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The Implementation of Glocalization Learning Using *Mayang Rontek* Dance from Mojokerto to Improve Students' Science Literacy

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ABSTRACT

This study investigates the implementation of glocalization learning using the *Mayang Rontek* Dance of Mojokerto to improve junior high school students' scientific literacy. The novelty of this research lies in applying a glocalized ethnoscience approach through *the Mayang Rontek* Dance beyond its original cultural setting. A pre-experimental one-group pretest–posttest design was employed involving 45 students. Data were collected through validation sheets, observation sheets, scientific literacy tests, and student response questionnaires, and analyzed using descriptive statistics, a paired-samples t-test, and N-gain analysis. The results showed that the teaching modules and instructional materials were highly feasible, with most validation aspects scoring above 90%, although the student worksheet (LKPD) component obtained the lowest score (75%). The implementation of the glocalization learning model was categorized as very good. Statistical analysis revealed a significant improvement in students' scientific literacy skills ($t = 4.993$, $p < 0.001$), with the mean score increasing from 48 on the pretest to 70 on the posttest and an N-gain value of 0.42 (moderate category). The greatest improvement occurred in students' ability to evaluate scientific information and make decisions based on credible evidence. Student responses were highly positive, particularly regarding the systematic presentation (97.78%) and clarity of illustrations (95.56%). These findings indicate that *Mayang Rontek* Dance-based glocalization learning is feasible and effective for enhancing scientific literacy while supporting local cultural preservation.

INTRODUCTION

Science literacy plays a crucial role in 21st-century education because it helps students develop critical thinking, problem-solving, and evidence-based decision-making skills in their daily lives. Developing students' abilities in science and technology through science education is essential to equip them with 21st-century skills, such as the ability to face challenges, make the right decisions, and adapt to global life (Aquino et al., 2025). Growing awareness of the importance of science education and literacy underscores the need to equip students with the skills relevant to the challenges and complexities of the 21st century (Hadiastriani & Djarot, 2024). In addition, training students' critical thinking skills is equally important, as these skills are needed to solve everyday problems and are in line with curriculum requirements that emphasize analytical,

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evaluative, and reflective thinking skills, even though in reality these skills are still relatively low among students (Auliya & Muchlis, 2024). Science literacy, which encompasses interdisciplinary understanding and active participation in science and technology issues, requires students to have critical thinking skills, as these abilities are necessary for interpreting information, analyzing data, and evaluating various perspectives in complex scientific contexts. Science literacy is the ability to understand and apply various interdisciplinary scientific concepts and practices, while also encouraging active participation in science, technology, and sustainability issues relevant to everyday life (Aquino et al., 2025). Science literacy also includes the ability to actively participate in discussions on issues of sustainability, science, and technology that are developing in society (OECD, 2023a). However, various studies show that students' science literacy levels at various levels of education are still relatively low, which has an impact on their lack of readiness to face global challenges. Although Indonesia's ranking in science literacy improved in PISA 2022, the average student score actually decreased by 13 points, reflecting the still low level of science literacy in Indonesia and the impact of the pandemic, which also affected these achievements (Apriliana & Anggrella, 2024). The 2022 PISA results show that Indonesian students' literacy achievements remain below international standards in mathematics, reading, and science, thus underscoring the need to strengthen scientific literacy through the application of appropriate learning methods and teacher capacity building (OECD, 2023b). This situation calls for strategic efforts to improve science literacy through relevant and contextual learning approaches.

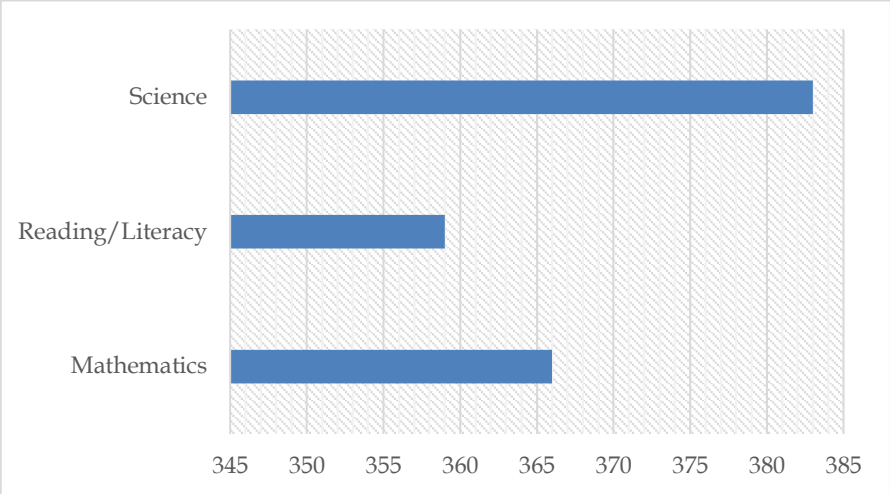

Figure 1. PISA results for Indonesia for the 2022 period.

Science literacy comes from the combination of the words literatus, meaning literate or educated, and scientia, meaning knowledge; thus, in terms of terminology, science literacy refers to the ability of an educated person to understand and use scientific knowledge (Echols & Shadily, 2003). Science literacy can also be understood as a person's ability to discuss and evaluate issues related to scientific concepts and challenges in life, enabling individuals to become critical and reflective citizens (OECD, 2017). The term "science" in English means knowledge, while according to PISA, initiated by the OECD, science literacy is an individual's ability to apply scientific knowledge and skills to answer questions, discover new information, explain phenomena, and draw conclusions from data that impact the intellectual, material, and cultural environment in the context of science and technology (OECD, 2013). The PISA 2025 Framework, which is a revision of the PISA 2024 Framework and was released after changes at the end of 2022, differs from previous revisions in its emphasis on decision-making and action to measure the ability of 15-year-old students to apply their knowledge, awareness, and proactive actions to environmental issues as a result of the science education they have received (White et al., 2023; Deta et al., 2024). In the context of glocalization, which increasingly influences social and cultural

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life, the development of scientific literacy needs to be integrated with the preservation of local identity. Therefore, the *Mayang Rontek* Dance, as a cultural heritage of Mojokerto, provides a relevant context for connecting scientific conceptual understanding with cultural awareness, enabling students not only to evaluate scientific information but also to apply it to address global challenges without losing local values.

Tabel 1. Science literacy indicators from aspects developed from PISA 2025 (OECD, 2023b)

No	Indicator	Aspect
1	Recognizing natural phenomena and technological phenomena	Explaining phenomena scientifically.
2	Compiling explanations about natural and technological phenomena.	
3	Applying and evaluating explanations of natural phenomena and phenomena related to technology.	
4	Assess and evaluate ways of investigating questions scientifically.	Constructing and evaluating designs for scientific investigations and interpreting scientific data and evidence.
5	Interpret and critically evaluate scientific data.	
6	Get scientific information about global, local, or group-specific science issues.	Research, evaluate, and use scientific information for decision making.
7	Evaluate the credibility of scientific information on global, local, or group-specific science-related issues.	
8	Evaluate the weaknesses, potentials, and applications of information in decision making.	

