Available online at: http://e-jurnal.lppmunsera.org/index.php/parahita
Wikrama Parahita: Jurnal Pengabdian Masyarakat
p-ISSN 2599-0020, e-ISSN 2599-0012

Local Wisdom-Based Multimodal Literacy Training for Elementary Teachers

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Article Information

Article history

Received: September 17, 2026
Revised: November 17, 2026
Accepted: November 21, 2026

Keywords: Community Engagement; Elementary Education; Local Wisdom; Multimodal Literacy; Pedagogical Competence

Abstract

Teachers at SDN 016 Sungai Kunjang face challenges in designing multimodal literacy learning that integrates the local wisdom of East Kalimantan. This community engagement program used a Participatory Action Research (PAR) approach to strengthen teachers' pedagogical competence in local wisdom-based multimodal literacy, involving 15 teachers, the school principal, and 23 Grade V students. Activities comprised needs analysis, three training sessions, collaborative development and validation of an Integrated Science and Social Studies (IPAS) module on East Kalimantan biodiversity, module and worksheet mentoring, classroom implementation, institutional development, monitoring, and evaluation. Twelve of the 15 teachers (80%) selected appropriate multimodal media, all 15 (100%) produced multimodal media assisted by artificial intelligence (AI), and 8 (53.3%) developed complete learning designs; the module obtained a validity percentage of 90, and classroom implementation achieved 85. Mean student scores rose from 78 to 85 (8.97%); the Wilcoxon signed-rank test indicated significant improvement ($Z = -4.138$; $p = 0.001$) with a mean normalized gain (N-gain) of 0.31, categorized as moderate. The program established the Literacy–Numeracy Team, the Digital Library Development Team, and a Google Sites-based digital library. Practice-oriented training with classroom mentoring and institutional strengthening may support sustainable school literacy.

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INTRODUCTION

Literacy and numeracy remain fundamental competencies in basic education and continue to pose considerable challenges. International and national evidence indicates that elementary school students still experience difficulties in reading comprehension, mathematical reasoning, and applying knowledge to contextual problems (Dewayani et al., 2021; OECD, 2019; Yuda & Rosmilawati, 2024). Strengthening literacy and numeracy requires systematic school programs, contextual learning activities, and continuous support for teachers (Anggreni et al., 2023; Deskoni et al., 2025; Perdana & Suswandari, 2021).

One approach that can support such strengthening is multimodal learning, which helps students construct meaning through interactions with texts, images, audio, videos, spatial arrangements, and movement. This approach enables students to connect abstract information with visual, auditory, and kinesthetic representations, particularly in science learning that involves environmental phenomena and data interpretation (Danielsson & Selander, 2016; Jewitt et al., 2016; Serafini, 2022). The integration of multiple modes can support conceptual understanding when the relationships among modes are clearly designed and aligned with learning objectives (Mayer, 2009; Sari et al., 2025). Because its effectiveness depends largely on teachers' ability to select, design, and manage learning modes (Jewitt et al., 2016; Mayer, 2009), the quality of multimodal learning is determined not only by the availability of media but also by teachers' competence.

Teachers' competence in multimodal learning can be strengthened through practice-oriented professional development. Training provides conceptual and technical foundations, whereas

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DOI: https://dx.doi.org/10.30656/jpmwp.v10i2.12591

mentoring, collaboration, implementation, and reflection give teachers opportunities to apply and refine their learning designs. Effective professional development involves active learning, collaboration, feedback, and direct relevance to teaching practice (Darling-Hammond et al., 2017; Lofthouse & Thomas, 2017; Thurlings & den Brok, 2017). Generative artificial intelligence (AI) can support the preparation of media drafts, but teachers remain responsible for verifying content accuracy and cultural relevance and for making pedagogical decisions (Fadiana et al., 2025).

In addition to teacher competence, learning quality requires content that is relevant to students' lives, and such content can be developed through local wisdom. Local wisdom provides authentic contexts that connect school knowledge with students' environment and experiences. The biodiversity of East Kalimantan, for example, offers objects and phenomena that are close to students' daily lives and can therefore be used to learn Integrated Science and Social Studies (IPAS) concepts contextually. Local wisdom-based learning materials have been reported to support conceptual understanding, scientific literacy, and critical thinking, depending on the appropriateness of the content and activities (Mulatsih et al., 2023; Uslan et al., 2025). The use of local contexts also strengthens the relevance of learning to students' lives and surrounding environment (Pratiwi et al., 2026). The local wisdom of East Kalimantan can therefore serve as a basis for developing multimodal learning.

The main problem at SDN 016 Sungai Kunjang is the limited implementation of multimodal learning. Initial observations indicated that texts and oral explanations still dominated learning activities, whereas images, videos, infographics, and kinesthetic activities had not been consistently integrated into instruction. This condition limits students' opportunities to understand the material through various modes of representation, particularly in IPAS learning, which requires connections between abstract concepts and real-world phenomena (Danielsson & Selander, 2016; Jewitt et al., 2016; Serafini, 2022). The implementation of multimodal learning also depends heavily on the ability of teachers to select, design, and manage learning modes (Jewitt et al., 2016; Mayer, 2009), so classroom practice at this school requires strengthening to become more varied and contextual.

A second problem at SDN 016 Sungai Kunjang concerns the limited availability of contextual learning materials and the limited ability of teachers to design complete learning activities. Learning materials relevant to the local wisdom of East Kalimantan have not been systematically developed; consequently, teachers have few resources for connecting the subject matter with the surrounding environment. Teachers also experienced difficulties in aligning learning objectives, content, activities, media, student worksheets, and assessment within one coherent learning design. These limitations are consistent with findings indicating that the development of contextual learning materials and coherent instructional design requires sustained support and mentoring (Dewayani et al., 2021; Faizah et al., 2016; Mulatsih et al., 2023). In addition, the school literacy team had not yet functioned optimally in supporting planned literacy activities. The school needed an intervention that not only trained teachers but also established institutional mechanisms to support sustainability.

