ABDI MASYARAKAT
Vol. 7 No 2 Desember 2025
***P-ISSN**: 2715-8799;**E-ISSN**: 2715-9108*
Link : *http://ejournal.mandalanursa.org/index.php/PB/issue/archive*

Deep Learning-based PjBL-based Teaching Material Development Training for Strengthening Pancasila Student Profiles in Junior High School Teachers

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Article Info
Article history:
Accepted: 15 September 2025
Publish: 01 December 2025

Keywords:
Project-Based Learning,
deep learning pedagogy,
digital literacy,
community service,
junior high school teachers.

Abstract
This community service project was motivated by the low digital literacy and limited capacity of teachers at SMP Negeri 2 Lambu in developing teaching materials based on Project-Based Learning (PjBL) and deep learning pedagogy. The main objective was to empower teachers through training, workshops, and intensive mentoring to enhance their ability to design contextual, innovative learning tools aligned with the Pancasila Student Profile. The methods included pre-test, practice-based training, continuous mentoring, and post-test to evaluate teachers' competency improvement. The results revealed a significant increase in all indicators: understanding of PjBL concepts rose from 38% to 87%, mastery of deep learning from 25% to 78%, ability to design PjBL lesson plans from 31% to 82%, digital literacy from 28% to 75%, and AI utilization from 12% to 61%. These findings confirm that the program successfully enhanced teachers' pedagogical capacity and digital literacy while fostering the establishment of a digital learning community to ensure program sustainability.

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1. INTRODUCTION

Education is a fundamental aspect in sustainable human resource development. One of the big challenges in 21st century education is to encourage teachers to be able to innovate in developing teaching materials that are in line with technological developments and the needs of students' character. This condition is very felt in areas such as Lambu District, Bima Regency, West Nusa Tenggara.

SMP Negeri 2 Lambu, as one of the formal educational institutions in this region, has great potential in producing a generation of superior Pancasila students, but faces various obstacles in terms of developing contextual, creative, and technology-based teaching materials. Based on initial observations and the results of discussions with the school, it is known that most teachers at SMPN 2 Lambu still use conventional learning methods that are oriented towards lectures and written assignments without strengthening the collaborative and critical thinking aspects of students. The use of technology in the learning process is still minimal due to the lack of technology-based training, limited digital literacy, and access to *deep learning-based* learning resources and *Project-Based Learning (PjBL).* The following will show a picture of the learning atmosphere carried out by teachers in the classroom that is still conventional.

Figure 1: Learning Conditions in the Classroom

Lambu District itself is an area that is still relatively limited to access to digital infrastructure, as well as the socio-economic conditions of the people who are mostly working in the agricultural sector. Data from the Bima Regency Education and Culture Office shows that only 35% of teachers in this sub-district have participated in educational technology-based training in the last five years [1]. This shows that there is a digital literacy gap between teachers in this area and teachers in urban areas.

The potential of SMPN 2 Lambu lies in the collaborative spirit of the teachers and the support from the principal for professional development programs. In addition, the teachers showed high enthusiasm in increasing their capacity through training activities that are relevant to the needs of the times. However, this potential has not been properly facilitated due to limited access to information, low digital skills, and the unavailability of *PjBL-based* learning models that integrate technology such as *deep learning*.

If not addressed immediately, this condition will widen the gap in the quality of education between urban areas and areas such as Lambu. Therefore, it is necessary to empower teachers through training and assistance in the development of teaching materials based on *Project-Based Learning* integrated *with deep learning* to support the strengthening of *the Pancasila Student Profile*.

SMP Negeri 2 Lambu is a junior high school located in the east coast area of Lambu District, Bima Regency. The school has a total of 307 students with 77 teachers and 11 educators. Of these, only 11 teachers have ASN status, 11 ASN P3K, 3 TPU Teachers, 3 TPU employees, and 60 people with honorary status. Based on the results of interviews with the school, almost all teachers have never received training or workshops related to the development of technology-based teaching materials and digital learning. In Table 1, the profile of SMP Negeri 2 Lambu will be presented as follows.

