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Development of HOTS-Based Mathematics Module Integrating Lubuklinggau Tourism Context to Improve Students' Mathematical Literacy

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ABSTRACT

Mathematical literacy among university students remains low, partly due to the lack of contextualized teaching materials that support higher-order thinking skills (HOTS). This study aims to develop a HOTS-based mathematics module integrating the tourism context of Lubuklinggau to improve students' mathematical literacy. The study employed a research and development (R&D) approach using the 4-D model (Define, Design, Develop, Disseminate). Participants included first-semester PGSD students at Universitas PGRI Silampari, comprising 6 students in small group testing and 31 students in field testing. Instruments included expert validation forms, practicality questionnaires, and a mathematical literacy test. Data were analyzed using descriptive quantitative techniques. Validation results showed the module was considered valid (content: 80%, media: 80%, language: 89%). Practicality assessments from lecturers (87%) and students (97%) indicated the module was highly usable. The module effectively improved students' mathematical literacy, with an average score of 80.31%, classified as "very effective." All assessed indicators—communication, problem-solving strategies, mathematization, representation, and reasoning—achieved either effective or very effective categories. The integration of local tourism context within a HOTS framework offers a promising strategy to enhance students' engagement and comprehension. The developed module not only meets the criteria of validity, practicality, and effectiveness but also serves as a relevant instructional tool for supporting 21st-century skills in mathematics education.

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1. INTRODUCTION

Educational institutions at all levels, from elementary to higher education, are beginning to realign their curriculum structures and programs to meet contemporary demands. One of these efforts is the Student Literacy Movement (SLM), initiated by the Ministry of Education and Culture, which is designed to be applied and integrated within the learning process. Empirical findings reveal that Indonesian students' reading, science, and mathematical literacy remain relatively low and less developed compared to their peers in other nations (Durriyah & Zuhdi, 2018; Sari, 2018). This condition is reflected in the outcomes of international assessments such as PISA and PIRLS, where Indonesia consistently ranks below many other countries. In the PIRLS 2011 evaluation, Indonesia placed 45th out of 48 participating nations (IEA, 2012). Similarly, in the PISA assessment, Indonesia ranked 62nd among 70 countries, obtaining scores of 371 in reading (global average: 487), 379 in mathematics (global average: 489), and 396 in science (global average: 489) (OECD, 2018). Furthermore, in the 2015 TIMSS survey, Indonesia ranked 44th out of 49 countries for Grade IV students, with an average score of 397 compared to the international average of 500 (Amaliya & Fathurohman, 2022). These outcomes underscore the urgent need for suitable interventions in curriculum design, instructional approaches, and assessment methods especially within the domain of mathematics education (Bilad et al., 2024; Stacey, 2011; Wijaya et al., 2024).

Mathematical literacy is deemed sufficient when students are able to assess, reason, and articulate their understanding of mathematics clearly, while also being capable of solving complex problems that require higher-order thinking skills (HOTS) (Astuti, 2018; Habibi & Suparman, 2020). The application of HOTS problems is one technique to support the improvement of mathematical literacy quality (Wulandari et al., 2023). The implementation of HOTS in the learning process is crucial as it can affect the students' abilities and learning effectiveness, as well as relate to learning outcomes (Ramdiah et al., 2019). HOTS refers to students' ability to think at higher levels in Bloom's Taxonomy, focusing on the components of C4-analyzing, C5-evaluating, and C6-creating in problem-solving (Ichsan et al., 2019; Abdullah et al., 2015).

Basic mathematics is a compulsory course with a credit weight of 3 SKS. This course aims to enhance students' theoretical understanding and practical skills in applying concepts related to elementary school mathematics. For future elementary school teachers, understanding basic mathematics concepts is crucial to developing their ability to foster mathematical comprehension in their students. However, current data indicate that students' mathematical literacy remains relatively low (Hayati & Asmara, 2021). In practice, many students struggle with understanding the material in this course. They face difficulties in formulating, reasoning, and solving mathematical problems related to contextual issues.