To address these problems, the community engagement team proposed an integrated intervention that combined multimodal literacy, the local wisdom of East Kalimantan, teacher mentoring, and the strengthening of school institutional capacity. The program included multimodal literacy training and AI-assisted media development, the collaborative development of an IPAS module on East Kalimantan biodiversity, the development of student worksheets and multimodal media, classroom implementation, the establishment of the Literacy–Numeracy Team and the Digital Library Development Team, and the development of a digital library. The intervention was designed as a participatory process involving teachers and the school in needs identification, learning material development, classroom implementation, classroom observation, and reflection on program outcomes (Kemmis et al., 2014; Lutfitasari et al., 2026). The program did not stop at training but continued through classroom practice and institutional strengthening.

The theoretical foundation of the intervention includes multimodal literacy, local wisdom-based learning, teacher professional development, and Participatory Action Research (PAR). Multimodal literacy refers to meaning-making through interactions among various modes, in which texts, images, sounds, movement, and spatial arrangements convey complementary information when they are clearly designed (Danielsson & Selander, 2016; Jewitt et al., 2016; Serafini, 2022). Multimedia learning principles emphasize that well-organized verbal–visual relationships support processing, whereas irrelevant material may increase cognitive load (Mayer, 2009; Sari et al., 2025; Yulianto et al., 2025). Local wisdom provides authentic contexts that can strengthen the relevance of learning and conceptual understanding (Mulatsih et al., 2023; Uslan et al., 2025). Effective teacher professional development emphasizes active learning, collaboration, and continuous support (Darling-Hammond et al., 2017; Thurlings & den Brok, 2017). PAR positions teachers and schools as active

DOI: https://dx.doi.org/10.30656/jpmwp.v10i2.12591

partners in needs identification, planning, action, observation, and reflection (Kemmis et al., 2014; Lutfitasari et al., 2026).

The novelty of this program lies in its integration of East Kalimantan local wisdom, multimodal literacy, the use of generative AI as a supporting tool, classroom implementation, and institutional strengthening toward sustainability within a single community engagement program. Unlike training that ends with media production, this program connects teacher learning with module development, classroom practice, student learning outcomes, and the establishment of school-level literacy mechanisms. This integration extends previous literacy and numeracy programs that emphasized contextual content, teacher participation, and school-based resources (Septika et al., 2025; Septika & Pangadongan, 2023). The use of AI as a supporting tool also expands teachers' opportunities to develop learning media (Fadiana et al., 2025; Pangadongan et al., 2026; Septika et al., 2025). What distinguishes the program, then, is not any single component but the way training, learning material development, classroom implementation, and institutional sustainability were linked within a single program cycle.

The objective of this community engagement program was to strengthen the pedagogical competence of teachers at SDN 016 Sungai Kunjang through training and mentoring in local wisdom-based multimodal literacy. Specifically, the program aimed to improve teachers' abilities to select and develop multimodal media, design contextual IPAS modules, implement multimodal learning in the classroom, and establish institutional mechanisms to support the sustainability of literacy practices.

MATERIALS AND METHODS

Materials

The main learning resource developed in the program was an IPAS module on the biodiversity of East Kalimantan, created collaboratively by the community engagement team and partner teachers. The module connects science and social studies concepts with the flora, fauna, environmental conditions, and community contexts of the region. Supporting materials included student worksheets, infographics, instructional videos, role-play cards, biodiversity illustrations, and a snake-and-ladder game. These materials integrated written, visual, audio, spatial, and kinesthetic modes into learning activities.

AI was used as a supporting tool for developing multimodal learning media. Teachers used generative features to produce draft illustrations, text-to-image materials, and presentation slides related to the biodiversity of East Kalimantan. The AI-generated materials were then reviewed and revised by teachers and the community engagement team to ensure factual accuracy, age appropriateness, cultural relevance, and alignment with the curriculum. The use of AI as a supporting tool is consistent with efforts to strengthen teachers' digital literacy (Fadiana et al., 2025; Pangadongan et al., 2026).

The digital library of SDN 016 Sungai Kunjang was developed using Google Sites. The initial collection included approximately 20 storybooks and 12 local wisdom-based children's stories in digital or flipbook formats. The digital library was intended to support independent reading, story-retelling activities, literacy projects, and access to locally contextualized reading materials. Its development aligns with efforts to strengthen school literacy (Dewayani et al., 2021).

Methods

Design and Program Location

The program employed a PAR design involving the community engagement team, teachers, the school principal, and students. PAR consists of problem identification, collaborative planning, action, observation, reflection, and adjustment. This design was combined with practice-oriented teacher professional development, including conceptual training, hands-on practice, collaborative learning material development, classroom implementation, observation, feedback, and reflection (Kemmis et al., 2014; Lutfitasari et al., 2026). The program was conducted at SDN 016 Sungai Kunjang, Samarinda, East Kalimantan, Indonesia.

Participants

The participants consisted of 15 teachers, the school principal, and 23 Grade V students. Teachers from Grades I to VI participated in training, mentoring, learning material development, classroom activities, monitoring, and evaluation. The school principal was involved in needs analysis, program planning, institutional development, and evaluation. All 23 Grade V students completed the pre-test, participated in the multimodal learning activities, and completed the post-test. The program adopted a partner-school approach and did not include a control group; the results were therefore interpreted descriptively as changes observed during the program rather than as definitive evidence of causality (Creswell & Creswell, 2014).

