; they do not demonstrate learning gain.

The consolidated observation record supported this classroom-context pattern: students generally attended to the literacy and collaboration activities (ON-C1-AFF). The see-stage minutes nevertheless recorded a need for clearer transitions and pacing (MIN-C1-REV). These sources contextualize the reflections; they do not independently establish learning.

In Cycle 2, verbatim translated statements included 'the lesson was very enjoyable and collaborative' (S4-C2), 'today's class was interesting and pleasant' (S5-C2), and 'it did not make me sleepy' (S6-C2). The negative cases are more diagnostically specific: 'if possible, the time should not be too long because I became sleepy and hungry' (S7-C2) and 'the learning time would be better in the morning' (S8-C2). These longer verbatim statements delimit the positive accounts by identifying duration and scheduling as unresolved conditions.

This tension is analytically important. A lesson can be enjoyable and still be cognitively or physically demanding if the activity sequence is too long, if transitions are unclear or if reflection is placed when students are already tired. Student reflection therefore functioned as diagnostic evidence: it showed not only that the learning atmosphere was positive, but also that pacing, activity duration and transition between LOC-R stages needed careful management.

Reflection-diagnosed collaboration and participation gaps

The second analytic theme concerns collaborative interaction without assuming equal participation. Cycle 1 verbatim translations included 'we could discuss with friends and cooperate' (S9-C1), 'we were directed to contribute to each other' (S10-C1), and 'it helped us build good cooperation' (S11-C1). These statements support the presence of peer interaction, not uniform participation or improved reasoning.

The consolidated record documented task-sharing and peer response during discussion (ON-C1-PART). A verbatim counterexample stated, 'the learning process was already good, but some students were still less active' (S12-C1). This longer statement prevents a uniform-success claim and directly supports the revision toward clearer participation opportunities. Although observer-to-group assignments were documented, ON-C1-PART is a traceable consolidated issue code rather than an observer-specific quotation because individual notes were integrated into the cycle-level record.

In Cycle 2, one verbatim translated phrase was 'share stories with the group' (S13-C2). S14-C2 was coded, from the Indonesian original, as cooperation with peers from outside the local province; it is reported as a paraphrase because no longer verbatim English excerpt was retained. These cases show contextual collaboration made visible by the revised activity, not an individual change in collaboration quality.

In Cycle 2, student reflections described peer engagement and the exchange of regional experience. These accounts show what the revised participation structure made visible, but they do not demonstrate a uniform increase in collaboration. Collaboration functioned as a social and intellectual space in which students could negotiate meaning, bring personal experience into discussion, and relate geographical concepts to different regional contexts. Reflection made these participation patterns visible and therefore useful for pedagogical interpretation.

Prompt-dependent SDG awareness and sustainability valuation

The third theme distinguishes map-based recognition from the stronger evidence required for socio-spatial reasoning. S15-C1 was coded as reporting understandable material, and S16-C1 as reporting that blind-map coloring supported country identification. These are paraphrased meaning-unit summaries, not verbatim quotations. They support conceptual recognition and use of spatial representation, not relational explanation.

Cycle 1 also disclosed conceptual difficulty. S17-C1 was coded as confusion in distinguishing the two country categories, while the consolidated record documented difficulty identifying countries on maps (ON-C1-MAP). This convergence supported a diagnosis that spatial-conceptual scaffolding needed strengthening and was recorded in the Cycle 1 revision minutes (MIN-C1-REV). It did not establish a baseline score for developmental comparison.

In Cycle 2, S18-C2 was coded as recognition of what the SDGs were, S19-C2 as future relevance, and S20-C2 as positive valuation of SDG-oriented learning. These are paraphrased coded summaries. None contains a retained causal or relational passage connecting demographic patterns, spatial inequality, development, environmental consequences, and sustainability. Under Table 3, they therefore qualify as SDG awareness or sustainability valuation, not critical socio-spatial explanation.

The evidence supports only a bounded conclusion: the revised content and sharper prompts elicited sustainability-oriented statements, but the available verbatim text does not document a reasoning chain. The explicit counterexamples fatigue and timing (S7-C2; S8-C2), uneven participation (S12-C1), and brief categorical or evaluative SDG statements (S18-C2–S20-C2) define the limits of the claim. Because no longer relational passage was retained, the manuscript makes no claim that students developed critical socio-spatial reasoning.