Furthermore, there is no teaching material or module available that caters to the learning needs and characteristics of students. Several studies have pointed out the challenges students face in understanding the Basic Mathematics course. Alyusfitri & Wahyuni, (2017) found that students had difficulty grasping the concepts and procedures necessary to solve problems. Nurhikmayati (2017) observed students' struggles with using mathematical concepts and principles. Taufik (2023) highlighted difficulties in students' ability to apply facts, concepts, skills, and principles. One of the factors influencing students' learning difficulties is the lack of teaching materials that are tailored to their needs and characteristics (Yantoro, 2019; Dirgantoro, 2019; Gaol, 2022).

Students can be given HOTS-type problems to sharpen their higher-order thinking skills and improve mathematical literacy (Santoso & Setyaningsih, 2020). To enhance mathematical literacy, a teaching material product is created to facilitate more focused learning and deliver the right messages tepat (Ladyawati & Rahayu, 2021). One type of teaching material that can support students' learning needs is a module. Modules play an important role in developing 21st-century skills in mathematics education (Nesri & Kristanto, 2020). A module is a systematically organized teaching material designed for students to learn independently or self-contained, allowing them to manage their study time and understand the material at their own pace (Hernawan et al., 2012; Nurdyansyah & Mutala'liah, 2018). Modules are presented systematically as a standalone learning resource, aligned with students' competency mapping (Fitriani & Yerizon, 2024). Modules can easily adapt to assist the learning process by integrating HOTS-based problems. In module design, it can be adjusted to the students' local context, using local contexts as an initial step in mathematics learning.

Context in mathematical literacy is essential (Nugrahanto & Zuchdi, 2019), as it helps activate prior knowledge, connect it to existing problems, and formulate appropriate solutions based on the given context (Mahdiansyah & Rahmawati., 2014). In mathematics learning, context serves explicitly four functions: 1) concept formation; 2) model formation; 3) application; and 4) training specific skills (Wijaya, 2012). Context plays a crucial role at the beginning of the lesson and is presented in the form of problems (Gravemeijer & Doorman, 1999). The use of context can help develop thinking and modeling skills in solving mathematical problems (Sari & Noviartati, 2022). It can also be related to real-life activities (Lu Pien Cheng, 2013)that are familiar to students, such as the tourism context (Lisnani et al., 2025; Sukasno et al., 2024a; Utami et al., 2025).

In the city of Lubuklinggau, various contexts can be explored for their mathematical content, including geometry learning (Adha et al., 2024). These include the Grand Mosque of Taman Kurma, Watervang, and Bukit Sulap, which is considered the lungs of the city. To improve students' mathematical literacy, an alternative solution is required, such as designing an HOTS-based module using local tourism contexts to facilitate students' mathematical literacy skills. Previous studies on the development of HOTS-based teaching materials and mathematical literacy include research by Hidayat et al. (2023), which developed HOTS-based worksheets integrated with Islamic values to explore mathematical literacy skills, Kamid et al. (2021), who developed HOTS questions based on Jambi's culture, and Sulistyani & Deviana (2021), focusing on HOTS worksheets for primary school-level mathematics with a local wisdom orientation. Furthermore, Aristiyo et al. (2021) developed HOTS question instruments to support mathematical literacy skills, and Widiantari (2023) developed reading literacy teaching materials based on local wisdom to enhance HOTS. However, there has been limited research integrating HOTS-based teaching modules with local tourism contexts, such as the city of Lubuklinggau, to support students' mathematical literacy, with a focus on university students as the subject of research. This provides a novel contribution to higher education, particularly in linking local contexts with mathematics teaching and enriching mathematics teaching approaches based on relevant local contexts at the university level.