Character and cultural education in the curriculum plays an important role in shaping a generation that is knowledgeable, has good character, and is able to think critically and solve problems, thereby supporting the strengthening of science literacy and preparing students to face the challenges of the future (Iskandar et al., 2022). The implementation of character education integrated with subjects, including science, enables students to not only understand scientific concepts but also relate them to moral and social values in everyday life. Indonesia's social and cultural diversity and geographical conditions require adaptive educational policies, as students' backgrounds and environments not only influence the quality of educational services but also have the potential to pose moral and character challenges. Therefore, an educational approach such as ethnoscience becomes a strategic solution for internalizing local cultural values while developing 21st-century competencies in a contextual and relevant manner (Fahrudin et al., 2023). By linking learning materials to the local cultural context, students can more easily understand the material and at the same time foster a sense of pride in their cultural identity. The relevance of science education can be improved through innovative curricula and exploratory learning strategies based on real-life contexts, traditional knowledge, and technology, in order to foster curiosity, analytical thinking, and student motivation to learn in understanding science as part of their reality (Yazidi & Rijal, 2024). This approach also encourages students to actively engage in the learning process, which ultimately improves their learning outcomes and prepares them for an ever-changing world.

Glocalization in education is a concept that combines global values with local wisdom to create a contextual and meaningful learning process. One form of knowledge and values that grows from the experiences and interactions of a community within a specific cultural context, reflecting the wise ways of thinking, acting, and behaving of humans in accordance with their social environment and living space, can be referred to as local wisdom (Suprapto et al., 2022). The concept of glocalization in the book written by Suprapto and Santoso (2024) is an illustration of the fusion of global and local values through a process of mutual adaptation, in which global standards are adjusted to the local cultural context to create harmony in facing global pressures while maintaining local identity. This approach enables students to understand global issues

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while remaining rooted in their culture and surroundings. The principle of "think globally, act locally" underscores the importance of integrating local wisdom into education that aligns with global developments, making the concept of glocalization a strategic approach to support cultural preservation while advancing the quality of learning (Suprapto et al., 2022). The integration of local wisdom into learning has been proven to increase student engagement because the material feels more relevant and closer to their lives. The integration of local wisdom in science education provides opportunities for students to learn scientific concepts through familiar cultures and environments, while bridging local and global knowledge and enriching scientific understanding through a multidisciplinary approach (Suprapto & Santoso, 2024). Glocalization-based learning also encourages the development of critical thinking and problem-solving skills through the processing of information from various perspectives. In addition, this approach is highly relevant in improving science literacy because it places science in a social and cultural context that is real to students. According to Deta (2024) the concept of glocalization, through the stages of identifying local phenomena with global nuances to scientific reflection, plays an important role in developing students' science literacy by connecting local cultural knowledge to the scientific process, which includes understanding concepts, investigation, data analysis, decision making, and science-based evaluation.

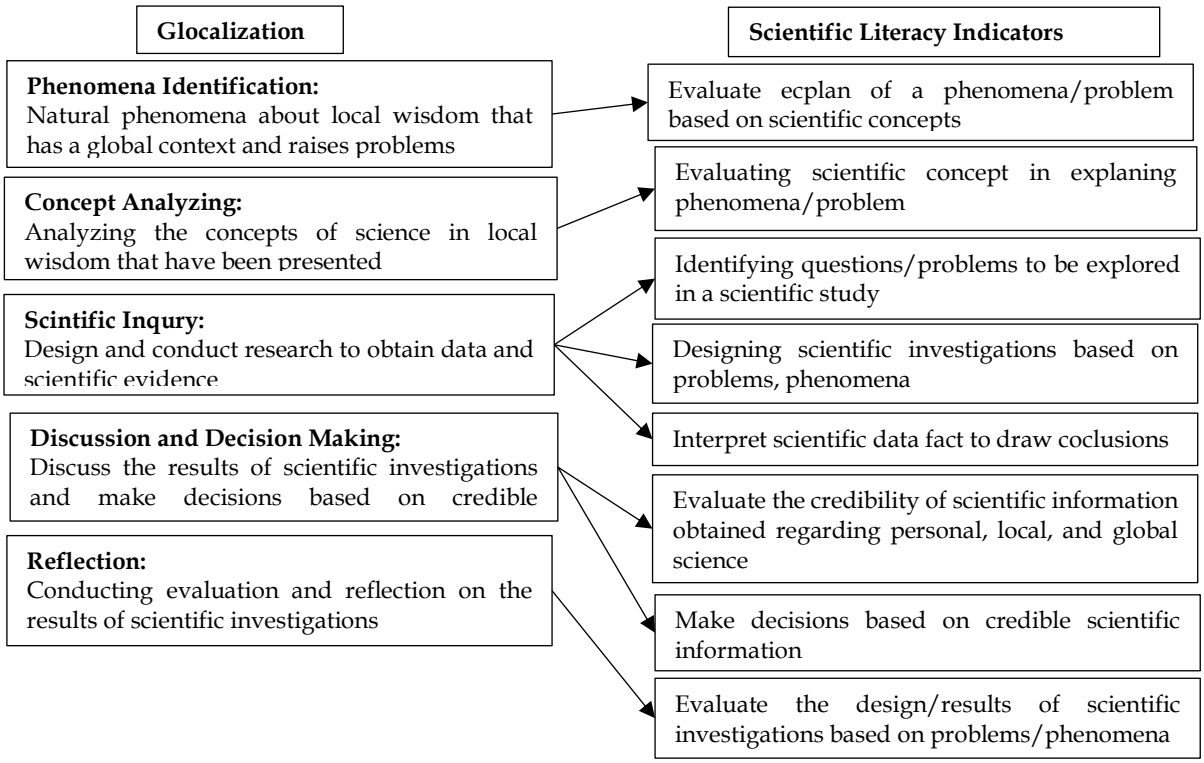

Figure 2. The relationship between the glocalization model and scientific literacy (Deta, 2024)

The glocalization model is systematically linked to the development of students' science literacy. In the phenomenon identification phase, students evaluate phenomena or problems rooted in local wisdom that have global relevance using scientific concepts (Deta, 2024). Next, in the concept analysis stage, students analyze and evaluate the scientific concepts underlying these phenomena (Deta, 2024). The scientific inquiry stage enables students to identify research questions, design investigations, and interpret scientific data and evidence to draw valid conclusions (Deta, 2024). During the discussion and decision-making stage, students evaluate the credibility of scientific information drawn from personal, local, and global perspectives, and then use this information as the basis for making responsible decisions (Deta, 2024). Finally, the reflection stage encourages students to evaluate both the design and results of the research they

have conducted so that they can critically assess the strengths and limitations of the scientific process (Deta, 2024). Thus, each component of the glocalization model directly supports the comprehensive development of science literacy competencies, ranging from understanding phenomena to evidence-based decision-making.

