

# Enhancing Geography Education Students' Competence in Sustainable Development Goals (SDGs): A Lesson Study Approach through LOC-R Learning

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## ABSTRACT

Preparing prospective teachers with a solid understanding of the Sustainable Development Goals (SDGs) and strong geographic literacy is essential for promoting sustainable development. This study explores how reflective practice, embedded in the Lesson Study (LS) model, can enhance geography education students' comprehension of SDGs. Using a qualitative approach, the research was conducted through two LS cycles, each comprising the standard stages: Plan, Do, and See. Data were collected via observation sheets and classroom video recordings to assess student engagement and instructional effectiveness. In the first cycle, several challenges emerged, including poor time management, insufficient geographic literacy, discomfort from observer presence, and difficulty linking global case studies to SDG concepts. The second cycle introduced targeted improvements: the use of visual maps, enriched SDG-related content, and integration of digital technologies. These adaptations significantly enhanced student engagement and understanding. Findings demonstrate that the LOC-R (Local Context-Reflective) learning model, when implemented through LS, effectively helps students relate geographic knowledge to real-world sustainability challenges. Reflective collaboration among educators also contributed to improved instructional strategies. The LS-based LOC-R model shows strong potential in advancing both geographic literacy and critical thinking in the context of education for sustainable development. This approach equips future educators to analyze global issues and devise informed, sustainable solutions.

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## 1. INTRODUCTION

Geography, as a scientific discipline, plays a vital role in addressing complex global and local challenges. Its applications span urban mapping, regional analysis, and spatial planning (Sihaseila & Lasaiba, 2022). Geographic tools and technologies, such as ArcGIS, have proven instrumental in public health efforts—particularly in tracking the spread of COVID-19 (Fadjarani, 2020). In the field of education, geographic competence is increasingly recognized as essential. According to National Geographic (2015), geographic skills enable learners to ask spatial questions and solve real-world problems (Setiani & Rafianti, 2018). These skills involve both spatial intelligence—the natural ability to comprehend spatial relationships (Sutarna & Maryani, 2021)—and spatial thinking, a cognitive process of interpreting and applying spatial data (Mayalagu, Jaafar, & Kuok Choy, 2018).

Developing geographic skills allows students to critically analyze spatial patterns, evaluate global issues, and design sustainable solutions (Kolvoord, 2021). In the 21st century, cultivating geographic thinking is essential for equipping learners to respond to interconnected global challenges. This capability aligns with the aims of sustainable development, which emphasizes the integration of scientific understanding with practical application (Wang et al., 2024).

The United Nations' Sustainable Development Goals (SDGs)—a set of 17 interlinked targets—seek to eradicate poverty, promote equity, protect the environment, and support inclusive economic growth by 2030. Education for Sustainable Development (ESD), grounded in these principles, has demonstrated positive impacts across learning environments. For instance, Grindsted and Nielsen (2021) found that field-based learning enhances students' ability to localize the SDGs while engaging community stakeholders. Similarly, Tarazé et al. (2022) reported that SDG-focused education boosts student responsibility, responsiveness, and motivation. This underscores the importance of preparing pre-service teachers with comprehensive SDG knowledge and strong geographic skills. Higher education institutions are therefore responsible for cultivating both subject mastery and pedagogical competence to address pressing global issues (Salimova & Saldatova, 2021).

A promising pedagogical framework is the Literacy, Orientation, Collaboration, and Reflection (LOC-R) model, which builds on map literacy and emphasizes geospatial analysis, critical thinking, and active student participation (Pasongli et al., 2022; Bayu et al., 2022). To optimize the implementation of LOC-R within SDG education, integration with Lesson Study (LS) is proposed. LS is a collaborative professional development model involving lesson planning, classroom observation, and reflective evaluation (Aizawa et al., 2023; Elliot, 2019; Sari et al., 2020). Its impact is evident in the growing scholarly attention it has received—over 19,000 LS-related publications between 2018 and 2024. Of particular importance is the reflection phase, where educators critically assess student understanding and refine instructional strategies.