Program Stages

The program was implemented through seven interconnected stages: initial observation and needs analysis, participatory mapping and planning, teacher training, mentoring in module and student worksheet development, classroom implementation,

DOI: https://dx.doi.org/10.30656/jpmwp.v10i2.12591

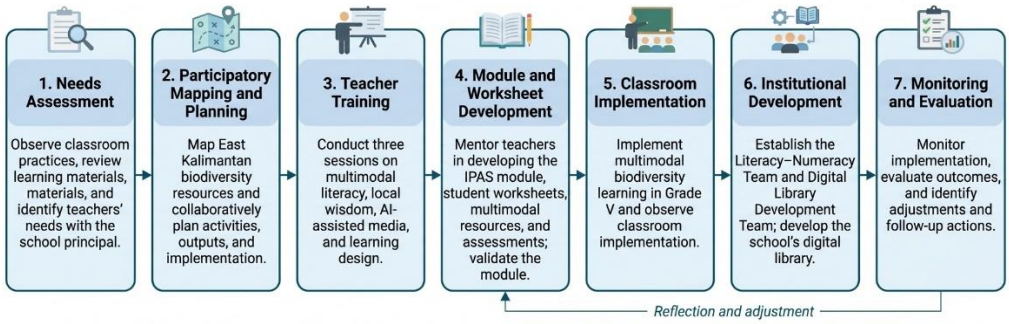

Fig. 1. Flow of the community engagement program

institutional development, and monitoring and evaluation. The implementation flow is presented in Fig. 1.

In the first stage, the community engagement team observed learning practices, reviewed available learning materials, and held discussions with the school principal and teachers. The needs analysis focused on teachers' understanding of multimodal literacy, the availability of contextual learning materials, the use of digital media, and existing literacy activities. The analysis resulted in three priorities: training in multimodal literacy and AI-assisted media, mentoring in the development of modules, student worksheets, and assessments, and institutional development through the Literacy–Numeracy Team and digital library.

In the second stage, the community engagement team and school partners mapped local resources related to the biodiversity of East Kalimantan and translated them into a collaborative program plan. The plan included training topics, mentoring activities, expected products, classroom implementation schedules, monitoring procedures, evaluation activities, and institutional outcomes.

The third stage consisted of three training sessions. The first session introduced multimodal literacy and local wisdom-based learning. The second session focused on the practical use of generative AI for developing learning media, emphasizing the need to review AI-generated content for factual accuracy, cultural appropriateness, and curriculum alignment. The third session focused on designing multimodal learning activities that combined reading, visual observation, video viewing, discussion, role-playing, and kinesthetic games.

The fourth stage involved mentoring teachers in developing a contextual IPAS module and student worksheets. The mentoring focused on formulating learning objectives, selecting local content, designing student activities, developing multimodal resources, designing assessments, and ensuring alignment among objectives, activities, media, and evaluation. The completed module was assessed using a 15-aspect validation rubric.

The fifth stage involved implementing the multimodal learning design in Grade V. The learning focused on the biodiversity of East Kalimantan and integrated texts, images, videos, infographics, role-playing, and a snake-and-ladder game. Classroom implementation was observed using a 10-aspect observation sheet.

The sixth stage focused on institutional development. The Literacy–Numeracy Team and the Digital Library Development Team were established through decrees issued by the school principal. The Literacy–Numeracy Team consisted of the school principal as the person in charge, community engagement team members as advisors, and teachers as the chairperson, secretary, treasurer, and members. A digital library was also developed using Google Sites to support the sustainability of literacy activities.

The seventh stage involved monitoring the quality of implementation and evaluating program outcomes. Mid-program monitoring was conducted on August 26, 2026, while the final evaluation was conducted on September 11, 2026. The evaluation involved the school principal, teachers, and members of the Literacy–Numeracy Team. It examined teacher participation, product quality, classroom implementation, student learning outcomes, the usefulness of the digital library, participant satisfaction, and sustainability plans.

Instruments and Data Collection Techniques

Data were collected from several quantitative and qualitative sources. Quantitative data included records of teacher participation, module validation scores, classroom implementation scores, and students' pre-test and post-test results. Qualitative data included classroom observations, mentoring notes, monitoring records, interviews, reflective discussions, and participant evaluations. The pre-test and post-test consisted of 20 multiple-choice and essay items with a score range of 1 to 100, focusing

DOI: https://dx.doi.org/10.30656/jpmwp.v10i2.12591

on students' understanding of the biodiversity topic taught through the multimodal learning design.

Data Analysis

The module was evaluated by three lecturers from the Primary School Teacher Education (PGSD) program, with expertise in language education and natural science education represented across the group. The validators assessed the module using a 15-aspect validation rubric with a four-point rating scale. The validity percentage was calculated using the following formula:

$$Validity\ percentage = \left(\frac{Total\ score\ for\ each\ criterion}{Maximum\ score}\right) \times 100\% \quad (1)$$

The criteria for interpreting the validity percentage are presented in Table 1 (Arikunto, 2008).

Table 1. Criteria for interpreting module validity

Validity percentage (%)	Category
0–20	Invalid
21–40	Less valid
41–60	Sufficiently valid
61–80	Valid
81–100	Highly valid

Learning implementation was observed by three observers using a 10-aspect observation sheet with a 1–4 rating scale. The percentage of implementation was calculated using the following formula:

$$Implementation\ percentage = \left(\frac{Total\ score}{Maximum\ Score}\right) \times 100\% \quad (2)$$

The criteria for interpreting the implementation percentage are presented in Table 2 (Sundayana, 2016)

Table 2. Criteria for interpreting learning implementation

Implementation percentage	Category
0–20	Very poor
21–40	Poor
41–60	Sufficient
61–80	Good
81–100	Very good

The percentage increase in students' mean scores was calculated using the following formula:

$$Percentage\ increase = \left(\frac{(Post\ test\ mean - Pre\ test\ mean)}{Pre\ test\ mean}\right) \times 100\% \quad (3)$$

The normalized gain (N-gain) was calculated using the following formula:

$$N - gain = \frac{(Posttest\ score - Pretest\ score)}{(100 - Pretest\ score)} \quad (4)$$

The criteria for interpreting N-gain values are presented in Table 3 (Hake, 1998)

Table 3. Criteria for interpreting normalized gain (N-gain)

N-gain range	Category
N-gain ≥ 0.70	High
0.30 ≤ N-gain < 0.70	Moderate
N-gain < 0.30	Low

The pre-test and post-test data were analyzed using prerequisite tests, including the Shapiro–Wilk normality test. To examine the significance of the difference between pre-test and post-test scores, a paired-sample t-test was used if the score differences were normally distributed, whereas the Wilcoxon signed-rank test was used if they were not. All statistical analyses were performed using SPSS.