This study aims to develop an HOTS-based teaching module using the tourism context of Lubuklinggau to support students' mathematical literacy. The research question is: How can HOTS-based teaching materials using the tourism context of Lubuklinggau be developed to enhance mathematical literacy for first-semester PGSD students at Universitas PGRI Silampari, in terms of validity, practicality, and effectiveness?. The purpose of this study is to develop HOTS-based teaching materials using the tourism context of Lubuklinggau to improve students' mathematical literacy, which can be measured from three aspects: validity, practicality, and effectiveness. This research is expected to contribute to higher education, especially in developing interventions that link local context or local wisdom with mathematics teaching.

2. METHODS

This research was conducted from September to December 2024 with first-semester PGSD students at Universitas PGRI Silampari. This study uses a development research approach, which focuses on creating, designing, developing, and assessing the effectiveness of a product (Plomp, 2013). The sample selection used purposive sampling, considering the characteristics and problems relevant to the research objectives. A small group consisting of 6 students from class I-C, with heterogeneous abilities, was chosen, while a larger group of 31 students from class I-B was also selected. The module development procedure was adapted from the 4-D model of instructional material development, created by Thiagarajan, Dorothy S. Semmel, and Melvyn I (1974) (Trianto, 2015), which consists of four stages: define, design, develop, and disseminate.

The define stage begins with analyzing the purpose and scope of the material, which includes several key steps: a) initial and final analysis, aiming to identify the main issues in learning; b) task analysis; c) concept analysis; and d) specific learning objectives. The design stage consists of three steps: (1) test preparation, (2) selection of appropriate media to convey the lesson material, and (3) choosing the format, which includes needs mapping, module framework, and initial module design. The development stage includes: (1) validation by experts followed by revisions, (2) simulation, which involves operating the teaching plan, and (3) limited trials followed by actual trials with the students in the class. The Introduction section should also present the research method, which encompasses a detailed description of the research approach, the study participants, the procedures undertaken during the research, the materials and instruments utilized, as well as the techniques applied for data collection and analysis. The dissemination stage refers to the process of packaging a product that has been trialed, where the developed materials are expanded for use on a larger scale, such as in other classes, schools, or by different teachers (Trianto, 2010). In this stage, Thiagarajan divides the process into three steps: (a) validation testing, which involves testing the validity of the product, (b) packaging, which is the process of preparing the product to be used and understood effectively, and (c) diffusion and adoption, which refers to the spread and acceptance of the product across various users and contexts.

The research instruments include validation questionnaires for content, construction, and language, as well as questionnaires assessing the practicality of the module for both lecturers and students, and a learning achievement test containing indicators of mathematical literacy skills. The data collection techniques in this study involve three aspects: 1) Validity data of the module, obtained through expert validation, which is used to revise the first draft, 2) Practicality data, collected through practicality questionnaires to revise the second draft, 3) Effectiveness data, obtained through learning achievement tests containing mathematical literacy questions, used to evaluate the impact of the module on students' skill improvement, and the results are used to revise the third draft. The validity and practicality questionnaire data are based on a Likert scale: 5 = very suitable, 4 = suitable, 3 = moderately suitable, 2 = less suitable, 1 = unsuitable. Data analysis will use descriptive quantitative analysis.

The stages of validity and practicality data analysis conducted by van den Akker (2012) and (Hidayat & Linda (2023) include several important steps. First, the scores given by the validators or participants are compiled. Second, the average score for each criterion being assessed is calculated. Third, the overall average score across all criteria is determined. Fourth, the validity and practicality categories are established by matching the total average score with the predefined categories to determine how well the tested product meets the desired standards. "The validity of the instructional module material and its categories is outlined in Table 1.

Table 1. Validity Category

Validity Value (%)	Category
$80< V \leq 100$	Very valid
$60< V \leq 80$	Valid
$40< V \leq 60$	Quite valid
$20< V \leq 40$	Invalid
$0< V \leq 20$	Very invalid

(Hidayat & Linda, 2023)

The practicality of the instructional module material and its categories is outlined in Table 2.