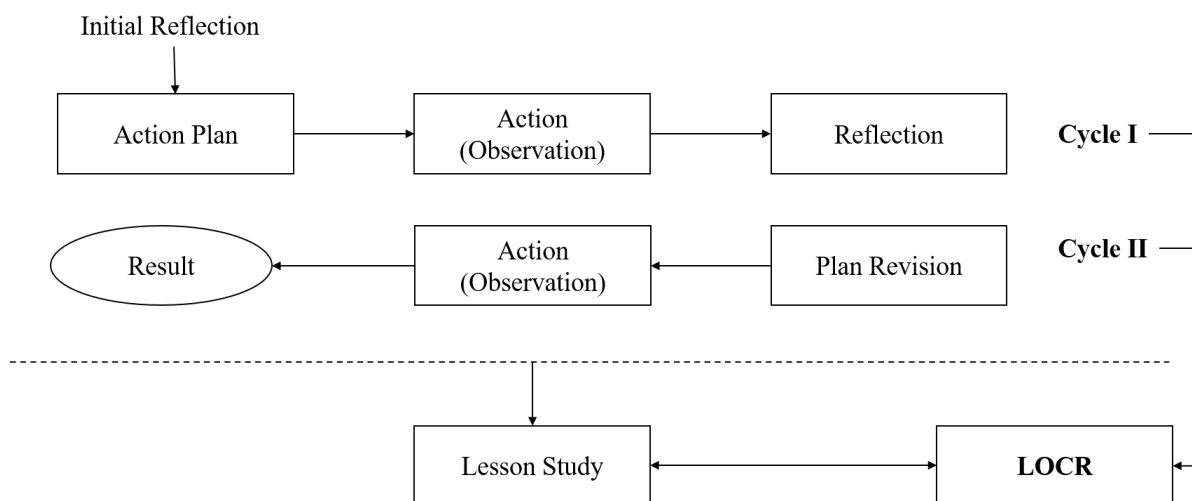
Despite the benefits of LOC-R, challenges remain in delivering SDG content effectively. For example, Crespo Castellanos et al. (2021) found that while landscape and environmental themes are often used to teach SDGs, educators struggle to connect these concepts to experiential learning, often presenting them in abstract or disconnected ways.

In this context, integrating LS-based reflection into the LOC-R model is essential. This combination enables educators to improve instructional quality, deepen students' conceptual understanding, and foster the critical thinking necessary for addressing sustainability challenges. Therefore, this study investigates how reflective practices embedded in Lesson Study can enhance geographic literacy and promote meaningful student engagement with SDG content, contributing to broader goals in sustainable development education.

## 2. METHODS

This study uses a qualitative approach with the Lesson Study (LS) method to improve problem-solving-based learning on Sustainable Development Goals (SDGs) materials. This research involves several stages, namely planning, implementation, observation, and reflection, which aim to understand how the integration of problem-solving in SDGs materials can be improved through teacher

collaboration in Lesson Study. This research is categorised as a classroom action research with a qualitative approach because the whole research and data collection process is a cycle of learning and teaching. There were two cycles in this action research process: Cycle I and Cycle II (see Figure 1). LS dominated the cycles, and then the LOC-R model was applied (Bayu et al., 2022; Pasongli et al., 2022; Syela, 2022). Action research has several benefits, including mapping the weaknesses and strengths in learning and innovating in learning, both in applying media and learning methods and strategies, so that learning can be maximised (Diana et al., 2021).



**Figure 1.** Cycle of classroom action research (PTK) with LS and LOC-R models (adapted and modified from Ulfatin, 2015: 118 in 8)

Lesson study is a form of research (Yoshida & Fernandez, 2016). The stages of lesson study implementation are similar to the PTK cycle (Kemmis & McTaggart, 2014). Lesson study incorporates the cycles of PTK. Teachers plan collaboratively, observe the learning model, and then reflect together. The methods and stages used in this study can be seen in Table 2 for more details.