Student reflection as pedagogical evidence in the see stage

The fourth analytic theme concerns how reflections were used in the see stage. Student reflections were not treated as isolated expressions of satisfaction. They were compared with observer notes to identify which parts of the LOC-R sequence supported learning and which parts required revision. For example, students' reports of fatigue were interpreted alongside observer notes on pacing and classroom transitions. Students' confusion in identifying developed and developing countries on maps was interpreted as evidence that spatial representation required stronger scaffolding. Reports of uneven participation were interpreted as evidence that collaboration needed clearer role distribution rather than merely more group work.

This use of reflection is central to the contribution of the study. The reflections made visible aspects of learning that could not be fully inferred from observation alone, including students' perceived clarity, uncertainty, confidence and meaning-making. In the Lesson Study process, these reflections strengthened the see stage by shifting the discussion from whether the lesson had been implemented as planned toward how students experienced, interpreted and struggled with the lesson.

The see-stage discussion also generated pedagogical learning for the model lecturer and observers. Initially, positive participation could have been interpreted as evidence of successful implementation. However, student reflections showed that positive engagement coexisted with fatigue, conceptual uncertainty and uneven participation. This evidence helped the Lesson Study team reconsider the pacing of the LOC-R sequence, the need for stronger visual scaffolding and the need to structure group participation more deliberately.

Taken together, the findings establish a pedagogical evidence chain. Reflections revealed positive engagement alongside fatigue, collaboration alongside participation gaps, and map-based recognition alongside conceptual difficulty. These data informed revisions to pacing, scaffolding, participation, and prompts. Cycle 2 reflections then made sustainability awareness more visible, although the design does not determine whether that difference arose from learning, content exposure, or elicitation.

DISCUSSION

This study advances Lesson Study scholarship by specifying how written student reflection can become actionable evidence in the see stage. Its strongest finding is the traceable connection between learner-reported experience, cycle-level observation, collective diagnosis, and concrete lesson revision, rather than a developmental shift in socio-spatial reasoning. This contribution extends student-voice work showing that learners can challenge educator assumptions and inform subsequent planning (Warwick et al., 2019; Salmon et al., 2022).

Reflections also differentiated positive experience from pedagogical adequacy. Enjoyment coexisted with fatigue, confusion, and uneven participation; when read with cycle-level observation and see-stage records, these reports informed revisions to pacing, visual scaffolding, instructions, and participation structures. Related participatory research likewise illustrates the methodological value of attending to learner-generated accounts, although its adaptive-AI context and learner population differ substantially from the present study (Kaharuddin et al., 2026; Muzaini et al., 2026).

For geography education, the findings show both the potential and the limit of reflective prompts. Map and demographic activities elicited conceptual and spatial recognition, whereas SDG-oriented prompts elicited awareness and valuation. Because no retained excerpt stated an explicit relationship, cause, consequence, comparison, or critical question, the study does not infer development in critical socio-spatial reasoning.

LOC-R offered a useful sequence for organizing these activities, but its evidence base remains locally concentrated. The present findings should therefore be interpreted as a context-specific account of how LOC-R was examined through Lesson Study, not as evidence that LOC-R independently caused the observed patterns. Its scholarly value here lies in the interaction between an instructional sequence and an evidence-sensitive plan-do-see process.

The study also surfaces a disciplinary problem in the use of 'developed' and 'developing' countries. No formal external binary classification was used as an analytic standard. The course labels served as instructional objects for map work and contextual questioning, not stable national facts. Because the United Nations system has no established definition of the binary (United Nations Statistics Division, 2026), future instruction should replace or qualify it with multidimensional indicators and within-country inequality. The present data do not establish that students themselves critically challenged the labels.

Methodologically, changed prompts produce changed evidence. The pedagogically useful Cycle 2 extensions prevent a paired developmental comparison because content exposure, tasks, and elicitation were not equivalent. Theme frequencies therefore describe corpus coverage rather than individual change. Future studies should retain equivalent core prompts and tasks, preregister a student-by-theme matrix, and report analytical extensions separately.

CONCLUSION

This study shows that undergraduate students' written reflections can function as learner-generated pedagogical evidence in LOC-R-based Lesson Study. Reflections disclosed engagement, fatigue, participation gaps, and conceptual obstacles that informed clearer instructions, stronger visual support, adjusted pacing, and more structured collaboration. The evidence supports a reflection-informed lesson-revision mechanism rather than a causal claim about LOC-R effectiveness.