Mayang Rontek Dance is a traditional cultural art from Mojokerto, created by Setu in 1995, which combines distinctive movements, sounds, and symbolic meanings and has evolved from a complementary dance in the *bedhol manten* procession into an important element of various ceremonial and social activities (Safitri & Rahayu, 2024). *Mayang Rontek* Dance is a traditional folk dance that symbolizes prayers and hopes, represented through the twin *mayang* motif in the form of floral tassels (*rontek*) used in wedding ceremonies (Agustin & Hadi, 2019). This dance not only reflects local identity, but also has great potential as a contextual learning medium that can link science material to students' real lives. In classroom activities, students observe and perform the *Mayang Rontek* dance while investigating the vibrations produced by movements and traditional musical instruments, enabling them to construct scientific understanding of sound, vibration, and energy within a meaningful local cultural context. The body, as the primary instrument in dance, plays a crucial role in forming the basic elements of movement, which are then systematically arranged into motifs, sequences, and ultimately a complete movement pattern that constitutes a meaningful dance piece (Safitri & Rahayu, 2024). The *Mayang Rontek* dance music that accompanied the welcoming ceremony for the Mojokerto Resort Police Chief in 2024 combined East Javanese *slendro gamelan* and *terbang* musical instruments as a reflection of a strong local cultural identity with Islamic nuances, creating musical harmony that fostered dynamic movement in the social context of the community (Safitri & Rahayu, 2024). Thus, the use of *Mayang Rontek* dance in science education can improve understanding of scientific concepts while fostering appreciation for local culture.

In research that integrates science learning with local culture, innovation is still needed to optimally improve students' scientific literacy. Research conducted by Kamila (2024) shows that the integration of local wisdom contributes significantly to learning outcomes, conceptual understanding, and 21st-century skills, such as critical thinking and problem-solving. However, the aspect of scientific literacy has not been a primary focus in this research. Furthermore, most science education approaches are still general and do not optimally utilize local culture as a contextual learning resource that can teach scientific knowledge with students' real-life experiences. Learning that integrates local potential is also rarely implemented, even though this approach can facilitate students' understanding of the material due to its connection to objects or phenomena they encounter in everyday life (Manalu & Suhartini, 2023). On the other hand, the global education system is pushed to strengthen its foundations with an emphasis on mastering the skills, knowledge, and attitudes necessary to face 21st-century challenges (Martinez, 2022). Therefore, integrating local potential with a global perspective through a glocalization approach is crucial to ensure that learning is relevant to the needs of students with diverse social, environmental, economic, and cultural backgrounds (Manalu & Suhartini, 2023). However, research integrating local culture into a glocalization framework to develop scientific literacy is still limited, particularly those utilizing traditional arts as a learning context. To fill this gap, this study implements a glocalization approach based on the *Mayang Rontek* Mojokerto Dance as an ethnoscience context that connects local culture with scientific concepts and global issues. This approach is expected to not only strengthen students' scientific literacy but also support the preservation of local cultural through meaningful learning experiences. The large student population in Indonesia living in a culturally diverse environment also provides strategic opportunities to develop educational innovations based on local wisdom that are valid, relevant, and appropriate to student (Suprapto, 2018).

The trend of Ethnoscience in Physics Learning (EPL) research publications shows an annual increase with a significant increase since 2000 and reaching a peak in 2021 (Sunarti et al., 2024), indicating increasing attention to the integration of local culture in physics learning. In line with the Independent Curriculum in Indonesia, the ethnoscience approach also has strong potential to

be implemented in entrepreneurship learning as a pedagogical opportunity for educators, as conveyed by Suprapto et al. (2024) through ethnopedagogy-based entrepreneurship learning that integrates the introduction of agricultural tools, cultural participation, and production and bazaar activities in the classroom. Another study by Nurroniah et al. (2023) strengthens these findings by showing that ethnoscience-based physics learning through the Lahbako Dance augmented reality media is effective and valid in improving scientific literacy and student learning interest using the ADDIE development model. This finding is in line with Alhusni et al. (2025) who emphasized that physics learning based on scientific literacy with a glocalization approach through the Boranan Dance is able to help students understand the concept of rigid body equilibrium in a contextual and meaningful manner, thus emphasizing the relevance and urgency of developing ethnoscience-based physics learning in the context of Indonesian education.

This study aims to implement globalization learning based on *Mayang Rontek* traditional art to improve the science literacy skills of students at SMP Negeri 1 Kesamben Jombang. The research subjects were taken from the Jombang area, because although the *Mayang Rontek* dance originated in Mojokerto, according to Agustin and Hadi (2019), this art form is a fusion of Jombang, Surabaya, and Malang styles, with adaptations from the *Remo* Jombang movements, such as the shawl hand movements (*iket*), which were developed into *tumpang tali* jombangan movements and adjusted in volume to suit the character of the princess dance. The novelty of this research lies in the application of ethnoscience learning with a glocalization model through the *Mayang Rontek* dance media from Mojokerto which is implemented across its cultural origin regions, an approach that has not been widely studied and has not been explicitly applied in previous ethnoscience research. Through this approach, it is hoped that students can understand science concepts, particularly those related to motion and force, in a more contextual and meaningful way. Additionally, the globalization learning process is expected to foster appreciation for local culture while also enhancing students' scientific literacy skills.

RESEARCH METHOD

This study used a pre-experimental design with a one-group pretest-posttest method. According to Sugiyono (2023), the reason for using this design and method is because randomization and full control of external variables are not possible in a real classroom setting, so bias is minimized through the use of control groups, initial ability measurements (pretests), and equalization of materials, learning duration, and research instruments across all groups. The experimental research method was chosen to obtain more accurate results through a comparison of conditions before and after treatment, so that the impact of the treatment can be measured objectively (Narlan et al., 2023).

Table 2. Pre-Experimental research design with one-group pretest-posttest method

Pretest	Treatment	Postest
O_1	X	O_2

This research design was used to measure the effect of *Mayang Rontek* dance-based glocalization learning on students' science literacy skills. This study used a purposive sampling method by selecting 45 eighth grade students who served as OSIS administrators at SMP Negeri 1 Kesamben, because they met specific criteria relevant to the research objectives and were able to participate in all research activities (Opara et al., 2024)

When designing lessons, teachers need to prepare detailed lesson plans so that lessons are conducted in a focused and systematic manner, minimizing confusion during the process (Sinaga & Lahindah, 2024). This assessment uses a rating scale method with a score range of 1 to 4 as the basis for decision-making based on the scores obtained. The rating scale model, as explained by Knoch (2021), plays an important role in improving the accuracy of assessment results, the consistency of assessors, and assisting scale developers in making appropriate decisions when designing assessment instruments. The validity of the instrument content was tested through

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expert judgment by three validators, with data analyzed using the average percentage score of each indicator from all validators, then classified into the categories of very poor, poor, sufficient, good, and very good based on the percentage interval of suitability. The results of the validation assessment of the Glocalization learning model developed by Deta (2024) below serve as the reference used by the author in applying the model.