**Table 1:** Research Stages with Lesson Study-LOC-R Research Stages with Lesson Study LOC-R

Stages	Research	Lesson Study	LOC-R
Planning Cycle I	<ul style="list-style-type: none"> <li>• Determination of research subjects</li> <li>• Research scenario planning</li> <li>• Development and validation of instruments used</li> <li>• Communication with the team to implement the lesson study</li> <li>• Prepare the necessary equipment (audio recorder)</li> </ul>	<p>Collaborate on the problems obtained on the MFL.</p> <ul style="list-style-type: none"> <li>• Furthermore, presenting, one person from a group representative presents or explains the results of literacy activities (understanding the content of texts, data and diagrams).</li> </ul> <p>Doo</p> <p>Collect student reflections after learning. Model lecturers and observers convey the results of observations at the site stage.</p>	<ul style="list-style-type: none"> <li>• All phases of the LOC-R activity are focused on student activities.</li> </ul> <p><b>LITERACY</b></p> <ul style="list-style-type: none"> <li>• literacy activities independently to understand, respond, reflect, evaluate, create knowledge, plan attitudes, and plan actions from a stimulus.</li> </ul>
Implementation Cycle I	<ul style="list-style-type: none"> <li>• Implement lesson study in the form of a peer group in the lecture room</li> <li>• The researchers and observers took notes on each stage of the lesson study.</li> </ul>		<p><b>ORIENTATION.</b> The stage where the teacher explains the learning objectives is where learning activities are carried out to construct knowledge of facts, concepts, and values by considering sociocultural literacy competencies.</p> <p><b>COLLABORATION</b></p> <p>Learning activities involve collaboration between students, teachers, and fellow students. These activities aim to improve cognitive levels with the help of partners, teachers, and peers.</p> <p>(Reflection at this stage is intended as a different activity from reflection at the research stage; here, reflection is intended by students giving impressions or messages or explaining their learning experience with the model lecturer.)</p>

Stages	Research	Lesson Study	LOC-R
Observation and Reflection Cycle I	<ul style="list-style-type: none"> <li>• Observation</li> <li>• The researcher and the Lesson Study team discussed and reflected on the observation results at the implementation stage. Reviewing and assessing the discussion results became an improvement in cycle II.</li> </ul>		
Planning Cycle II	Learning steps follow the stages of cycle 1		<b>LITERACY</b>
Implementation Cycle II			<b>ORIENTATION</b> <b>COLLABORATION</b> <b>REFLECTION</b> (reflection at this stage is intended as a different activity from the research stage; reflection here is intended with students giving impressions or messages or explaining their learning experience with the model lecturer).
Observation Cycle II			
Reflection Cycle II			

Source: Adaptation of Zulfiani et al, 2014 (7).

The research subjects were students of the Geography Education program at Khairun University, who were studying the Population Geography course on the theme of *Sustainable Development Goals* (SDGS). The research participants comprised 30 students who enrolled in the Population Geography course and acted as learners in the learning process. The observers in this study consisted of 5 lecturers from the Geography Education study program, 2 lecturers from the Biology Education study program, and Lesson Study activists at Khairun University. Data collection was taken from the 7 observers, who came from the recording of the do stage and the results of observations made by the observers. Data analysis is based on the results of the reflection of observers involved in the Lesson study.

### 3. FINDINGS AND DISCUSSION

Lesson Study (LS) is a collaborative approach to improving the quality of learning by shifting instruction from teacher-centred to student-centred. Rather than a specific method, LS provides a framework in which various strategies, such as the LOC-R (Literacy, Orientation, Collaboration, and Reflection) model, can be applied contextually. As noted by Wiharto (2018), LS integrates principles of total quality management, encouraging the formation of professional learning communities focused on continuous improvement.

The LOC-R model used in this study is rooted in Vygotsky's sociocultural theory (Bayu, 2022), emphasising social interaction and reflection to enhance student understanding. The reflection stage is particularly crucial, as it allows lecturers and students to evaluate learning processes, identify challenges, and propose improvements collaboratively. This aligns with Gurol (2011), who highlights that reflective thinking fosters deep conceptual understanding and purposeful evaluation.

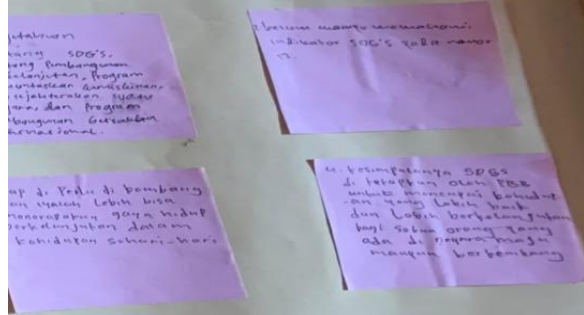
Through LS reflection, students were actively involved in analysing SDGS material and developing geographic literacy. The reflection also helped lecturers recognise areas needing adjustment, leading to more meaningful and responsive learning. Table 2 summarises the stages of improvement observed from Cycle I to Cycle II.