Qualitative data were analyzed through data reduction, categorization, theme identification, and interpretation. Observation notes, mentoring records, monitoring records, interview results, and reflective discussions were organized according to the following themes: teacher participation, learning material development, classroom implementation, student engagement, implementation constraints, institutional development, and sustainability.

Trustworthiness of the Findings

The trustworthiness of the qualitative findings was supported through triangulation and an audit trail. Triangulation was conducted by comparing evidence from classroom observations, mentoring notes, monitoring records, product documentation, student test results, and evaluation discussions. The audit trail consisted of documentation of program activities, training materials, mentoring notes, module revisions, classroom observation sheets, student test results, and evaluation reports.

Formal member checking was not conducted in this program. However, the findings and implementation experiences were discussed with teachers and the school principal during monitoring and final evaluation sessions. This discussion allowed participants to provide feedback, confirm their implementation experiences, and identify remaining constraints. This participatory discussion served as a form of collaborative verification within the PAR process but was not claimed as formal member checking.

Ethical Considerations

This community engagement program was conducted with permission from SDN 016 Sungai Kunjang. Participation by teachers and students was voluntary. Informed consent was obtained directly from the teachers. Parental consent was obtained for

DOI: https://dx.doi.org/10.30656/jpmwp.v10i2.12591

students' participation in learning activities and the collection of pre-test and post-test data. Students' identities were kept confidential, and the data were used only for program evaluation and reporting purposes.

RESULTS AND DISCUSSION

Program implementation

The community engagement program was implemented through the seven stages described in the Methods section. It proceeded sequentially but remained flexible, because observation and monitoring results were used to adjust subsequent activities.

The first stage confirmed the needs that had been identified in the introduction. Discussions with the school principal and teachers showed that texts and oral explanations still dominated learning, whereas images, videos, infographics, and kinesthetic activities had not been consistently integrated, and that learning materials relevant to the local wisdom of East Kalimantan had not been systematically developed. On the basis of these findings, the community engagement team and the school agreed on three intervention priorities: training in multimodal literacy and AI-assisted media, mentoring in module and student worksheet development, and institutional strengthening through the Literacy–Numeracy Team and digital library.

The second stage produced a collaborative program plan that included training topics, mentoring activities, expected products, classroom implementation schedules, monitoring procedures, evaluation activities, and institutional outcomes. That plan served as a shared reference for the community engagement team and the school throughout the program.

In the third stage, teachers received training in three sessions. The first session introduced the concepts of multimodal literacy and local wisdom-based learning, in which teachers learned that multimodal learning does not merely mean adding more media but also involves designing clear relationships among texts, images, audio, videos, spatial arrangements, and movement. In the second session, teachers practiced producing draft illustrations, presentation slides, and text-to-image materials related to the biodiversity of East Kalimantan, and they were guided to review AI-generated outputs for factual accuracy, cultural appropriateness, language quality, and alignment with curriculum objectives. The third session focused on designing multimodal learning activities that combined reading, visual observation, video viewing, discussion, role-playing, and kinesthetic games.

In the fourth stage, teachers were mentored collaboratively by the community engagement team in developing the IPAS module and student worksheets. Teachers were guided in formulating learning objectives, selecting local content, designing student activities, developing multimodal resources, designing assessments, and ensuring alignment among objectives, activities, media, and evaluation. The module that was developed focused on the biodiversity of East Kalimantan and integrated local content into learning activities, and the accompanying student worksheets were designed to support reading, observing, analyzing, discussing, and expressing students' understanding through various modes. The completed module was then assessed by three validators using a 15-aspect validation rubric.

In the fifth stage, multimodal learning was implemented in Grade V by integrating texts, images, videos, infographics, role-playing, and a snake-and-ladder game. Students were invited to read texts on biodiversity, observe images and videos, discuss in groups, perform role-plays, and participate in a snake-and-ladder game designed to strengthen conceptual understanding. Classroom activities were observed by three observers using a 10-aspect observation sheet.

In the sixth stage, the program established the Literacy–Numeracy Team and the Digital Library Development Team through decrees issued by the school principal, and the structure and responsibilities of both teams were regulated in their respective decrees. A Google Sites-based digital library was also developed to house a collection of storybooks and local wisdom-based children's stories.

In the seventh stage, monitoring focused on implementation constraints, facility availability, the need for further mentoring, and practical adjustments required. At the same time, the final evaluation, conducted with the school principal, teachers, and members of the Literacy–Numeracy Team, examined teacher participation, product quality, classroom implementation, student learning outcomes, the usefulness of the digital library, participant satisfaction, and sustainability plans.

Development of Teachers' Competence

Following training and mentoring, 12 of the 15 teachers (80%) selected appropriate multimodal media based on East Kalimantan local wisdom, and all 15 teachers (100%) produced multimodal learning media using generative AI. Eight teachers (53.3%) completed full multimodal learning designs comprising learning objectives, contextual activities, multimodal resources, student worksheets, and assessment instruments. The remaining seven teachers (46.7%) did not complete the full designs within the program period because of competing teaching responsibilities, school duties, and school activity deadlines. These percentages represent

DOI: https://dx.doi.org/10.30656/jpmwp.v10i2.12591

post-program achievements and task completion rather than changes measured against quantitative baseline data.