In terms of socio-economy, the majority of students' families come from the lower middle economic class. The main livelihood of students' parents is farming and planting. This has an impact on the low economic carrying capacity of families for digital learning support facilities at home, such as laptops or stable internet connections. In addition, geographically, the location of SMP Negeri 2 Lambu is quite far from the center of the Bima Regency government and the center of Bima City, with a distance of about 76.3 km and a distance of 1 hour and 59 minutes, and quite limited road access, especially during the rainy season.

Nevertheless, the students' enthusiasm for learning is quite high, and the school is committed to improving the quality of education through various forms of partnerships and teacher capacity building. School principals and teachers welcome this training and mentoring plan as a concrete form of improving the quality of teaching in the digital era.

The main purpose of this activity is to empower teachers of SMP Negeri 2 Lambu through training and assistance in developing *Project-Based Learning-based* teaching materials that are integrated with *a deep learning approach*, to encourage the strengthening *of the Pancasila Student Profile* and improve the digital literacy of teachers and students. This

activity is in line with several goals in the Sustainable Development Goals (SDGs), especially SDG 4: Ensuring inclusive and quality education and supporting lifelong learning opportunities for all. SDG 9: Building resilient infrastructure, supporting inclusive and sustainable industrialization, and fostering innovation. From the side Key Performance Indicators (IKU) Universities, this activity supports IKU: IKU 2: Students gain experience outside the campus through community service collaborations. IKU 3: Lecturers in off-campus activities (community service). IKU 7: Collaborative and participatory classes, especially on the development aspect of contextual learning.

This activity also supports Asta Cita number 5, namely "Improving the quality of life of Indonesian people", and intersects with the focus of the National Research Master Plan (RIRN) in the field of education and information technology. In this context, *the deep learning* approach is not only interpreted in the aspect of artificial intelligence technology, but also in a pedagogical context, namely deep learning pedagogy that prioritizes conceptual understanding, connections between knowledge, and 21st-century skills [2][3].

The focus of the problems taken in this activity are: (a) low teacher digital literacy in developing technology-based teaching materials, (b) the lack of optimal strengthening of Pancasila student profiles through contextual learning, and (c) limited access for teachers to innovative learning-based training such as *PjBL* and *deep learning*.

This activity is also designed to produce outputs in the form of digital teaching materials modules based on *Project-Based Learning* and *deep learning*, which can be used continuously by schools and replicated by other teachers in the surrounding area. In addition, student involvement in this activity is expected to have a double impact, namely, strengthening student competence and increasing the involvement of academics in community empowerment [4,5]. With the support of technology and *a coaching and mentoring* approach, this activity will focus on direct practice, learning reflection, and impact evaluation, so that the results are not only ceremonial but able to foster real and sustainable changes in the learning process at SMPN 2 Lambu.

Based on the results of field identification, focus *group discussions*, and direct coordination with SMP Negeri 2 Lambu partners, two main priority issues have been agreed to be addressed through this service activity. These problems are related to the social aspects of society in the field of education, with a focus on empowering teachers as the main agents of improving the quality of learning. The following is a description of the problems and sub-problems that were mutually agreed:

Low Ability of Teachers to Develop Technology-Based Contextual Teaching Materials and PjBL, Sub Problem: Teachers have not fully understood the concept *of Project-Based Learning (PjBL)* and have not been able to integrate it systematically in classroom learning. The teaching materials used tend to be textual and theoretical, do not utilize digital media, and are less relevant to the local context and the needs of 21st-century students. There is no teaching material development module based on *deep learning pedagogy* as a guide for teachers in developing meaningful and collaborative learning. The lack of continuous training in the development of technology-based teaching tools makes it difficult for teachers to develop effective and impactful learning projects.