Table 2. Practicality Category

Practicality Value (%)	Category
$80< P \leq 100$	Very Practical
$60< P \leq 80$	Practical
$40< P \leq 60$	Quite Practical
$20< P \leq 40$	Impractical
$0< P \leq 20$	Very Impractical

(Hidayat & Linda, 2023)

The analysis of effectiveness is conducted by utilizing a teaching module focused on HOTS in the context of tourism in Lubuklinggau, with the effectiveness indicators outlined by Kemp et al. (1994). Learning is deemed effective when the following conditions are met: (a) the students' average test score reaches a minimum of 70%; (b) the level of student activity alignment attains at least 60%; (c) there is a noticeable improvement trend in formative test results or student progress; (d) more than 50% of learners express positive responses toward the learning process; and (e) the teacher also gives favorable feedback regarding the implementation of the lesson. The effectiveness of the instructional module and its categories is evaluated in Table 3.

Table 3. Effectiveness Category

Effectiveness Value (%)	Category
$80< E \leq 100$	Very Effective
$60< E \leq 80$	Effective
$40< E \leq 60$	Quite Effective
$20< E \leq 40$	Effective
$0< E \leq 20$	Very Effective

(Hidayat & Linda, 2023)

3. FINDINGS AND DISCUSSION

3.1 Findings

The Define phase begins with an initial analysis that showed a lack of active student engagement, indicating the need for the development of an HOTS-based module with a tourism context. The Task Analysis phase focuses on analyzing the tasks students must master to achieve the specified competencies. Based on the curriculum emphasizing 21st-century skills, the teaching module must familiarize students with HOTS learning processes and highlight mathematical literacy. The required competencies include the ability to C4-analyze, C5-evaluate, and C6-create (Anderson et al., 2001). The tasks in this module emphasize HOTS-based learning with the context of Lubuklinggau's tourism, helping students understand topics such as sets and spatial geometry. The Concept Analysis phase organizes the developed content systematically. The learning concepts align with the initial analysis, student analysis, task analysis, curriculum, and the application of HOTS and mathematical literacy in the context of Lubuklinggau's tourism. These concepts are structured in a concept map illustrating the relationships between topics and their real-world applications. The specific course objectives are as follows: a) solving set operations, b) determining subsets, c) calculating the distance between two points, d) determining the distance from a point to a line, and e) calculating the distance from a point to a plane. The Design phase involves creating an initial module draft that aligns with the selected media and the format for structuring the teaching module. The initial design of the HOTS-based teaching module is as follows:

3.1.1 Cover

The cover of the teaching module includes the title, curriculum, used aspects, target class focus, and user identity (name, class, and program of study). The design of the module cover is as shown in Figure 1.

Figure 1. Cover

3.1.2 Concept Map Page

The concept map page contains the sections of the material presented in the developed teaching module. The appearance of the concept map is shown in Figure 2.