Teacher training combined conceptual explanations with hands-on media development activities. Teachers practiced selecting local content, preparing visual resources, developing presentation materials, and creating learning media related to the biodiversity of East Kalimantan. Training and hands-on practice activities are presented in Fig. 2.



Fig. 2. Training and hands-on practice in developing multimodal learning media based on East Kalimantan local wisdom

Table 4 presents the initial conditions of the partner school, the interventions implemented, and the changes or outcomes achieved. Table 4 summarizes how the intervention targeted the principal challenges identified at the partner school: limited teacher understanding of multimodal literacy, difficulty developing comprehensive and documented learning designs, insufficient contextualization of instructional materials, and the lack of a formal school-level literacy coordination structure. Corresponding outputs comprised post-program teacher achievements in multimodal literacy practice (as indicated in Table 4), a validated IPAS teaching module, classroom implementation of the module, establishment of a Literacy–Numeracy Team, and provision of a digital library to support sustained literacy–numeracy activities.

Module Validation

The IPAS module on the biodiversity of East Kalimantan obtained a validity percentage of 90. The mean total score per validator was 54 out of a maximum score of 60, corresponding to a validity percentage of 90. The scores for each aspect represent the mean ratings of the three validators.

Table 4. Initial conditions, interventions, and program outcomes

Initial condition	Intervention	Change/ outcome
Most teachers had limited understanding of multimodal literacy.	Three training sessions on multimodal literacy and local wisdom-based learning.	12 of 15 teachers (80%) selected appropriate multimodal media; all teachers (100%) produced AI-assisted multimodal media.
Teachers had difficulty designing complete learning designs.	Mentoring in the development of modules, student worksheets, activities, and assessment instruments.	8 of 15 teachers (53.3%) developed complete multimodal learning designs.
Learning materials had not been contextualized with the local wisdom of East Kalimantan	Collaborative development of an IPAS module on the biodiversity of East Kalimantan.	The module obtained a validity percentage of 90.
Classroom practice still used limited modes.	Implementation of multimodal learning using texts, images, videos, infographics, role-playing, and games.	Classroom implementation obtained an implementation percentage of 85.
The school literacy team had not been formally established.	Establishment of the Literacy–Numeracy Team through a decree issued by the school principal.	The Literacy–Numeracy Team was established with clear tasks and structure.
Digital learning resources had not been systematically organized.	Development of a digital library using Google Sites.	A digital library was available with collections of storybooks and local wisdom-based children's stories.

DOI: https://dx.doi.org/10.30656/jpmwp.v10i2.12591

The detailed validation results are presented in Table 5, while the module and student worksheets are presented in Fig. 3.

Table 5. Module validation results based on 15 aspects

No.	Validation aspect	Mean score	Category
1	Module identity and information	4.00	Highly valid
2	Learning objectives	4.00	Highly valid
3	Content appropriateness	4.00	Highly valid
4	Learning activities	3.33	Valid
5	Strategies and methods	4.00	Highly valid
6	Integration of multimodal literacy	4.00	Highly valid
7	Intermodal connections	3.00	Valid
8	Multimodal literacy activities	4.00	Highly valid
9	Contextualization of learning	4.00	Highly valid
10	Media and learning resources	3.67	Highly valid
11	Student worksheets/activities	3.00	Valid
12	Learning assessment	3.00	Valid
13	Reflection and feedback	3.00	Valid
14	Readability and presentation	4.00	Highly valid
15	Module implementation	3.00	Valid
Total score per validator		**54/60**	**90 (Highly valid)**



Fig. 3. IPAS module and student worksheets integrating multimodal literacy and the local wisdom of East Kalimantan

The module and worksheet integrated learning objectives, East Kalimantan biodiversity content, local flora and fauna, multimodal activities, student tasks, and assessment instruments. The products were revised during mentoring before classroom implementation.

Classroom Implementation

Classroom implementation obtained an implementation percentage of 85. The mean total score per observer was 34 out of a maximum score of 40, corresponding to an implementation percentage of 85. The scores for each aspect represent the mean ratings of the three observers. The detailed observation results are presented in Table 6.

Table 6. Classroom implementation observation results based on 10 aspects

No.	Observation aspect	Mean score	Category
1	Opening and closing learning	4.00	Very good
2	Class management	3.67	Very good
3	Explaining	3.00	Good
4	Questioning	3.00	Good
5	Guiding discussion	3.33	Good
6	Providing reinforcement	3.00	Good
7	Intermodal integration	3.67	Very good
8	Student engagement in multimodal literacy	3.00	Good
9	Multimodal contextualization	4.00	Very good
10	Checking understanding	3.33	Good
Total score per observer		**34/40**	**85 (Very good)**

Classroom implementation achieved an implementation percentage of 85 (mean total score of 34 out of 40 across ten observation aspects). The teacher opened and closed the lesson effectively, explained the objectives, managed the classroom, integrated texts with visual media, implemented role-play and the snake-and-ladder kinesthetic game, and checked students' understanding. Students engaged with the biodiversity of East Kalimantan through texts, images, videos, infographics, discussion, role-play, and kinesthetic activity.

Student learning outcomes

Of the 23 students who completed both the pre-test and post-test, the mean score increased from 78 (standard deviation [SD] = 4.02; minimum = 70; maximum = 82) to 85 (SD = 3.74; minimum = 78; maximum = 90). The mean difference was 7 (SD =

DOI: https://dx.doi.org/10.30656/jpmwp.v10i2.12591

4.64), representing an increase of 8.97%. Twenty-two students showed an increase in scores, one student obtained the same score, and no student experienced a decrease. The mean N-gain was 0.31 (SD = 0.17), which was categorized as moderate according to Hake (1998), as presented in Table 3.