Priority Problem 2: Lack of Teachers' Digital Literacy in the Use of Educational Technology. Sub Problem: Teachers are not familiar with digital platforms that support learning, such as Canva for Education, Google Classroom, Padlet, or AI tools such as ChatGPT, in a pedagogical context. Low teacher confidence in integrating technology in the learning process due to limited training and hands-on experience. There is no mentoring system to help teachers explore and innovate learning technology independently and sustainably. Infrastructure and the use of ICT are not optimal in schools, as well as the limitations of devices in each teacher's home.

Socio-Economic Impact and Benefits of the Program. This service program is expected to have a broad socio-economic impact, especially in**:** Improving the quality of

education services in remote areas, which will directly support the improvement of the quality of the young generation as future human resources. Teacher empowerment is the spearhead of educational change, which indirectly encourages the improvement of digital literacy in the surrounding community, because teachers become agents of knowledge dissemination. Efficiency of learning costs through the use of digital teaching materials that can be used continuously and multiplied without the need for large printing costs. Strengthening the teacher community as a forum for collaboration that has an impact on the productivity of ideas and creativity of learning, which can foster the confidence and social position of teachers in the community.

This activity is in line with the concept of education as a tool of social transformation, where the empowerment of teachers in mastering modern technology and pedagogy can form agents of change that are resilient to the challenges of the times and encourage local development based on regional potential [6,7,8]. Thus, the solutions offered not only target increasing the capacity of individual teachers, but also contribute to strengthening the social system in general in Lambu District and its surroundings.

Solutions offered to Solve Partner Problems, Based on two priority problems that have been agreed with partners, namely (a) Low ability of teachers to develop teaching materials based on PjBL and deep learning, and (b) Lack of digital literacy of teachers in the use of educational technology, the solutions offered are as follows: Solutions to Priority Problems 1; Low Ability of Teachers in the Development of PjBL-Based Teaching Materials and Deep Learning. Intensive Training on the Concept and Implementation of Deep Learning Integrated PjBL. Material: PjBL philosophy, stages of implementation, and application *of deep learning pedagogy* in the context of the junior high school curriculum. Methods: blended learning (face-to-face + online), simulation, case discussion. Support: print and digital modules.

Project-Based Teaching Materials Preparation Workshop: Teachers will design teaching materials in the form of *project-based modules* associated with Pancasila student profiles. The theme of the project is adapted to the student's local context (environment, maritime culture, coastal economy). Strengthened by the integration of literacy, numeracy, and 21st-century skills. Individual and Group Assistance; The service team provides *coaching and mentoring* for 2 months for the implementation of teaching materials into classroom practice. Reflection and evaluation are carried out periodically through a forum to share good practices.

Solutions to Priority 2 Problems: Lack of Digital Literacy of Teachers; training on the use of digital educational technology; Material: the use of Canva for Education, Google Workspace, Padlet, and AI-based tools such as ChatGPT for learning planning. Teachers are trained to prepare digital lesson plans and interactive presentations. Introduction and Simulation of Deep Learning Platforms in Learning. Focus on *the pedagogical approach of deep learning*, not just artificial intelligence. Teachers learn how to design learning experiences that are meaningful, relevant, and encourage deep understanding. the establishment of a digital learning community; A WhatsApp/Telegram-based forum was formed for discussion between teachers and the service team. This community is a means of exchanging information and solving technical problems.