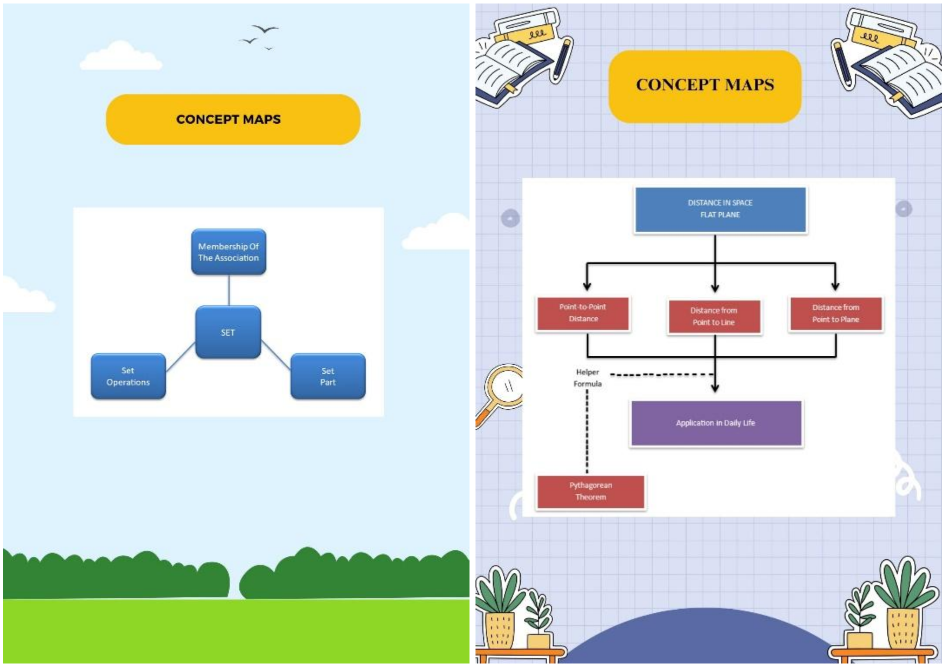

Figure 2. Concept Map Page

3.1.3 Learning Activities

This section provides an orientation to the initial problem related to the tourism context of Lubuklinggau City, allowing students to explore and construct their intuitive knowledge to discover the concepts to be learned. The appearance of the activity page is presented in Figure 3.

Figure 3. Learning Activities

3.1.4 Exercise

Next, students are given contextual activities emphasizing HOTS levels and literacy based on the tourism context of Lubuklinggau City, which must be completed in groups. These activities include exploration, collaboration, analysis, and evaluation of the given problems. The exercise page is shown in Figure 4.