**Table 2.** Reflection Results of Meeting 1 and Meeting 2

No.	Action	Description of LOCR Activity Results	LS Reflection
1	Literacy	The model lecturer distributed pretest questions to assess students' understanding of geography literacy related to the upcoming material. These questions were derived from relevant literacy sources aligned with the SDGS content. Students then watched a video on SDGS and were encouraged to ask questions or summarise the content. However, none initiated questions, prompting the lecturer to engage them directly. Although a few students responded, their answers revealed limited comprehension and inability to interpret key information from the video, indicating a gap in conceptual understanding and geography literacy.	LN, the model lecturer, implemented the LOCR learning model, which consists of four stages: Literacy, Orientation, Collaboration, and Reflection. She noted that time efficiency is essential for its success. Observer NT reported that students appeared nervous due to the presence of several observing lecturers. However, learning proceeded without significant disruption. Observer EM observed that students had difficulty identifying developed and developing countries, indicating weak geography literacy. At the collaboration stage, some students failed to locate and colour countries accurately on the map. This issue was addressed during the reflection stage, where suggestions for improvement were given.
	Orientation	The lecturer conveyed the learning objectives and facilitated activities to construct students' conceptual understanding. According to Pasongli et al. (2022), this stage requires teachers to assign tasks assessing students' grasp of delivered information. Accordingly, students were tasked with constructing a population pyramid based on demographic data to analyse population trends and forecast socio-economic needs in developed and developing countries.	EM emphasised that learning should be centred on student activities guided by the lecturer. Clear instructions are needed at each stage, and students should be encouraged to explore information independently. Lecturers must reinforce key points after student presentations and discussions. To improve learning outcomes, EM suggested that student groups be named after SDG themes (e.g., "Poverty Group", "Education Group") instead of numbers. Each group should explore problems faced by developed and developing countries within their topic and locate them on a map using different colours. EM also highlighted the students' lack of geographic understanding. Many could not distinguish which countries were developed or developing, nor identify their locations by hemisphere or climate zone. He recommended providing explicit, structured materials to support geographic literacy.
	Collaboration	Model lecturers encouraged students to work in groups to foster cooperation, exchange opinions, and respect diverse perspectives. Students were divided into groups and assigned to analyse distribution maps of developed and developing countries about the SDGS indicators. During discussions, students actively explored information and collaboratively shaded blind maps provided by the lecturer. Some used smartphones to research relevant country data, indirectly enhancing their digital and geographical literacy. The lecturer guided groups experiencing difficulties and reminded all students to respect map boundaries while colouring. Despite this, several students struggled to identify countries and interpret boundaries accurately. After completing the activity, each group presented their findings, received peer responses, and received reinforcement from the lecturer, who was a facilitator. This stage	Observer NN confirmed that all LOCR stages were implemented but noted that some students required further guidance, especially during collaboration. Student engagement varied depending on the learning method. For instance, student IR became active when assigned to create a population pyramid. In the second cycle, the lecturer improved lesson preparation and encouraged students to use smartphones to search for information. Apps like Chatgpt or Perplexity were recommended to support literacy. Using the blackboard after digital searches, known as the Banzo Technique, helped reinforce visual learning. The collaboration stage showed progress, though some groups still needed assistance. With continued refinement, the LOCR model is expected to enhance students' geography literacy and improve learning outcomes.