The Wilcoxon signed-rank test was used in this analysis because the Shapiro–Wilk test showed that the score differences were not normally distributed (W = 0.851; p = 0.003). The test results indicated a significant improvement (Z = -4.138; p = 0.001). These results indicate that an improvement followed multimodal learning in students' understanding of the biodiversity topic. However, the absence of a control group limits causal interpretation.

Multimodal Learning Products

Training and mentoring produced multimodal learning resources, including illustrations, infographics, presentation slides, videos, role-play cards, and other visual resources. These materials supported reading, observation, listening, discussion, performance, and movement activities. Examples of the products are presented in Fig. 4.



Fig. 4. Examples of multimodal learning products for East Kalimantan biodiversity learning

The products supported reading, observation, discussion, role play, and kinesthetic activities. The materials were revised during the mentoring process before being used in classroom implementation.

Institutional Development

Institutional development was conducted to ensure the sustainability of literacy and numeracy programs at SDN 016 Sungai Kunjang. Institutional strengthening was achieved by establishing the Literacy–Numeracy Team and the Digital Library Development Team as two formal school teams. Both teams were established by school principal decree, which provided the legal basis and the guidelines for implementing their respective responsibilities. The establishment of these institutions is important to ensure that literacy activities do not depend solely on short-term training or mentoring but have a clear structure, responsibilities, and working mechanisms at the school level (Dewayani et al., 2021).

The Literacy–Numeracy Team of SDN 016 Sungai Kunjang was established through School Principal Decree Number 422.10559100.0118.0816, which stipulated the team's organizational structure, responsibilities, and term of service. The school principal served as the person in charge, and community engagement team members served as advisors; the chairperson, secretary, treasurer, and members were all teachers. The responsibilities of the Literacy–Numeracy Team include planning, implementing, monitoring, and evaluating literacy and numeracy activities at the school: developing annual activity plans, coordinating literacy activities, monitoring teacher and student engagement, managing learning resources, and evaluating program outcomes. The team is also responsible for maintaining the sustainability of programs initiated through training, module development, and classroom implementation. The organizational structure of the Literacy–Numeracy Team is presented in Fig. 5.

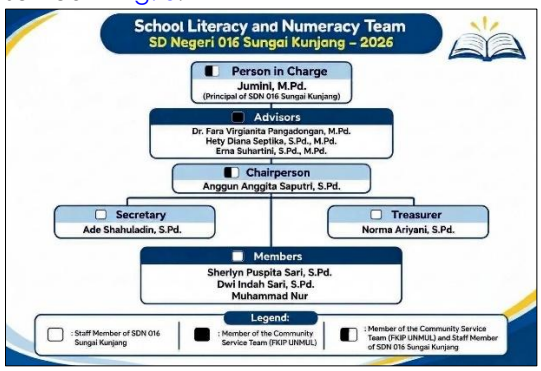

Fig. 5. Organizational structure of the Literacy-Numeracy Team at SDN 016 Sungai Kunjang

The Digital Library Development Team of SDN 016 Sungai Kunjang was established through School Principal Decree Number 422.10559.11100.0118.0816, which stipulated the team's organizational structure and responsibilities for developing and managing the school's digital library. Team members consisted of teachers, library staff, and students from the community engagement program. The responsibilities of the Digital Library Development Team include managing digital collections,

DOI: https://dx.doi.org/10.30656/jpmwp.v10i2.12591

developing local wisdom-based content, maintaining links and the website interface, and monitoring the use of the library by teachers and students. The team is also responsible for gradually adding collections, including works by teachers and students, and for coordinating literacy activities that utilize the digital library. The digital library was developed using Google Sites and initially contained approximately 20 storybooks and 12 local wisdom-based children's stories. The digital library is presented in Fig. 6.

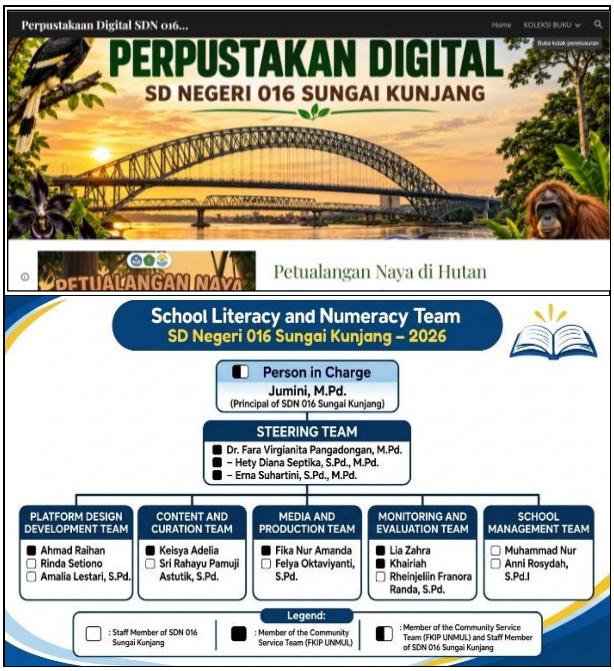

Fig. 6. Google Sites-based digital library of SDN 016 Sungai Kunjang and Organizational structure

Both teams worked in a coordinated manner under the direction of the school principal. The Literacy–Numeracy Team focused on planning and implementing literacy and numeracy activities, whereas the Digital Library Development Team focused on managing digital learning resources that support those activities. Coordination between the teams was conducted through regular meetings, task distribution, and periodic monitoring. Community engagement team members served as advisors to the Literacy–Numeracy Team and as directors of the Digital Library Development Team, according to the school's needs. The working mechanisms of both teams included developing annual work plans, implementing activities, monitoring implementation, and evaluating outcomes, and the school principal was responsible for ensuring that both teams carried out their respective tasks and functions. Through this structure and mechanism, the school now has a stronger institutional basis for continuing literacy and numeracy activities and digital learning resource development on a sustainable basis.