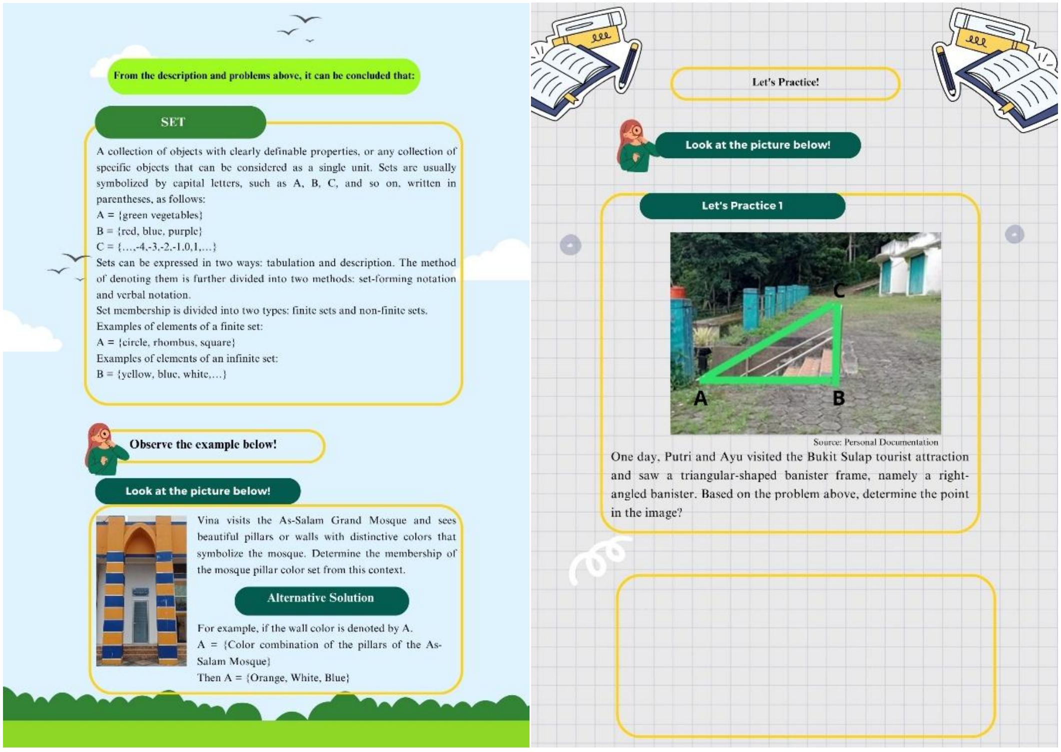

Figure 4. Exercise

Develop Phase: After the design process is completed, the design is evaluated and revised based on feedback from experts. Revisions include the requirement for reflection on student understanding after each activity. Additionally, images of tourist attractions in Lubuklinggau can be used to illustrate geometric shapes that students can observe, making the material more contextual and applicable. The development phase consists of validity, practicality, and effectiveness testing. The validation results from the experts are presented in Table 4.

Table 4. Summary of Results and Validity Categories

Validator	Validity (%)	Category
Material Validator	80 %	Valid
Media Validator	80%	Valid
Language Validator	89%	Very Valid

Table 4 shows the validation results from three validators for the developed module. The content validator rated the module at 80%, indicating that the material meets the established standards, though some aspects still require improvement. The media validator also gave a score of 80%, suggesting that the media used in the module is fairly effective but could still be refined. Meanwhile, the language validator provided the highest score of 89%, categorized as "Very Valid," indicating that the language used is clear, easy to understand, and adheres to the applicable guidelines. Overall, the validation results demonstrate that the module is valid, with certain areas in the content and media still needing improvement. Next, the results of the practicality evaluation from both the lecturers and students can be seen in Table 5.

Table 5. Summary of Results and Practicality Categories

Subject	Practicality (%)	Category
Lecturer	87 %	Very practical
Students (6 people)	97%	Very practical

Table 5 shows the practicality assessment results of the module provided by both the lecturers and students. The lecturers rated the module at 87%, placing it in the "Very Practical" category, indicating that the module is highly practical and easy to implement in the learning process. On the other hand, the assessment from 6 students yielded an even higher score of 97%, also categorized as "Very Practical," meaning the students found the module very easy to use and helpful in their learning process. Overall, these results suggest that the developed module is highly practical for both lecturers and students. The test results for the recap of students' literacy skills can be seen in **Table 6.**

Table 6. Summary of Mathematical Literacy Score Results

No	Indicator	Average (%)	Category
1	Communication	86.72	Very Effective
2	Formulating Strategies to Solve Problems	82.03	Very Effective
3	Mathematization	85.16	Very Effective
4	Representation	72.66	Effective
5	Reasoning and Argumentation	75	Effective
	Average	80.31	Very Effective

Table 6 presents a summary of the test scores for mathematical literacy based on the tested indicators. Overall, the results show that the students' mathematical literacy skills fall under the "Very Effective" category with an average score of 80.31%. The communication indicator received a score of 86.72%, indicating that students were highly effective in communicating mathematical ideas. The ability to formulate strategies to solve problems scored 82.03%, also categorized as very effective. Mathematical modeling skills were at 85.16%, showing high effectiveness in transforming problems into mathematical forms. However, the representation and reasoning/argumentation indicators scored lower, at 72.66% and 75%, respectively, yet still remain categorized as Effective. Overall, these results demonstrate that the developed module has successfully improved students' mathematical literacy.

In the dissemination phase, the HOTS-based teaching module, using the tourism context of Lubuklinggau City, was implemented with 32 students from semester I-C. The aim of this phase was to further develop and disseminate the learning product that had been tested, enabling its broader use by other faculty and students in different classes. The dissemination process followed three main steps as proposed by Thiagarajan (1974): validation testing, packaging, and diffusion and adoption. The tested module was evaluated to ensure its validity and effectiveness, after which it was packaged for easier use and finally disseminated to faculty and students in other classes to gather feedback and make adjustments. This process aims to make the module applicable on a larger scale for enhancing mathematical literacy in various educational contexts.