Cycle 2 reflections contained explicit references to the SDGs, sustainability, and future relevance. Because content exposure and prompts changed, these statements are interpreted as prompt-dependent awareness or valuation, not demonstrated development in critical socio-spatial reasoning. The contribution to geography education is a transparent account of how reflection diagnosed learning conditions and where stronger comparable evidence remains necessary.

Implications

Theoretically, the study extends Lesson Study scholarship by identifying a concrete mechanism through which learner-generated evidence can inform see-stage interpretation. Methodologically, it demonstrates a cross-cycle evidence chain from meaning unit to diagnostic code, revision decision, and cautious post-revision interpretation.

Practically, LOC-R implementation should use clear instructions, concrete examples, visual media, explicit group roles, and manageable pacing. Reflection forms should retain equivalent core prompts across cycles and place any new analytical prompts in a separate section so that pedagogical enrichment does not obscure comparability.

Limitations and future research

This study is a secondary analysis of a previously reported classroom project; its contribution lies in the new reflection coding and inferential analysis rather than a new intervention. It involved one class and two cycles. Cycle 2 changed visual scaffolding, examples, participation roles, SDG emphasis, and prompts, so content exposure, elicitation, and learning cannot be separated. The reflection-level category frequencies are descriptive rather than an established paired developmental matrix. No equivalent paired task or standardized developmental rubric was available. Reflections are brief self-reports; the retained excerpts do not contain relational reasoning chains. Coding used a 50% independent cross-check and consensus review rather than a reliability coefficient. Intervention-team involvement permits confirmation effects. Observer records were consolidated and see-stage discussions were retained as written minutes rather than audio transcripts.

Future research should retain equivalent prompts and tasks across cycles, preregister paired student trajectories and theme distributions, and preserve longer verbatim passages and counterexamples. Full independent double-coding, bilingual consistency checking, observer-specific note retention, interviews, and an established rubric could distinguish recognition, sustainability awareness, relational explanation, and critical questioning. Replication studies

should standardize and archive lesson duration, cycle interval, group roles, visual materials, lecturer prompts, and SDG activities, and replace binary country labels with multidimensional indicators.

Acknowledgments

The authors gratefully acknowledge the Indonesia Endowment Fund for Education (LPDP), Ministry of Finance of the Republic of Indonesia, for supporting the first author through the LPDP Affirmation Scholarship.

Funding

The funder provided financial support through the LPDP Affirmation Scholarship and had no role in the study design, data collection, data analysis, interpretation of the results, or writing of the manuscript.

Ethics statement

This study involved 28 undergraduate students whose anonymized written reflections were supported by consolidated observer records and written see-stage minutes. A research-team member who was not responsible for grading administered written consent seven days before Cycle 1. All 28 students consented. Consent forms were stored separately from the coded reflection corpus, the model lecturer did not receive the individual consent list, and consent decisions were not used in grading. Had a student declined, the reflection would have been excluded before coding while remaining available only as a routine learning record. Approval was granted under Letter No. 1627/UN40.A2/PT.01.01/2026.

Conflict of interest

The authors declare that they have no conflict of interest.

Informed consent

Written informed consent was obtained from all 28 students seven days before Cycle 1. The procedure was administered by a research team member who was not responsible for grading. Participation was voluntary; refusal would have triggered exclusion before coding and would not have affected grades. Consent forms were stored separately from coded reflections, and the model lecturer did not receive the individual consent list.

Author contributions

H.P: Research concept and design; Collection and/or assembly of data; Data analysis and interpretation; Writing the article; E.M: Data analysis and interpretation; Critical revision of the article; M.R: Data analysis and interpretation; Critical revision of the article; BW: Data analysis and interpretation; Critical revision of the article; J.O.A: Critical revision of the article; A.K: Data analysis and interpretation; Writing the article, Critical revision of the article.

Data availability

The anonymized data supporting the findings of this study may be made available from the corresponding author upon reasonable request, subject to ethical and institutional restrictions.

AI Disclosure

The authors acknowledge using ChatGPT (OpenAI) to support language polishing, structural and APA 7 consistency checks, and revision of schematic figures under direct author supervision. The tool was not used to generate, alter, or analyze research data, was not used as a primary scholarly source, and did not replace author interpretation. The authors checked the sources, figure content, data interpretation, originality, and final manuscript and remain fully responsible for the work.