	Orientation	<p>emphasised both collaborative learning and access to information within guided parameters.</p> <p>The model lecturer and students no longer focused on content delivery but reflected on their learning experiences and feelings during the lesson. This reflective process allowed both parties to evaluate the learning methods' effectiveness and identify improvements for future sessions. Reflection was a valuable foundation for lecturers to refine instructional strategies and select more suitable media for subsequent meetings.</p>	
2	Literacy	<p>Model lecturers and the LS team carry out <i>lesson plans</i> (recalling the second plan stage) by preparing RPS, LKPD, and learning media. They also <i>opened a class on sustainable development goals (SDGS)</i> as an approach to the characteristics and conditions of the population of developed and developing countries.</p> <p>The first stage in LOCR learning is literacy. At this stage, the model lecturer provides a stimulus to students by playing a learning video as initial information before the model lecturer delivers lecture material. Students are also asked to use their gadgets to dig up information related to the material. Not to forget, the model lecturer asked for every answer found to be conveyed on the blackboard to make it easier for students to remember and correct answers if they were wrong.</p>	<p>Model lecturer LN stated that, based on the reflection results from the first meeting, Lesson Study observers provided valuable input. In the first cycle, the lecturer dominated the literacy stage. However, in the second meeting, LN allowed students more opportunities to analyse the video material and use the blackboard. This change aimed to enhance student literacy. Student engagement during the collaboration phase also improved significantly compared to the first cycle.</p> <p>Observer NT noted that while student literacy had developed, some students still hesitated to express their ideas. This limited their comprehension. NT suggested that the lecturer group students based on varied academic abilities and manage seating arrangements to foster more effective interaction. At the orientation stage, students were active because they used a game-based strategy. Group discussions were lively, although individual answers more effectively prevent misunderstanding. Appreciation and reinforcement should follow each response. NT also proposed a more interactive orientation method using SDGs-themed sticks and a Spinwheel box. Students could match images with the SDGS goals and provide relevant solutions based on the issues depicted.</p> <p>During collaboration, the lecturer's assistance was essential. LN actively guided groups needing support, which students appreciated. Some showed clear understanding by non-verbal cues such as nodding.</p> <p>Observer EM highlighted that literacy activities need not rely on long texts. Instead, triggering visuals, such as slides showing SDGs-related problems (poverty, environment, health, education, etc.), can focus students' attention—a table drawn on the board compares issues in developed and developing countries. Students</p>
	Orientation	<p>The mastery of geography content in the Population Geography course with the theme of <i>Sustainable Development Goals (SDGS)</i> has been understood by students, as seen from the results of observations at the orientation stage, where the model lecturer uses images and <i>spinwheel</i> learning media. Students are asked to match the SDGS image with the 17 SDGS goals. In addition, students are also asked to analyse the meaning of the picture. In this stage, students are very enthusiastic to find answers through <i>cellphones</i>,</p>	



	<p>Collaboration</p> <p>Reflection</p>	<p>especially in this learning, the teacher uses the <i>Spinwheel</i> application.</p> <p>The collaboration stage is carried out to form a group that aims to find a variety of opinions or thoughts issued by each individual in the group to meet common goals (Taman; 2019, Sato, 2007; Nadhiroh &amp; Trilisiana, 2020) The results showed that there was interaction, communication cooperation in groups, between groups and model lecturers. This collaboration carried out by students can cover comprehensive learning that can bridge students with high, medium and low academic abilities.</p> <p>At the end of the lesson, students express their impressions and messages during the learning process. Messages and impressions are two of the stages of LOC-R, namely the reflection stage. The results of student reflection can be seen in the picture below.</p> 	<p>observed the projected images and then wrote their observations on the board, strengthening visual and analytical skills.</p> <p>EM also recommended dividing groups based on SDGS themes using the Spinwheel technique. For instance, a group assigned to SDG 9 (Industry, Innovation, and Infrastructure) would explore related issues in developing and developed countries, making comparisons to deepen understanding.</p> <p>Observer RHN observed that, despite the positive progress, the physical environment, particularly classroom heat, negatively affected the collaboration phase, reducing focus.</p> <p>Observer YN advised lecturers to provide materials in advance or assign pre-reading on SDGS topics. This would help students arrive in class with baseline knowledge. YN also pointed out that some students misunderstood the SDGS image on the sticky note during orientation, leading to conceptual errors.</p> <p>Observer NN stated that learning in the second cycle became more student-centred. During collaboration, activities developed students' higher-order Thinking Skills (HOTS), particularly at the analysis (C4) and evaluation (C5) levels. Students were able to formulate solutions to national problems in line with the SDGS targets. NN further suggested integrating knowledge from the first cycle into the second cycle by connecting the SDGS components of developed and developing countries. For example, students could analyse why a country is considered developed by examining a specific SDG issue. This approach would help them trace a conceptual link between topics and deepen their understanding of global development classifications.</p>
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The reflection phase in Lesson Study (LS) served as a key evaluative component in this study, allowing model lecturers to assess teaching effectiveness and identify instructional gaps. This phase involved detailed observations, feedback discussions, and the comparison of outcomes between teaching cycles. Unlike the reflection stage in the LOC-R model, which focuses on students' self-evaluation of learning activities, LS reflection involves lecturers critically analysing their instructional approaches based on real-time classroom data (Aizawa et al., 2023). The collective input from observing lecturers during post-lesson reflections was essential for identifying problems, proposing solutions, and enhancing pedagogical strategies. All discussions and outcomes from the reflection sessions were meticulously documented for continuous improvement.