3.2 Findings

The development of educational materials must meet the criteria of validity, practicality, and effectiveness (Kristanto, 2018; Tobing et al., 2021). Educational materials are essential in the learning process, and integrating HOTS and character values can be facilitated through the development of teaching materials (Pratama & Retnawati, 2018; Sofiyan et al., 2020). This is in line with the Ministry of Education and Culture's recommendation, which integrates these aspects into the MBKM program for

HOTS development (Suwarma & Apriyani, 2022). Thus, the development of HOTS-based teaching modules using the tourism context of Lubuklinggau has become essential to provide students with the opportunity to enhance both their HOTS and mathematical literacy, addressing the demands of the educational world and globalization.

The validation results from content, media, and language experts show that the HOTS-based module using the Lubuklinggau tourism context meets validity criteria. This indicates that the module aligns with the standards for content, language, presentation, and graphics, making it ready for use (Karimah et al., 2020). Valid teaching materials can proceed to small group testing or practicality trials (Purwasi & Fitriyana, 2020; Khotimah et al., 2022).

The practicality results indicate that the module is easy to use, engaging, and efficient, with material organization fitting the learning needs (Nesri & Kristanto, 2020). The organization of the material is a critical element in facilitating student learning (Zhao & Sullivan, 2017). Once the practicality trial results in draft III, the module can be implemented in real classroom settings. When the students' assessment of the developed teaching materials is favorable, the module can move to the effectiveness phase in field trials (Sagala & Andriani, 2019).

Throughout the course, students were able to follow along with the HOTS-based module, assisted by the Lubuklinggau tourism context. This aligns with the idea that the developed module contributes to enhancing the knowledge, skills, and practices of teachers in teaching HOTS (Hamzah et al., 2022). Curriculum reforms and innovations in teaching and learning must continue to produce students who master HOTS well (Wah et al., 2024). HOTS are necessary to evaluate the quality of thinking and foster a positive attitude toward developing skills. In this regard, educators play a crucial role in developing integrated processes and tools that enhance HOTS (Heong et al., 2016; Sugiharti et al., 2024).

The final results show that the HOTS-based teaching module using the Lubuklinggau tourism context meets the criteria for validity, practicality, and effectiveness, which can facilitate students' mathematical literacy. The use of the tourism context facilitates student engagement and enhances understanding and retention of mathematical learning (Sukasno et al., 2024b). Integrating local wisdom contexts can positively influence and enhance mathematical literacy skills (Domu & Mangelep, 2023; Leton et al., 2025). Additionally, Susanta et al., (2022) showed that using the Bengkulu tourism context in teaching modules could support mathematical literacy skills. Similarly, Saragih et al., (2023) demonstrated that HOTS-based materials improve students' learning outcomes, while Zhenduo et al., (2024) highlighted the development of interdisciplinary HOTS teaching modules for first-year university students, which help students think critically, analyze, and solve problems. Dalifa et al. (2024) found that developed teaching modules significantly contribute to improving scientific literacy and higher-order thinking skills. Lastly, Suanto et al. (2023) showed that teaching materials involving concrete experiences, observations, conceptual abstractions, and experiments support HOTS and mathematical learning motivation.

4. CONCLUSION

This research shows that the HOTS-based teaching module using the tourism context of Lubuklinggau successfully enhanced students' mathematical literacy. The validation results indicate that the module meets the validity criteria. The practicality assessment by both lecturers and students shows that the module is very practical and easy to implement in the learning process. Additionally, the test results indicate an improvement in students' mathematical literacy, with an average score of 80.31%, categorized as very effective. This study provides an important contribution to the development of HOTS-based teaching materials that are relevant to local contexts, which can be widely applied to enhance mathematical literacy in various educational settings. Future research could develop HOTS-based teaching modules with other local contexts to expand their application across different regions. Additionally, research could explore the integration of other contexts, such as local wisdom and culture, into teaching modules to enhance higher-order thinking and students' mathematical literacy. Broader trials, including at various universities, are also needed to assess the effectiveness of the module on a larger and more diverse scale.

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