Table 3. Aspects and description of teaching module validation

No	Description	Aspects
1.	Completeness and clarity of the identity of the teaching module (title, class, basic competencies, etc.)	General information
2.	The suitability of learning objectives with the competencies to be achieved.	Learning objectives
3.	Suitability of learning methods and approaches with ethnoscience.	Use of learning methods (approaches, strategies, and creativity)
4.	Suitability of the sequence of science learning activities in the Glocalization model.	
5.	The suitability of the description of student and teacher activities for each stage of learning with the Physics learning activities of the Glocalization model.	
6.	Clarity of learning scenarios (stages of learning activities; beginning, core, closing)	
7.	Suitability of assessment instruments with scientific literacy indicators.	Assessment
8.	Use of language that is clear, systematic, and in accordance with writing rules.	Language and presentation.
9.	The language used is communicative and the sentence structure is simple.	
10.	Suitability of allocation used in learning	Time used

Table 4. Aspects and description of teaching material validation

No	Rated aspect	Description
1.	Description of teaching materials	Clarity and completeness of explanations regarding the teaching materials used.
2.	Instructions for using teaching materials.	Understandability and clarity of instructions for using teaching materials for students.
3.	Learning objectives.	The suitability of learning objectives with the competencies to be achieved and the material presented.
4.	Concept maps.	Clarity, integration, and relevance of concept maps to the material presented.
5.	Science literacy	Presentation of indicators that are in accordance with the latest scientific literacy competencies.
6.	Depth of teaching materials.	Accuracy, completeness, and clarity of presentation of material related to movement and style in the *Mayang Rontek* dance.
7.	Application of technology.	Utilization of technology to obtain learning materials.
8.	Student worksheet (LKPD)	The suitability, completeness, and clarity of the LKPD used to deepen understanding of the material.
9.	Assessment.	The suitability and clarity of the assessment instruments used in measuring scientific literacy skills.
10.	Language and presentation	Use of language that is communicative, clear, and in accordance with good language rules.
11.	Integration of teaching material content	Consistency and connectedness between all components of the teaching materials.
12.	Illustration view	Use of clear illustrations that do not bias students outside the learning topic.

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In lesson planning, teachers are required to prepare a Lesson Plan (RPP) that contains details of the learning process so that when the learning process takes place, teachers can carry out the lesson in a structured and effective manner without confusion (Sinaga & Lahindah, 2024). This assessment uses a checklist method with a check mark (√) to measure whether each aspect being assessed has been implemented or not. The checklist method was chosen because it is in line with research by Ngadiman (2023) which found that checklists are effective for novice software developers, as they help those with limited knowledge of evidence-based principles to understand and develop educational applications in a more focused manner. The following are the assessment aspects of the Glocalization or Glocal Wisdom learning model developed by Deta (2024) and used by the author.

Table 5. Aspects of the implementation of glocalization learning are assessed

No	Description	Assessment aspects
1.	The teacher opens the lesson with greetings and greetings.	Learning activities: Opening
2.	The teacher invites students to pray before studying.	
3.	The teacher checks the students' attendance and readiness to follow the lesson.	
4.	The teacher conveys the learning objectives	
5.	Phase 1. Phenomena Identification: The teacher provides contextual images regarding the concept of object motion and force that are related to local wisdom	Learning activities: Core activities
6.	Phase 2. Concept Analysis: The teacher provides an opportunity for students to ask questions.	
7.	Phase 3. Scientific Inquiry: The teacher instructs each student to form groups of 6 people per group to discuss.	
8.	The teacher distributes the *Mayang Rontek* Dance Student Activity Sheet containing contextual problems.	
9.	The teacher provides directions for completing the Mayang Rontek Dance Student Activity Sheet.	
10.	The teacher monitors each group in completing the *Mayang Rontek* Dance Student Activity Sheet.	
11.	Phase 4. Discussion and Decision Making: The teacher asks each group to prepare the results of the discussion briefly, concisely, and clearly.	
12.	The teacher determines the groups that advance randomly using a random spinner on the website.	
13.	The teacher invites the selected groups to present the results of their group work.	
14.	The teacher encourages active Q&A on the presentations delivered by the selected group.	
15.	The teacher explains the solution to the LKPD problem on the motion of objects and forces and corrects students' misconceptions and provides reinforcement.	
16.	Phase 5. Reflection: The teacher provides a conclusion in understanding the LKPD on the motion of objects and forces, and gives rewards to those presenting and students who are active during learning activities.	
17.	The teacher closes the learning with a prayer and then says hello before leaving the class.	Learning activities: Closing
18.	Learning arrangement: Utilization of media and learning resources	
19.	Classroom discipline arrangement	Other aspects of activities

No	Description	Assessment aspects
20.	Assessing/evaluating learning: Conducting process assessments	
21.	Conducting outcome assessments	
22.	Quality of Student Learning Interactions with Teachers: Providing Opportunities to Ask Questions	
23.	Providing opportunities to get advice in learning	
24.	Building trust, listening, and providing support to students	
25.	Responding to the needs and learning styles of individual students	

The research instrument was a science literacy test consisting of 15 questions, including 10 multiple choice questions and 5 descriptive questions, which were compiled based on the latest science literacy indicators. The independent variable in this study was globalization-based learning, while the dependent variable was science literacy, measured before and after the intervention to determine the changes that occurred. The results of the students' scientific literacy test answers were then analyzed using prerequisite tests such the required statistical analysis.

Data analysis began with a normality test using the Kolmogorov–Smirnov test to determine whether the pretest and posttest data were normally distributed (Ahadi & Zain, 2023). The results of the normality test were then used to determine the type of hypothesis test to be used. If the data were normally distributed, the analysis continued with a paired-samples t-test to determine the significance of differences in students' scientific literacy abilities before and after learning (Montolalu & Langi, 2018). Conversely, if the data were not normally distributed, the Wilcoxon Signed-Rank test was used as a nonparametric alternative (Montolalu & Langi, 2018). After obtaining the results of the difference test, the increase in students' scientific literacy abilities was analyzed using the N-Gain score to measure the relative change between pretest and posttest scores (Sukarelawan et al., 2024).

Table 6. N-gain score (Hariadi, 2021)

Criteria	Score
high	$(g \geq 0.7)$
medium	$(0.3 < g < 0.7)$
low	$(g < 0.3)$

Furthermore, learning effectiveness was interpreted based on the N-Gain categories obtained, the significance of differences in learning outcomes, and the level of students' scientific literacy abilities according to the criteria proposed by Prahani et al. (2020). Responsive data on student needs is also needed to determine teachers' ability to adapt learning strategies to individual learning styles and respond to and meet each student's learning needs (Putri et al., 2024). To realize this, the adaptation of the questionnaire according to Basaruddin and Mustafa (2023) by using a checklist in material analysis helps teachers identify weaknesses and adjust the material to suit the needs and differences of students, thereby creating a more effective learning experience.

Table 7. Aspects and student response questions

No	Question	Assessment aspects
1	Can you understand the learning objectives contained in this teaching material?	Content criteria
2	Do you have difficulty understanding the material contained in this teaching material?	
3	Can you answer the questions presented in the teaching material?	
4	Can the material presented help you be more active in learning?	