The following are the results of previous research that became the basis of this activity, as well as showing the *gaps* that are the basis for the novelty of the activity: First, the Development of Project Teaching Materials for Junior High School. The development of project-based teaching materials increases student motivation, but has not integrated digital technology optimally [9]. Second, the Teachers' Needs for PjBL Training research shows that teachers have difficulty designing contextual teaching materials based on PjBL without training [10]. Third, Project-Based Learning to Improve Critical Thinking, PjBL-based modules are effective in improving critical thinking skills, but have not focused on teachers in the 3T area [11]. Fourth, Digital Literacy for Teachers in Remote Areas, teachers in rural areas face great challenges in the use of digital learning platforms [12]. Fifth, Teacher

Training and PjBL Implementation, the teacher training model is still theory-centered, and has not yet adopted *deep learning pedagogy* [13]. Sixth, the Development of Contextual Teaching Materials, project-based learning is more effective if it is associated with the local context of students [14]. Seventh, Digital Literacy Assistance for Junior High School Teachers, teachers need intensive assistance to adopt technology in learning [15]. Eighth, AI in Education: Opportunities for Teachers, the study mentioned that there is no AI-based PjBL training model for junior high school teachers in coastal areas [16]. Ninth, Deep Learning Pedagogy and Its Implications, the integration of *deep learning pedagogy* encourages students' metacognitive skills, but its application by teachers is not optimal [17]. Tenth, the Digital-Based Teacher Learning Community, there is no structured digital learning community model in rural high schools [18]. Based on the results of the research above, the novelty of this activity**:** First, this activity integrates Project-Based Learning training with a deep learning pedagogy approach simultaneously. Second, the solution includes the development of contextual teaching materials based on *Pancasila student profiles* and locally-relevant technology. Third, there is a continuous mentoring model and the formation of a digital learning community that will continue to run even after the program is completed.

2. RESEARCH METHODS

The following is the Implementation Method part of the Community Service (PKM) proposal for the 2025 Community-Based Empowerment scheme with SMP Negeri 2 Lambu Teacher partners:

1. Solution Implementation Stages

The implementation of this service program is carried out systematically and gradually to overcome problems that have been agreed with partners. The stages of program implementation include five main steps: socialization**,** training**,** technology application**,** mentoring and evaluation, and program sustainability. Each stage is designed to answer the needs of partners and contextually solve problems.

2. Method of Stages of Implementation of Community Service

a. Program Socialization

Socialization is the initial stage that aims to convey program information comprehensively to partners, explaining the objectives, benefits, stages of activities, and the expected form of participation. Socialization was carried out in a participatory manner in the teacher's room of SMP Negeri 2 Lambu with a focused group discussion approach.
Main activities:

- Program exposure by the proposing team.
- Signing of partnership agreements.
- Initial data collection from partners (baseline).

Benefit:

- Building mutual understanding and collective commitment.
- Ensure the active role of partners in all stages of the program.

b. Training

The training is designed in the form of an intensive workshop for 3 days, focused on increasing the capacity of teachers in developing *Project-Based Learning (PjBL)*-based teaching materials and deep *learning pedagogy integration*.
Materi pelatihan:

- The concept and practice of PjBL in the context of secondary education.
- Deep *learning approach* for teachers.
- Strengthening *the Pancasila Student Profile* through contextual projects.
- Utilization of digital learning platforms

Training method:

- Interactive lectures, simulations, case studies, and *hands-on activities.*

Exterior:

- Teachers have a theoretical understanding and initial skills in designing innovative teaching materials.

c. Application of Technology

After the training, teachers are given technical training on the use of educational digital platforms and applications to support the learning process.

Technologies introduced:

- Canva for Education: for creating visual teaching materials.
- Google Classroom and Padlet: as collaborative media.
- ChatGPT and other AI tools: as assistants in content development.
- A simple Learning Management System (LMS): for the management of digital modules.

Activity targets:

- Teachers can utilize technology to compile and deliver teaching materials interestingly and interactively.
- Teachers can design project-based digital learning.

d. Mentoring and Evaluation

Mentoring is carried out for two months after training. Each teacher will be accompanied individually and in groups by the service team and students.

Form of activity:

- *Weekly coaching and mentoring*.
- Observation and evaluation of learning practices in the classroom.
- Reflection and revision of teaching materials.

Evaluation is carried out through:

- Pre-test and post-test questionnaires.
- Learning documentation (photos/videos).
- Teacher and student interviews.
- Assessment of the quality of teaching materials and digital lesson plans.