Monitoring and Evaluation

Monitoring identified several implementation constraints, including projector problems, uneven availability of reading corners, teachers' need for further mentoring in developing creative student worksheets, and students' limited access to mobile phones and internet connectivity. The school and the community engagement team developed practical adjustments, including checking equipment before learning, preparing printed alternatives, arranging student groups and seating, continuing student worksheet mentoring, and gradually expanding the digital library collection.

The final evaluation indicated that teachers and the school principal considered the program beneficial. Participants appreciated the practical training, the opportunities to use multimodal media, the mentoring in module and student worksheet development, and the direct classroom implementation. Participants also expressed their readiness to continue using the module, maintain literacy activities, activate the Literacy–Numeracy Team, and update the digital library. Table 7 summarizes the main outcomes of the program for teachers and students.

Discussion

The post-program outcomes suggest that practice-oriented training and mentoring may support teachers' competence in multimodal learning. The finding that 80% of the teachers were able to select appropriate media and that all of them produced AI-assisted media suggests that teachers responded positively when multimodal literacy was introduced through concrete classroom tasks. These findings are consistent with research showing that professional development is more effective when it involves active learning, collaboration, mentoring, and direct relevance to teachers' teaching practice (Darling-Hammond et al., 2017; Lofthouse & Thomas, 2017; Thurlings & den Brok, 2017). Similar community engagement programs have shown that guided practice can improve teachers' digital competence and confidence in using AI-assisted learning media (Fadiana et al., 2025; Pangadongan et al., 2026). Taken together, training and classroom mentoring provide an important basis for strengthening teachers' competence in multimodal learning.

The difference between the proportion of teachers who produced AI-assisted media (100%) and those who completed full learning designs (53.3%) should be interpreted in relation to the time available for completing the tasks. Seven teachers did not complete their designs within the program period because of competing teaching

DOI: https://dx.doi.org/10.30656/jpmwp.v10i2.12591

Table 7. Summary of program outcomes for teachers and students

Indicator	Outcome
Number of teachers participating in training	15 teachers
Teachers able to select multimodal media	12 of 15 teachers (80%)
Teachers able to create AI-assisted multimodal media	15 of 15 teachers (100%)
Teachers able to develop complete learning designs	8 of 15 teachers (53.3%)
Module validity percentage	90
Learning implementation percentage	85
Instructional practice video	A video of the classroom implementation is available on the team's YouTube channel.
Students' mean pre-test score	78 (SD = 4.02)
Students' mean post-test score	85 (SD = 3.74)
Mean difference	7 (SD = 4.64)
Percentage increase	8.97%
Mean N-gain	0.31 (moderate)
Wilcoxon signed-rank test	Z = -4.138; p = 0.001
Literacy–Numeracy Team	Established through School Principal Decree No. 422.10559100.0118.0816
Digital Library Development Team	Established through School Principal Decree No. 422.10559.11100.0118.0816
Digital library	Available through Google Sites at https://sites.google.com/view/perpustakaandigitalsdn016skj/home

responsibilities, school duties, and school activity deadlines. This difference does not, by itself, demonstrate difficulty with particular pedagogical components. Although a complete learning design requires alignment among objectives, content, activities, media, student worksheets, and assessment, the present findings do not identify which components, if any, posed difficulties for these teachers. Future programs should provide more flexible submission schedules and allow additional time for completing full learning designs.

Generative AI supported teachers in producing locally relevant multimodal materials. All teachers were able to create multimodal media after receiving guided practice, indicating that AI tools can reduce the technical barriers to producing visual and presentation materials (Fadiana et al., 2025). AI-generated materials nevertheless require teacher review to ensure factual accuracy, cultural relevance, language quality, and alignment with curriculum objectives. Multimedia learning principles emphasize that media should be designed in line with students' cognitive processing capacity rather than merely increasing the number of learning resources (Mayer, 2009; Sari et al., 2025; Yulianto et al., 2025). AI therefore functions as a supporting tool, while teachers remain primarily responsible for pedagogical decision-making (Fadiana et al., 2025).

The strength of the IPAS module lies in the formulation of objectives, content appropriateness, multimodal literacy integration, and contextualization of learning. Research indicates that clarity of learning objectives and alignment among objectives, activities, and assessment play an important role in supporting learning quality (Yulhendri et al., 2025). The validation results bear this out: module identity and information, learning objectives, content appropriateness, strategies and methods, multimodal literacy integration, multimodal literacy activities, contextualization of learning, and readability and presentation received the highest scores. The module accordingly rests on a sound foundation in objective formulation, content selection, activity design, and material presentation. Its integration of the biodiversity of East Kalimantan as local content strengthens this result, because multimodal learning principles indicate that local content can be represented through various modes, including texts, images, videos, infographics, role-playing, and kinesthetic activities (Gunawan et al., 2025).

The aspects of intermodal connections, student worksheets, assessment, reflection, and module implementation require strengthening to optimize module quality. Multimodal learning principles indicate that meaning is constructed through interactions among texts, images, audio, videos, and movement (Febriyanto et al., 2026; Gunawan et al., 2025), whereas formative assessment and feedback play an important role in supporting student learning (Putri et al., 2025). The validation results bear this out, since these five aspects received lower scores than the others. Module implementation relates to the extent to which the module design is realistic and can be implemented given the available time, facilities, classroom conditions, and student characteristics.