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No	Question	Assessment aspects
5	Can you predict the content of the material if you look at the front page (cover) of this teaching material?	Presentation criteria
6	Are the materials, images, and videos presented in this teaching material boring to study?	
7	Is the material presented in the teaching material coherent, concise, and clear?	
8	Are the illustrations/images in the teaching material coherent, concise, and clear?	
9	Can the illustrations/images in this teaching material help you understand the material?	
10	Is the text layout presented systematically?	
11	Does the language used in the teaching materials violate the Indonesian EYD?	Language criteria
12	Can you understand the language used in this teaching material?	
13	Is the language used in this teaching material in accordance with your thinking ability?	
14	Do you get clear information after reading this teaching material?	
15	Does the color combination used in this teaching material reduce your interest?	Graphical criteria
16	Can you clearly read every word in the teaching material?	
17	Can you clearly see the illustrations/pictures in the teaching material?	
18	Can you explain phenomena scientifically?	Criteria for scientific literacy competency aspects
19	Can you build and evaluate designs for scientific investigations and interpret scientific data and evidence?	
20	Do you have difficulty in researching, evaluating, and using scientific information for decision making?	

RESULTS AND DISCUSSION

Analysis of the Results from Observations Research of *Mayang Rontek* Dance

The analysis of the observations of *Mayang Rontek* dance art uses interviews to collect data. Interviews in ethnographic research are a method of data collection conducted through direct conversation between the researcher and informants, either face-to-face or through communication media, with the aim of obtaining in-depth and targeted information in accordance with the interview guidelines (Manan, 2021). The type of interview chosen was a structured interview to identify the sources of information to be researched. A structured interview is a commonly used data collection method in quantitative research, where the researcher reads out pre-prepared questions from an interview guide without improvisation, while the respondent answers according to the available options. This process involves minimal interaction, is highly controlled, inflexible, and aims to systematically explain a phenomenon (Manan, 2021).

Based on an interview with Setu, the originator of the *Mayang Rontek* Dance in Mojokerto (personal communication, May 30, 2025), this dance contains a philosophical meaning about the journey of human life, especially the transition from adolescence to family life, which is necessary in the Mojoputri wedding tradition and the cultural values of the Mojokerto people. The *Mayang Rontek* Dance combines movements, music, costumes, and accessories typical of Mojokerto as a means of conveying moral messages and preserving local culture that remains relevant and receives support from the community amidst the current of globalization (Setu, personal communication, May 30, 2025). Setu (personal communication, May 30, 2025) emphasized that the *Mayang Rontek* Dance is highly suitable for integration into learning because it can train precision, concentration, and self-control through mastery of rhythm and tempo of movement.

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In addition to serving as a means of cultural preservation, this dance also has links to scientific concepts, such as body coordination, sensory responses, and the development of systematic thinking patterns. Therefore, the integration of the *Mayang Rontek* Dance in education is considered to support the development of character and competency of students, as long as it is implemented consistently without eliminating the cultural values contained within.

Figure 3. Analysis of the displacement of the *Mayang Rontek* dancer's movements

Figure 4. Analysis of the *Mayang Rontek* dancer's style

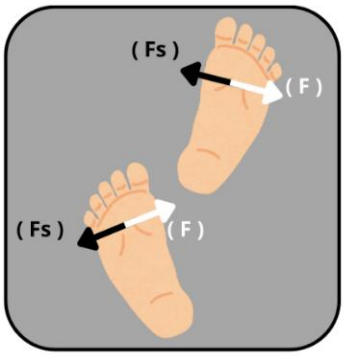

Figure 5. The *Mayang Rontek* dancer's foot swiping style

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Figure 6. Analysis of the total style of *Mayang Rontek* dancers

Figure 7. Analysis of Newton's third law of dance by the *Mayang Rontek* Dancer

Based on the analysis of the *Mayang Rontek* Dance movement in Figure 3, the dancer performs a horizontal position shift (Δx) with a certain path length (s) which indicates the concept of translational motion, while in Figure 4 the body rotation and orientation changes at each stage of the movement (1–4) illustrate the rotational motion produced by the force (F) and foot support (F_s). During the movement, the feet act as a fulcrum that produces frictional forces and floor reaction forces in Figure 5 so that the body remains stable when moving, rotating, or changing direction. From a mechanical perspective, the still condition at the beginning of the movement indicates a resultant force ($\sum F = 0$) (ΣF = 0) which occurs in Figure 6, while when the dancer moves to the right or left, a non-zero resultant force applies ($\sum F = m.a$) which causes acceleration and changes in position. In addition, the interaction between the action force of the feet on the ground and the reaction force of the ground on the feet in Figure 7 in accordance with Newton's Third Law allows the dancer to maintain balance while producing controlled movements. So overall, the *Mayang Rontek* Dance not only contains aesthetic value, but also represents physics concepts such as displacement, trajectory, force, friction, balance, rotation, and Newton's laws which can be used as a context for local culture-based science learning.

Analysis of the Results from Validation of Glocalization Learning Tools

Based on the results of the teaching module validation, it can be concluded that overall, the module has a very good level of feasibility, with most aspects scoring above 90%. The most notable aspect is the alignment of learning objectives with the competencies to be achieved, which scored perfectly (100%), indicating that the learning objectives are highly relevant to the learning outcomes. This aligns with the statement by Clark & Hsu (2023) that learning objectives and goals play a crucial role in curriculum design, assessment, and learning. Additionally, aspects such as the completeness of the module's identity, the use of ethnoscience-based learning methods, and

the clear and systematic use of language also received high scores (91.67%). However, there are several aspects that still require attention, such as the clarity of the learning scenarios, the alignment of assessment instruments with science literacy indicators, and the communicative style of language, each of which received a score of 83.33%. This indicates that while the teaching module is suitable for use, further refinement is needed in certain areas to achieve optimal quality.