Evaluation objectives:

- Measuring the improvement of teacher competence.
- Assess the effectiveness of program interventions.
- Compile achievement reports and recommendations for improvement.

e. Program Sustainability

This program is designed to be able to continue even after the service is completed.

Sustainability strategies include:

- Establishment of a Digital Learning Community for Lambu Junior High School Teachers.
- Preparation of technical guidelines (manual book) for the use of technology.
- Appointment of "mentor teachers" as local facilitators.
- Continued collaboration between the proposer team and partners through an online platform.

Post-program activities:

- Evaluation meetings and follow-up plans.
- Online assistance by the proposer team.
- Replicate the program to nearby schools (if possible).

f. Methods of Approach and Technological Innovation

The approach method used in this program is participatory-collaborative**,** where teachers play an active role in the entire process, from planning to evaluation. The technology and innovations used are applicable, simple, and in accordance with the conditions of the partner's infrastructure.

Suitability of work volume and priority scale:

- The volume of activities is focused on two aspects: teacher capacity building and the integration of learning technology.

- Priority is given to teachers of core subjects (Science, Mathematics, Indonesian, Social Studies).

Partner participation:

- Teachers are involved as active participants and implementers of experiments in the classroom.
- The principal provides administrative and technical support.
- Partners participate in the evaluation and reflection process.

g. Stages of Implementation of Social Community Programs

In addition to the educational aspect, this program also touches on social aspects of society, such as:

- Inclusive education services: Teachers are trained to develop teaching materials that accommodate student diversity and educational inclusivity.
- Social conflict and classroom security: Teachers are equipped with a collaboration-based learning approach that fosters the values of tolerance, cooperation, and dialogue (Pancasila values).
- Prevention of digital illiteracy: The program reduces the digital literacy gap among teachers and the school community at large through access to open learning resources and technology training.

h. Partner Participation in Program Implementation

Partners (teachers and principals of SMP Negeri 2 Lambu) showed high participation by:

- Provide study spaces and training facilities.
- Prepare a conducive implementation schedule.
- Be directly involved in evaluation, evaluation, and follow-up discussions.
- Assign teacher representatives to be local facilitators.

i. Program Evaluation and Sustainability

- Formative evaluation**:** Conducted during the mentoring process to measure progress per individual.
- Summative evaluation**:** Conducted after all activities are completed to assess final achievements and sustainability.

Program sustainability:

- Digital learning community remains active with online mentoring
- Schools can use modules and video tutorials as in-house training materials
- Teachers can share good practices with other schools in the MGMP or KKG forums

3. RESULTS AND DISCUSSION

3.1 Results

Before the service activity was carried out, a pre-test was first carried out for 72 teachers to find out their initial understanding of PjBL, digital literacy, and the use of learning technology. These results are the basis for measuring the effectiveness of the program to be provided. After the program is completed, a post-test is carried out again to find out the extent of improvement in teacher competence. The following pre-test and post-test results show a clear comparison between the conditions before and after the activity.

Table 1. Teacher Pre-Test and Post-Test Results

Indicator	Pre-Test (% of Teachers Mastered)	Post-Test (% of Teachers Proficient)	Increased
Understanding the concept of PjBL	38%	87%	+49%
Understanding of Deep Learning concepts	25%	78%	+53%

Ability to prepare lesson plans based on PjBL	31%s	82%	+51%
Digital literacy (Canva, Padlet, etc.)	28%	75%	+47%
Utilization of AI (ChatGPT, LMS, etc.)	12%	61%	+49%

The results of the pre-test showed that teachers' understanding of the concept of Project-Based Learning (PjBL) was still limited, with only 38% of teachers able to explain correctly. This condition is natural because most teachers have never participated in intensive training related to PjBL before. In addition, mastery of the concept of deep learning pedagogy is also very low; only 25% of teachers understand that this learning focuses on deep understanding and critical thinking. This low initial achievement emphasizes the importance of service activities to improve the quality of learning. In general, this baseline is a reference in designing training and mentoring strategies that are more targeted.