DOI: https://dx.doi.org/10.30656/jpmwp.v10i2.12591

Strengthening these aspects will improve the alignment among objectives, activities, media, and evaluation, while ensuring that the module is more realistic for classroom implementation.

The variety of classroom activities reinforced teachers' pedagogical competence in multimodal learning. According to Darling-Hammond et al. (2017), effective teacher professional development involves active learning, collaboration, feedback, and direct relevance to teaching practice. The observation results showed that the learning implementation percentage reached 85. The aspects that received the highest scores included opening and closing learning and multimodal contextualization, whereas explaining, questioning, providing reinforcement, and engaging students in multimodal literacy still required strengthening. Teachers were thus able to implement the basic components of multimodal learning but still needed to strengthen their skills in explaining, questioning, providing reinforcement, and engaging students. The variety of multimodal activities in the classroom provides opportunities for students to construct and communicate meaning through various modes (Jewitt et al., 2016; Serafini, 2022). Implementing multimodal learning in the classroom therefore has the potential to support student engagement while providing teachers with opportunities to improve their pedagogical competence continuously.

The establishment of the Literacy–Numeracy Team and the Digital Library Development Team strengthened the institutional basis of the program. Both teams were established through school principal decrees and had clear structures and task divisions, creating mechanisms for planning, coordinating, monitoring, and evaluating literacy and numeracy activities at the school. The establishment of a literacy team and the strengthening of the roles of the school principal and teachers in literacy activities are consistent with the principles of the School Literacy Movement (Faizah et al., 2016). The digital library developed through Google Sites expanded the school's access to reading materials and local wisdom-based content, and the role of the library as part of the school literacy ecosystem is also supported by the School Literacy Movement guidelines (Faizah et al., 2016). However, the sustainability of the digital library still depends on the availability of devices, internet connectivity, and school management. Students' limited access to mobile phones and the internet was one of the constraints identified during program implementation. The school therefore needs to develop support strategies, including the use of printed alternatives and the strengthening of reading corners, to ensure that literacy activities can continue.

The monitoring process demonstrated the value of reflection and adaptive problem-solving. Technical problems, uneven availability of reading corners, and the need for further student worksheet mentoring were identified during implementation and addressed through practical adjustments. This process is consistent with the reflective cycle of Participatory Action Research, in which observation and reflection are used to refine subsequent actions and strengthen local ownership of the intervention (Kemmis et al., 2014; Lutfitasari et al., 2026). Reflection and adaptation are important components in ensuring program sustainability.

The improvement in students' learning performance indicates the positive effect of the intervention, although its causal effects remain limited. Students' mean scores increased from 78 to 85, supported by significant Wilcoxon signed-rank test results and a moderate N-gain (Hake, 1998). These results are consistent with research showing that contextual and local wisdom-based learning can support scientific literacy, critical thinking, and students' understanding of the material (Mulatsih et al., 2023; Uslan et al., 2025). The observed improvement should nevertheless be interpreted as descriptive evidence rather than definitive causal evidence, because the program did not include a control group, the sample was limited to 23 students, and the post-test was conducted after a relatively short intervention period (Creswell & Creswell, 2014; Yuda & Rosmilawati, 2024). Student learning outcomes should accordingly be interpreted as an initial indication of the program's effectiveness rather than as strong causal evidence.

The main contribution of this program is the integration of teacher development, local wisdom, multimodal learning, and institutional support for literacy. The intervention did not stop at training teachers to create media but connected media production with the development of an IPAS module, student worksheets, classroom implementation, student assessment, the establishment of the Literacy–Numeracy Team, and the creation of a digital library. This integrated approach is consistent with teacher professional development principles that emphasize relevance to teaching practice (Darling-Hammond et al., 2017) and with School Literacy Movement principles that involve the school principal, teachers, and the library (Faizah et al., 2016). It also extends previous literacy and numeracy programs that emphasized contextual content, teacher participation, and school-based resources (Septika et al., 2025; Septika & Pangadongan, 2023). Future programs should use larger samples, comparison groups, delayed post-tests, and longer monitoring periods to strengthen causal claims and assess sustainability (Creswell & Creswell, 2014; Yuda & Rosmilawati, 2024).

A further limitation concerns the evaluation of teacher outcomes. Quantitative baseline data on

teacher competence were not collected; therefore, the post-program percentages cannot establish the extent of improvement attributable to the program. In addition, the completion of full learning designs was affected by teachers' competing school responsibilities and deadlines. Future evaluations should combine baseline and follow-up assessments with records of task completion and the time available for completing the tasks.

CONCLUSION

This community engagement program supported teachers in developing multimodal literacy learning based on East Kalimantan local wisdom. Following the program, 12 of the 15 participating teachers selected appropriate multimodal media, all 15 produced AI-assisted media, and eight completed full contextual IPAS learning designs. The developed module obtained a validity percentage of 90, while classroom implementation achieved an implementation percentage of 85. Students' mean scores increased from 78 to 85, with a statistically significant Wilcoxon signed-rank test result (Z = -4.138; p = 0.001) and a moderate N-gain of 0.31. The program also established the Literacy–Numeracy Team, the Digital Library Development Team, and a Google Sites-based digital library to support the sustainability of school literacy practices. Practice-oriented training combined with classroom mentoring and institutional strengthening has the potential to strengthen teachers' competence and support sustainable literacy development in elementary schools.

ACKNOWLEDGEMENTS

This community engagement program was funded by the Community Engagement Grant Program of the Faculty of Teacher Training and Education, Universitas Mulawarman, in 2026, under contract number 1246/UN17.5/PG/01.01/2026. The authors would like to thank the Faculty of Teacher Training and Education, Universitas Mulawarman. They also express their appreciation to the school principal, teachers, and students of SDN 016 Sungai Kunjang, Samarinda, for their participation and active collaboration throughout the program.

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