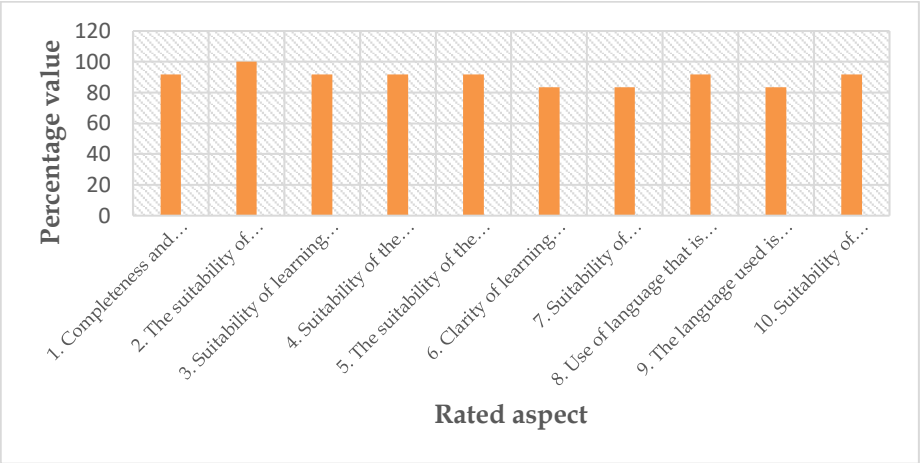

Figure 8. Teaching module validation results

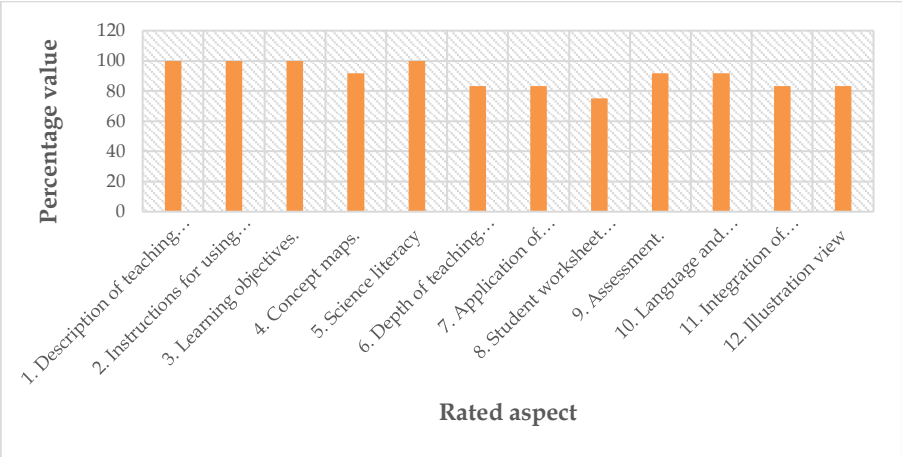

Figure 9. Teaching material validation results

The results of the teaching material validation show that, in general, the teaching materials have been compiled with excellent quality, as indicated by perfect scores (100%) in several important aspects such as teaching material descriptions, usage instructions, learning objectives, and science literacy. In line with Junaedi (2022) opinion that teaching material modules must contain explicit and specific instructional objectives and complete instructions for teachers so that the learning process can be carried out efficiently, purposefully, and easily understood by students. This reflects that the teaching materials have a clear, focused structure and support the optimal achievement of competencies. The aspects of concepts (91.67%), assessment, and language and presentation also show high quality. However, there are several aspects that still need improvement, such as the depth of the material, content integration, technology application, illustration display, and especially the student worksheets (LKPD), which received the lowest score (75%). This means that while the instructional materials are generally suitable for use, revisions to the LKPD section and strengthening the integration of content would further enhance the quality of these materials. This is in line with the findings of Rodiah et al. (2025) who stated that the development of ethnoscience-based physics teaching materials requires a continuous improvement process based on validator input, especially on the aspects of integrating physics

concepts, local cultural contexts, and learning activities, so that the teaching materials are not only academically valid but also effective in improving students' thinking skills.

Analysis of the Results from Implementation of the Glocalization Learning Model

The development of LKPD and teaching materials is carried out through the stages of analyzing student needs, designing LKPD and teaching materials that are adapted to the context of the phenomenon and learning model, validation by three experts, evaluation based on the validation results, and implementation of the revised development products.

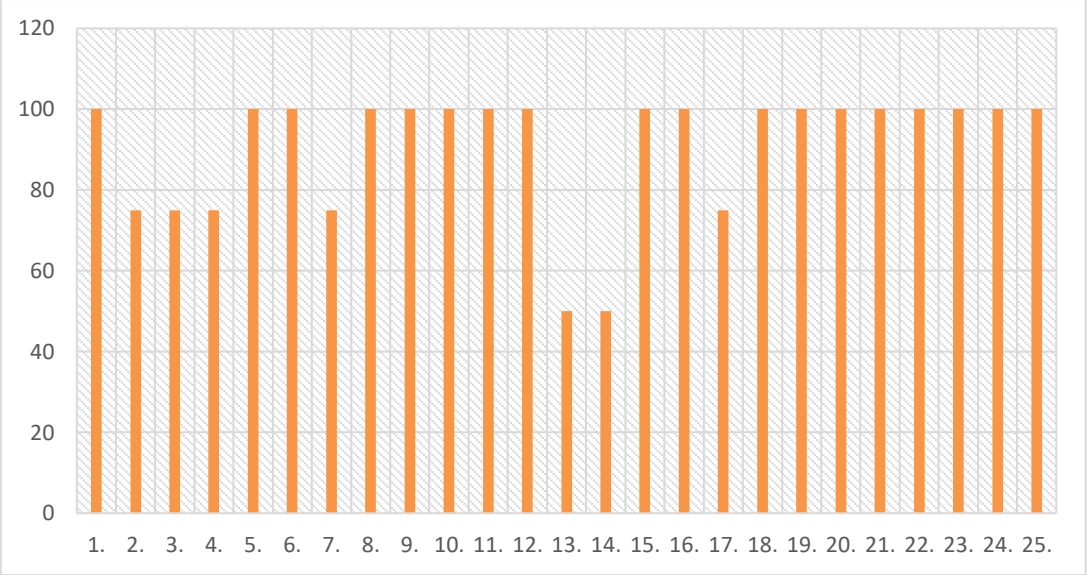

Figure 10. Percentage results of the implementation of glocalization learning that has been carried out

The results of the validation of the implementation of the glocalization learning model show that in general the implementation of learning has gone very well, especially in the main aspects such as the use of media and learning resources, class discipline management, implementation of process and outcome assessments, providing opportunities to ask questions, and supporting individual student needs—all of which received a perfect score (100). The teacher also demonstrated skills in connecting material with local wisdom, facilitating group work, and providing reinforcement for understanding concepts. However, there are several aspects that need to be improved, such as conveying learning objectives, initial readiness before learning (prayer, attendance, and student readiness), and forming discussion groups, each of which received a score of 75. In addition, the aspect of presenting group work results and encouraging active discussion between students showed the lowest score (50), this is none other than due to the limited time used to provide opportunities for students to discuss so that it is less than achieved in terms of students' ability to communicate their learning outcomes. Optimization of speaking teaching is greatly influenced by students' discussion time, the role of which varies depending on their level of foreign language ability (Vladimirovna, 2022). Overall, the glocalization model is effective but still requires improvement in building active interactions and comprehensive student involvement.

Analysis of the results from Improving Students' Scientific Literacy Skills

Table 8. Normality test results

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statitstic	df	Sig.	Statitstic	df	Sig.
Pretest	0.125	45	0.077	0,940	45	0.022
Postest	0.125	45	0.077	0.961	45	0.138

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Based on the results of the normality test using the Kolmogorov-Smirnov and Shapiro-Wilk methods, it is known that the significance value (Sig.) for the pretest data is 0.077 (Kolmogorov-Smirnov) and 0.022 (Shapiro-Wilk), while for the posttest data is 0.077 (Kolmogorov-Smirnov) and 0.138 (Shapiro-Wilk). In the normality test, data is considered normally distributed if the significance value is more than 0.05. Based on the Kolmogorov-Smirnov value, both data (pretest and posttest) meet the normality assumption with a pretest data value of 0.077 (Sig.> 0.05), as well as posttest data 0.077 (Sig.> 0.05). Therefore, the results of the Kolmogorov–Smirnov test were used as the basis for determining data normality. A significance value greater than 0.05 indicates that both data groups are normally distributed, thus the assumption of normality has been met and the data is suitable for analysis using parametric statistics (Aslam, 2024).