After participating in a series of training, workshops, and mentoring, the post-test results showed a significant improvement in all indicators. The understanding of the concept of PjBL increased to 87%, while the mastery of deep learning pedagogy reached 78%. Quite interesting is the ability of teachers to prepare PjBL-based lesson plans, which were initially mastered by only 31% of teachers, but jumped to 82% after mentoring. This improvement reflects the effectiveness of training programs that are based on hands-on practice and contextual case studies. In addition, teachers' skills in implementing the student-centered learning approach have also experienced significant improvements.

Digital literacy and technology utilization have also increased significantly. Initially, only 28% of teachers were used to using digital platforms such as Canva, Padlet, and Google Classroom, but after the program, the figure rose to 75%. The use of AI, such as ChatGPT, has also increased from 12% to 61%, although some teachers still need advanced assistance. Overall, this improvement shows that teachers can integrate technology into the learning process with more confidence. With these results, it can be ensured that service activities have had a real impact on increasing teacher capacity, both in pedagogical and digital literacy aspects.

In addition to the table, documentation of the activity is also presented in the form of pictures to show the real atmosphere during the implementation. This image shows the interaction, participation, and enthusiasm of the teachers in participating in the activity. This visualization complements the quantitative data, thus providing a comprehensive picture of the program's results. With the images, readers can see how the teacher is involved in hands-on practice and collaboration.

Figure 2. Documentation of Teacher Activities and Participants

Figure 2 shows the atmosphere of teacher training and mentoring activities that take place actively and participatively. A total of 72 teachers were involved in this activity, representing various subjects and grade levels at SMP Negeri 2 Lambu. This photo of the documentation shows how the teachers enthusiastically participated in the training sessions, discussed, and collaborated in compiling teaching materials based on PjBL. The presence of a large number of teachers shows that there is strong support from the school for this program. This active participation is also an indicator of the success of the training approach carried out.

The atmosphere of togetherness reflected in the picture shows that this activity is not only a transfer of knowledge, but also a network and learning community between teachers. The participants looked excited, using symbolic hand gestures that signaled full involvement in the program. The warmth of the interaction between participants also strengthened their confidence in trying new learning methods. This shows that community service not only produces outputs in the form of modules and lesson plans, but also changes the mindset of teachers. Thus, this picture is clear evidence of a transformation of learning culture in the school environment.

The picture also illustrates the achievement of the main goal of the activity, which is to produce Champion Teachers who can become agents of change in schools. Teachers who were previously less familiar with technology are now showing readiness to adapt to digital learning. This visual documentation is an important part to complement the quantitative data presented in the pre-test and post-test results tables. With the visualization of activities, the public can more easily understand the real impact of this service program. In addition, the documentation also serves as evaluation material and inspiration for similar activities in the future.

3.2 Discussion

Improving Understanding of PjBL and Deep Learning

Increasing teachers' understanding of PjBL and deep learning shows that practice-based training methods are very effective. Teachers are not only given theory, but also invited to prepare lesson plans and project-based teaching materials that are relevant to the local context. This helps teachers understand that learning is no longer centered on the teacher, but rather on students actively exploring knowledge. The direct involvement of teachers in developing projects makes it easier for them to understand the concept of meaningful learning. Significant improvements in this indicator are in line with research findings on the effectiveness of the PjBL model [19].

In addition, this increase also shows a change in the learning paradigm among teachers. Those who were originally familiar with the lecture method are now more open to

student-oriented learning models. Understanding deep learning also enriches teachers' perspectives in designing more in-depth learning activities. Thus, students not only acquire basic knowledge, but are also trained to think critically and solve real problems. This change has the potential to improve the quality of learning in the classroom continuously.