Biographical Sketch

Hernita Pasongli is a permanent faculty member in the Geography Education Study Program at Universitas Khairun, Indonesia, and a doctoral student in the Geography Education Study Program at Universitas Pendidikan Indonesia. She holds a master's degree in Geography Education. Her research interests include geography education, pedagogical content knowledge (PCK), critical reflection, geographic literacy, pre-service teachers' self-efficacy, collaborative learning, and Lesson Study. Her research also encompasses population geography, environmental education, and sustainability education. Her current research focuses on integrating PCK and

critical reflection into teaching and field-based teaching practice to develop reflective, geographically literate pre-service geography teachers. She also actively develops teaching and learning practices through Lesson Study, LOC-R, student reflection, experiential learning, and collaboration.

Enok Maryani is a Professor of Geography Education at Universitas Pendidikan Indonesia, Indonesia. She holds a doctoral degree in Geography Education and is actively involved in postgraduate teaching, research supervision, and academic development. Her principal research interests include geography education, human geography, tourism geography, geographical literacy, and sustainability-oriented learning. Her scholarly work also addresses the development of geography learning models, teacher competence, spatial understanding, and educational approaches that connect geographical knowledge with contemporary social and environmental issues.

Mamat Ruhimat is a Professor in the Geography Education Program at Universitas Pendidikan Indonesia, Indonesia. He holds a doctoral degree in Geography Education and has extensive experience in postgraduate teaching and research. His main academic interests include geography education, educational assessment, geographical literacy, curriculum development, and the evaluation of learning models. His research particularly emphasizes the design and assessment of geography instruction that strengthens students' spatial understanding, life skills, and ability to interpret geographical and environmental phenomena.

Bagja Waluya is a lecturer in the Geography Education Program at Universitas Pendidikan Indonesia, Indonesia. He holds a doctoral degree in Geography Education. His research interests include geography pedagogy, digital instructional media, teacher professional learning, Geo-STEM integration, environmental literacy, and curriculum development. His recent work examines the use of technology and innovative learning resources in geography education. He has also contributed to the development of educational textbooks and learning materials in geography and sociology for secondary and higher education.

Joseph Ozgiris Akomodi is an educator and interdisciplinary researcher affiliated with the Department of Education at Long Island University, New York, United States. He holds a doctoral degree and several graduate-level qualifications in education and related fields. His research interests include educational leadership, digital literacy, artificial intelligence-supported learning, inclusive education, student well-being, and technology-enhanced teaching. His academic work connects extensive experience in educational practice with research on emerging technologies, institutional leadership, and contemporary challenges in education.

Andi Kaharuddin is a lecturer in Mathematics Education at Universitas Lakidende Unaaha, Indonesia. He holds a doctoral degree in Mathematics Education and is actively engaged in developing innovative and technology-supported instruction. His primary research field is immersive digital mathematics education, with particular emphasis on Technological Pedagogical Content Knowledge and Skills, artificial intelligence in learning, and educational research methodology. His recent work focuses on three-dimensional hologram-based geometry instruction, adaptive AI learning systems, mathematical problem-solving, cognitive agency, and the development of students' critical and visual-spatial thinking.

Disclaimer/Publisher's Note

The statements, opinions, and data contained in all publications are solely those of the individual author(s) and contributor(s) and do not necessarily reflect the views of Lectito Publications and/or the editor(s). Lectito Publications and/or the editor(s) disclaim responsibility for any injury to persons or property resulting from any ideas, methods, instructions, or products referred to in the content.

REFERENCES

- Berendsen, M. E., Hodza, P., & Hamerlinck, J. D. (2023). Researching student interaction with GIS software while learning spatial concepts: Toward a standard measure of GIS interaction. *Journal of Geography*, 122(4), 81-92. <https://doi.org/10.1080/00221341.2023.2220328>
- Fouché, I. (2024). Pre-service teacher investment through dialogic action learning. *Reading & Writing*, 15(1), Article a452. <https://doi.org/10.4102/rw.v15i1.452>
- Fuertes-Camacho, M. T., Dulsat-Ortiz, C., & Alvarez-Canovas, I. (2021). Reflective practice in times of COVID-19: A tool to improve education for sustainable development in pre-service teacher training. *Sustainability*, 13(11), Article 6261. <https://doi.org/10.3390/su13116261>
- Graneheim, U. H., Lindgren, B. M., & Lundman, B. (2017). Methodological challenges in qualitative content analysis: A discussion paper. *Nurse Education Today*, 56, 29-34. <https://doi.org/10.1016/j.nedt.2017.06.002>
- İleritürk, D. (2026). The effectiveness of Lesson Study on the development of curriculum literacy of pre-service English language teachers: A mixed method study. *SAGE Open*, 16(1), Article 21582440251357696. <https://doi.org/10.1177/21582440251357696>