Table 9. Paired t-test results

		Paired Differences				Significcance	
		Mean	Std. Deviation	t	df	One-Sided p	Two-Sided p
Pair 1	Pretest-Postest	23.144	43.976	4.993	89	<0.001	<0.001

Based on the results of the paired sample t-test between the pretest and posttest scores, the average difference value was obtained at 23.144 with a standard deviation of 43.976 and a calculated t value of 4.993 at 89 degrees of freedom (df). The significance value (p-value) for both one-sided and two-sided tests is <0.001, which means it is less than 0.05, so it can be concluded that there is a significant difference between the pretest and posttest scores. Thus, the treatment or intervention in the form of glocalization learning given in this study has been proven to have a significant effect on improving learning outcomes in the form of students' scientific literacy skills.

Table 10. Average results of N-gain test

Average N-gain	Percentage of N-Gain	Category
0.42	42	Medium

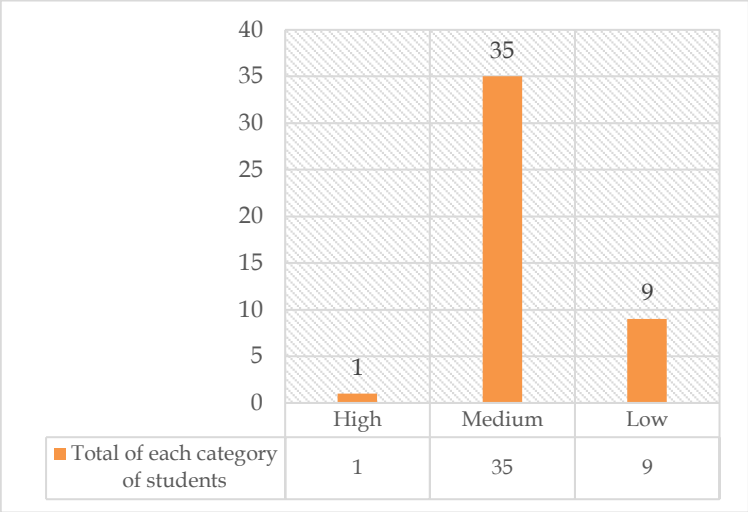
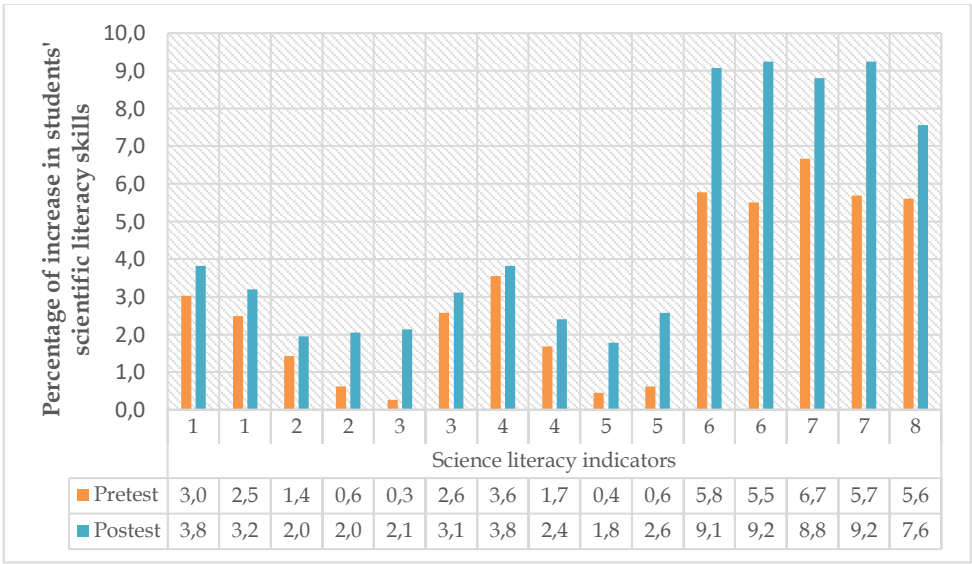


Figure 11. Science literacy profile results

Based on the results of the N-Gain test analysis shown in Table 10 and Figure 11, the average N-Gain of students is 0.42 or 42%, which is included in the moderate category. The science literacy profile graph shows that most students (35 students) are in the moderate category, while only 9 students are in the low category, and 1 student reaches the high category. This finding indicates that the glocalization learning intervention implemented is quite effective in improving students' overall science literacy skills, although there are still a small number of students who need more attention to achieve optimal learning outcomes. These findings are consistent with Alhusni et al.

(2025) who stated that physics learning based on scientific literacy through a glocalization approach by utilizing the Boranan Dance is effective in facilitating students' conceptual understanding of rigid body equilibrium in a contextual and meaningful manner, thus emphasizing the importance of developing ethnoscience-based physics learning in the context of Indonesian education.

Graph in figure 12 shows an increase in the percentage of students' scientific literacy skills in all indicators after the implementation of the learning, as seen from the comparison between the pretest and posttest scores. The most significant increase occurred in indicators 6, 7, and 8—which relate to the ability to analyze data, evaluate scientific arguments, and draw scientific conclusions—with a posttest score reaching 9.2%, far above the pretest score of around 5.5%–6.7%. Higher increases in the indicators of evaluating the credibility of scientific information and making decisions based on credible information are thought to occur because students not only acquire conceptual knowledge, but are also involved in the process of comparing scientific information with the local cultural context, so that the ability to evaluate evidence and make decisions based on reliable sources develops more deeply (Dawson et al., 2024). Evaluating scientific literacy involves understanding its core content, which remains consistent even though the scientific and technological context evolves (Yi, 2023). In accordance with research conducted by Lieskovský and Sunyík (2022) that scientific literacy skills, although still low among Slovak students, can be improved through interventions that emphasize scientific argumentation, understanding the nature of science, and the discovery process, with effectiveness also influenced by teaching strategies, level of guidance, gender, and intervention context. Indicators 1 to 5 also increased, although not as much as the other indicators, indicating that basic skills such as identifying concepts and understanding scientific information still need to be further improved. Overall, these data reflect that the learning implemented is quite effective in improving students' science literacy skills, especially in the aspects of high-level thinking and the application of science in more complex contexts.