### **3.1 Cycle I: Identified Challenges**

Several issues were identified during the first cycle:

1. **Time Management:** The LOC-R model consists of four sequential stages—literacy, orientation, collaboration, and reflection. Model lecturer LN noted that without careful planning, time management became a significant hurdle, negatively impacting the learning flow.
2. **Literacy Stage Implementation:** According to observer EM, students lacked foundational geographic literacy, particularly in identifying and classifying developed and developing countries on a map. The absence of supporting instructional materials further hindered comprehension.
3. **Student Discomfort:** Observer NT noted that many students felt uneasy due to the presence of multiple lecturers acting as observers, which impacted their confidence and focus during the lesson.
4. **Collaboration Challenges:** During the collaboration phase, students struggled with map-reading tasks and integrating geographical data with SDG components. Observer EM attributed this to weak geography literacy and suggested reinforcing map skills through guided practice and comprehensive materials.
5. **Geographic Literacy Gaps:** EM also observed that students lacked the critical thinking skills necessary to analyse SDG-related issues from a geographical perspective. Students struggled to connect spatial concepts with socio-economic indicators in different global regions.

### **3.2 Cycle II: Improvements and Enhancements**

Informed by the reflections from Cycle I, strategic improvements were implemented in Cycle II. The model lecturer introduced clear instructional guidance and encouraged students to explore resources using digital tools such as ChatGPT and Perplexity AI. These tools have been shown to enhance student productivity, engagement, and motivation in higher education settings (Bitzenbauer, 2023; Rasyitet et al., 2024; Yukadhirza & Muslem, 2023; Fauzi et al., 2023). However, successful integration of AI tools requires lecturer supervision to ensure alignment with learning objectives.

Additionally, the Banzo Technique, a visual learning method using blackboards, was employed to strengthen visual literacy. Though often underutilised, visual strategies like whiteboards support active learning, boost student confidence, and improve knowledge retention (Huicapi-Ocollantes et al., 2020; Willes, 2016).

### **3.3 Pedagogical Approaches Across LOC-R Stages**

Each stage of the LOC-R model contributed to enhancing students' geographic skills:

- **Orientation Stage:** Students engaged in interactive activities using images and Spinwheel media to match visuals with the 17 SDG goals. These activities promoted engagement and eased discomfort caused by the presence of observers.
- **Collaboration Stage:** The model lecturer offered structured guidance to support struggling student groups. Visual aids, such as tables and maps, helped students understand the spatial characteristics of developed and developing nations. This stage underscored the value of

instructor facilitation, consistent with Vygotsky's scaffolding theory, which suggests that teacher support helps students internalise complex concepts (Pasongli et al., 2022).

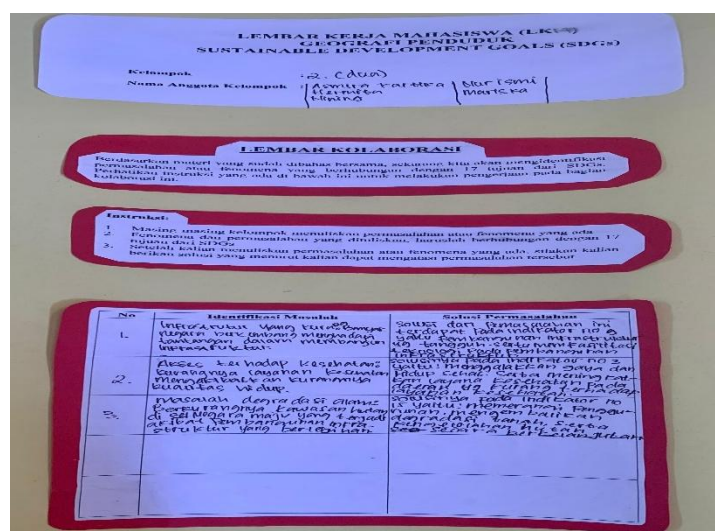
- Reflection Stage (LOC-R): Students reviewed their learning and connected it to real-world global challenges. Reflection facilitated critical thinking, enabling students to relate theoretical concepts to practical SDG applications.