- Iskandar, S. (2024). Analysis of the effectiveness of the literacy-orientation-collaboration-reflection (LOC-R) learning model in science learning activities of Islamic elementary school students. *Jurnal Pijar Mipa*, 19(5), 797-802. <https://doi.org/10.29303/jpm.v19i5.7364>
- Kaharuddin, A., Tulak, T., & Tulak, H. (2026). Co-constructing concepts: A participatory inquiry into slow learners' engagement with an adaptive AI tutor. *Educational Technology Research and Development*. <https://doi.org/10.1007/s11423-026-10702-2>
- Ko, P. Y. (2019). Beyond labels: What are the salient features of lesson study and learning study? *Educational Action Research*, 27(4), 543-563. <https://doi.org/10.1080/09650792.2018.1530126>
- Meechandee, S., & Meekaew, N. (2025). Integrating phenomenon-based learning and GIS to improve geo-literacy and student engagement: An action research approach. *Discover Education*, 4(1), Article 91. <https://doi.org/10.1007/s44217-025-00468-9>
- Muzaini, M., Arriah, F., Sulong, A., Kaharuddin, A., & Jumiarti. (2026). Mapping students' cognitive load profiles in solving geometric integral problems. *European Journal of STEM Education*, 11(1), 19. <https://doi.org/10.20897/ejsteme/18288>
- Pasongli, H., Sufia, R., Marthinu, E., & Nasution, L. A. (2025). Transformation of the teaching process in learning Population Geography subjects through Lesson Study with LOC-R: A real action. *Journal of Education, Teaching and Learning*, 10(1), 97-111. <https://doi.org/10.26737/jetl.v10i1.6148>
- Rothinam, N., Vengrasalam, R., Naidu, S., Nachiappan, S., & Jabamoney, S. (2025). Systematic literature review on critical thinking in higher education. *Edelweiss Applied Science and Technology*, 9(5), 2046-2063. <https://doi.org/10.55214/25768484.v9i5.7377>
- Salmon, I. H., Salvador, A. C., & Rodriguez-Hoyos, C. (2022). Lesson Study as a lever for improving university teaching in Spain: Listening to students' voices. *European Journal of Higher Education*, 12(1), 18-34. <https://doi.org/10.1080/21568235.2021.1873814>
- Segara, N. B., Alwi, Z., Huriyah, L., Musyaropah, A. R., Saifuddin, S., & Bisri, S. S. (2022). Teacher's perception: Designing step-by-step LOC-R (literacy, orientation, collaboration, reflection) in sociocultural literacy teaching. In *Proceedings of the International Conference on Madrasah Reform 2021* (pp. 173-177). Atlantis Press. <https://doi.org/10.2991/assehr.k.220104.026>
- Segara, N. B., Maryani, E., Supriatna, N., & Ruhimat, M. (2018). Investigated the implementation of map literacy learning model. *Geosfera Indonesia*, 3(2), 146-162. <https://doi.org/10.19184/geosi.v3i2.7808>
- Tamura, T., & Uesugi, Y. (2020). Involving students in lesson study: A new perspective. *International Journal for Lesson and Learning Studies*, 9(2), 139-151. <https://doi.org/10.1108/IJLLS-04-2018-0026>
- United Nations Statistics Division. (2026). Note to the reader. *The Sustainable Development Goals Report 2026*. <https://unstats.un.org/sdgs/report/2026/note-to-reader/>
- Warwick, P., Vrikki, M., Faeroyvik Karlsen, A. M., Dudley, P., & Vermunt, J. D. (2019). The role of pupil voice as a trigger for teacher learning in lesson study professional groups. *Cambridge Journal of Education*, 49(4), 435-455. <https://doi.org/10.1080/0305764X.2018.1556606>
- Wijaya, N. M., Herlina, M., Widodo, S., & Suhendro. (2026). Integrating Web-GIS and inquiry learning to enhance spatial thinking in geography learning. *Journal of Educational Technology Development and Exchange*, 19(1), 163-184. <https://doi.org/10.18785/jetde.1901.08>
- Xega, E., Cyfeku, J., & Bilalli, S. E. (2024). Using videos as authentic material to encourage university students' autonomy in reflective writing. *XLinguae*, 17(4), 59-73. <https://doi.org/10.18355/XL.2024.17.04.05>