	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8
Pretest	3,0	2,5	1,4	0,6	0,3	2,6	3,6	1,7	0,4	0,6	5,8	5,5	6,7	5,7	5,6
Postest	3,8	3,2	2,0	2,0	2,1	3,1	3,8	2,4	1,8	2,6	9,1	9,2	8,8	9,2	7,6

Figure 12. Percentage increase in students' scientific literacy skills

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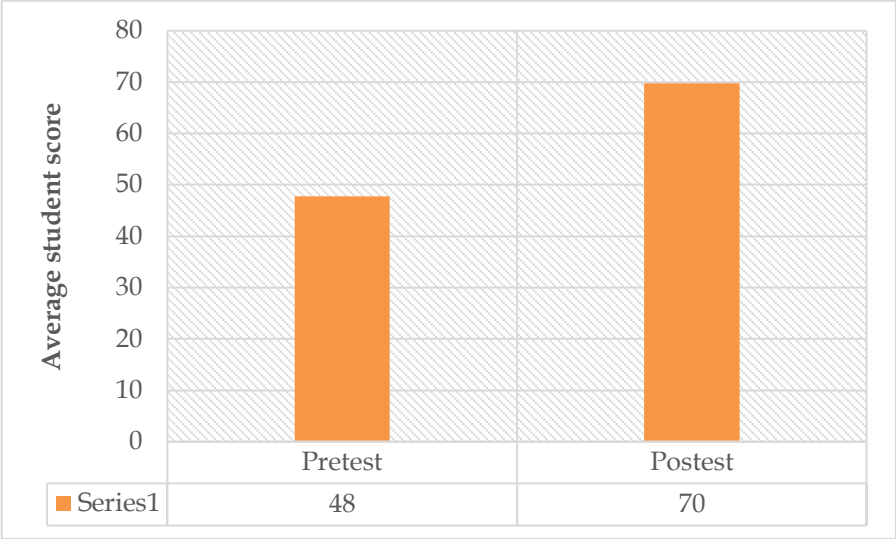

Figure 13. Average student score

The graph in Figure 13 shows a significant increase in the average score of students after participating in the learning process. The average score of the students' pretest was 48, while the average score of the posttest increased to 70. This shows an increase of 22 points after the learning process took place. This increase indicates that the learning that was applied was able to improve students' understanding and mastery of the material effectively. In other words, the learning strategy or model used succeeded in having a positive impact on student learning outcomes. However, further development in implementation is needed because in fostering scientific literacy as the main goal of science education, an interdisciplinary approach is needed in the general education curriculum, with an emphasis on understanding the scientific research process and scientific thinking to equip students in dealing with complex social issues triggered by advances in science and technology (Cho, 2022).

Analysis of Student Response Results

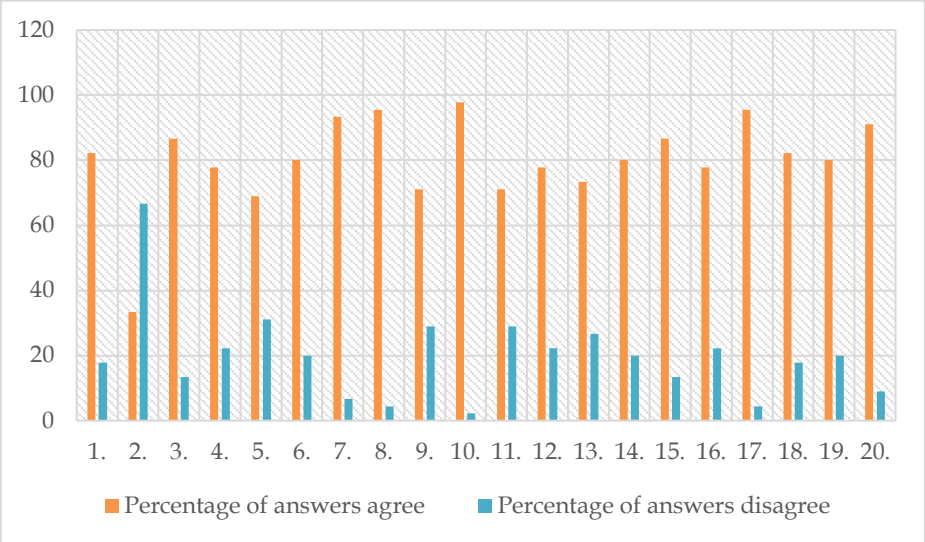

Figure 14. Percentage results of student response answers

Based on the percentage data of student responses to the revised teaching materials, the majority of students gave positive responses to almost all aspects of the assessment. Most students stated that they could understand the learning objectives (82.22%), answer the questions presented (86.67%), and felt that the material helped them be more active in learning (77.78%). The material was considered coherent, concise, and clear (93.33%), as were the illustrations that supported

understanding (95.56%). In terms of appearance, the text layout was considered systematic (97.78%) and the illustrations were easy to see (95.56%). The language used was also considered in accordance with EYD rules and easy to understand, at 71.11% and 77.78%, respectively. In addition, 82.22% of students stated that they could explain phenomena scientifically and 80% were able to build and evaluate scientific investigation designs. This shows that overall the teaching materials are of good quality and support students' understanding and scientific literacy skills.

Although students generally responded positively to the teaching materials, several items received relatively lower scores, particularly those related to understanding the material, predicting content from the cover design, interpreting illustrations, and evaluating scientific information for decision-making. These findings indicate that some students still experienced difficulties in connecting visual representations with scientific content and in critically assessing information before making decisions. Similar findings were reported by Kresin et al. (2024), who found that students often struggle to evaluate the credibility of scientific information and rely heavily on the coherence and presentation of textual and visual information when making judgments.

CONCLUSION

Based on the research results, the integration of *Mayang Rontek* Dance in glocalization learning is proven to be feasible and effective in supporting the development of students' scientific literacy as well as the preservation of local culture. Validation of the teaching modules and teaching materials shows a very good category, with most aspects obtaining scores above 90% and several aspects reaching 100%, although the LKPD component still requires improvement with the lowest score of 75%. The implementation of learning was also carried out very well, indicated by the achievement of 100% in several main aspects, although student interaction and presentation of discussion results still need to be improved. The effectiveness of learning is reflected in a significant increase in students' scientific literacy skills ($t = 4.993$; $p < 0.001$), an increase in the average score from 48 to 70, and an N-Gain value of 0.42 (moderate category). The greatest improvement occurred in the ability to transmit scientific information and make decisions based on credible information, while student responses to the teaching materials were very positive with the percentage of agreement reaching 97.78% in the systematic aspect of the display and 95.56% in the clarity of the illustrations. Theoretically, this study contributes to the development of the concept of ethnoscience through the framework of the glocalization model, while practically it shows that glocalization learning based on the Mayang Rontek Dance phenomenon is effective in improving junior high school students' scientific literacy, although it still has limitations such as the unavailability of supporting media and the lack of cross-school comparisons and testing in the area of origin of the culture.

AUTHOR CONTRIBUTIONS

Irsyad Yusuf Santoso: Conceptualization, Methodology, Formal Analysis, Writing-Original Draft; **Pradipta Ramadhan Putra Wirawan**: Executor, Data Curation, Project Administrator; **Hasan Subekti**: Director and Validator; **Beni Setiawan**: Director and Validator; and **Maharani Agustina Arivi**: Director, Resources, and Theoretical Support for International Literature. All authors have read and approved the final version of this manuscript.

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