These strategies resulted in improved student confidence, greater engagement, and deeper comprehension of geographic and sustainability issues. Spatial literacy development was emphasised through hands-on map activities, reinforcing the importance of spatial reasoning in geography education (Sugiono et al., 2022; Zahra et al., 2021).

### 3.4 Impact of LS-Based LOC-R Implementation

The combination of LS and LOC-R models proved effective in improving instructional quality and student learning outcomes. Reflection during LS allowed instructors to tailor their strategies based on observed student needs, such as providing visual aids to clarify the geographic locations of countries. Consequently, students demonstrated improved analytical and problem-solving abilities during Cycle II.

The integration of SDG content into classroom learning helped students think critically and develop holistic perspectives. Rather than relying solely on memorised information, students began synthesising knowledge to propose context-specific solutions. This aligns with previous research, which emphasises that action-oriented, interdisciplinary approaches in SDG education can strengthen student capacity to address global issues (Tarazé et al., 2022; Grindsted & Nielsen, 2021).



**Figure 2.** Results of Student Collaboration on SDGs contained in the LKPD

Observations during the implementation of the LOC-R learning model revealed an overall improvement in students' geographic literacy and critical thinking abilities. However, a notable limitation was identified: students struggled to deeply integrate the concepts discussed in earlier sessions—particularly the socio-economic disparities between developed and developing countries—with the broader framework of the Sustainable Development Goals (SDGs). This indicates a partial understanding of global challenges and their alignment with specific SDG targets such as poverty reduction, equitable education, and environmental sustainability.

As noted by Annur (2018), students must not only learn about sustainable development but internalize its principles to become responsible individuals capable of addressing shared global challenges. Without such integration, students may lack the critical insight needed to formulate meaningful responses to sustainability issues. Therefore, refining the LOC-R model to strengthen the

connection between geography content and SDG objectives is crucial. Doing so can better equip students to analyze the dynamics of global inequalities and propose context-specific strategies for addressing these issues at both national and international levels.

This challenge underscores the necessity of further reinforcing the link between geographic literacy and SDG-related content in subsequent lessons. Geography instruction must be rooted in contextual and real-world applications to ensure students can effectively apply theoretical concepts to pressing global issues (Prasetyo, 2019). In this regard, LOC-R serves not only as a pedagogical model but also as a strategic platform to enhance spatial literacy—particularly in distinguishing and analyzing the characteristics of developed and developing nations.

Lecturers play a vital role in facilitating this connection. By guiding students to contextualize geographic knowledge within the SDG framework, instructors can help transform theoretical understanding into practical competencies. This alignment not only fosters deeper engagement but also prepares students to become proactive contributors to global sustainability efforts.

#### 4. CONCLUSION

Based on observer reflections during the *See* stage, the implementation of the LOC-R learning model within the Lesson Study framework demonstrated significant positive outcomes. Students showed notable improvements in collaborative learning, comprehension of the material, and geographic literacy. The structured stages of LOC-R—Literacy, Orientation, Collaboration, and Reflection—effectively supported students in critically analysing problems, proposing solutions, and applying geographic concepts to real-world contexts. However, a key limitation identified was the insufficient integration of content between the first and second meetings, which hindered students from fully connecting foundational concepts to more advanced discussions. This suggests a need for more cohesive instructional design and continuity between learning sessions. Future research should explore strategies to strengthen content integration across LOC-R stages and examine the long-term impact of LS-based LOC-R learning on students' ability to apply geographic literacy to global sustainability challenges. Additionally, further studies could assess the model's adaptability across different subject areas and educational levels to broaden its applicability and effectiveness.

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