Transforming Teachers' Digital Literacy

The results of the post-test showed that teachers' digital literacy increased significantly, especially in the use of applications such as Canva, Google Classroom, and Padlet. Before the training, teachers were limited to getting to know digital platforms, but had not used them for learning. After mentoring, teachers are not only able to use the application but also integrate it into the teaching and learning process. This indicates a transformation in 21st-century skills that teachers must have. This condition also supports the national education strategy that emphasizes digital literacy as a basic competency [20].

The increase in teachers' digital literacy can also be seen in their ability to develop interactive teaching materials. Teachers can produce engaging digital modules by utilizing visual and audio media. This makes learning more contextual and in accordance with the characteristics of digital generation students. Teachers' ability to integrate technology into learning also opens up opportunities for collaboration across subjects. Thus, developing digital literacy is an important capital in creating learning innovations in schools.

Utilization of AI in Learning

One of the important achievements of this service activity is the increasing courage of teachers in using AI technology, such as ChatGPT, to help design teaching materials. Before the training, only a small percentage of teachers had ever tried, and most had doubts. But after training, more than half of the teachers were able to use AI to support their creativity. This shows that with the right mentoring, teachers can adopt new technologies quickly. The use of AI in learning is an important breakthrough in improving teachers' work efficiency [21].

In addition, the use of AI also has an impact on the quality of the teaching materials produced. Teachers can enrich teaching materials with a wider variety of content, ranging from sample questions, case studies, to learning simulations. AI helps teachers save time in designing learning tools, so they can focus more on mentoring students. However, it is still necessary to strengthen digital literacy so that the use of AI can be carried out ethically and responsibly. With a good understanding, AI can be a strategic partner for teachers in the era of digital education.

Impact on Teacher Professionalism

The increase in post-test results also illustrates a change in teachers' mindset regarding professionalism. Teachers who initially tended to be passive are now more confident in designing project-based learning. In addition, teachers also show reflective ability in evaluating the learning outcomes they compile. This professionalism is further strengthened by the existence of a teacher learning community formed after the training. The community is a forum to share good practices and maintain the sustainability of the program. Thus, this service activity contributes to strengthening the capacity of teachers in a sustainable manner [22].

The professionalism of teachers is also evident from their commitment to implementing learning innovations in the classroom. Many teachers have started to try the PjBL approach and integrate technology in daily learning. This indicates that the results of service activities do not stop at training, but continue in real practice. Teachers are increasingly aware of their role as learning facilitators, not just material presenters. With this increased professionalism, the quality of education in schools can improve significantly.

Implications for Education in Schools

The implications of the results of this activity are wide-ranging, not only for teachers but also for students and schools as a whole. Teachers who are skilled in PjBL and digital literacy will be able to create learning that is more creative, collaborative, and relevant to the needs of the times. This is expected to have an impact on increasing students' motivation and

critical thinking skills. In addition, schools can also be a model for the implementation of technology-based learning in coastal areas. With this positive impact, community service activities can be a reference for similar implementations in other schools [23].

In addition, the implications of this activity can also be seen in the context of strengthening the learning culture in schools. Teachers who are more confident will be able to create a conducive and inspiring learning environment. Students will be more actively participating in learning because they feel involved in the process of finding real solutions. This can improve the quality of interaction between teachers and students, so that the learning atmosphere becomes more enjoyable. Thus, schools can build an identity as a center of educational innovation in their region.

4. CONCLUSIONS

Community service activities through training and mentoring of SMP Negeri 2 Lambu teachers in developing teaching materials based on Project-Based Learning (PjBL) integrated *deep learning* have succeeded in achieving the goals that were expected from the beginning in the *Introduction*. The main problem in the form of low digital literacy of teachers and limitations in understanding PjBL can be overcome through intensive training programs, workshops, and continuous mentoring. This is clearly seen in the *post-test* results which show a significant increase in all teacher competency indicators.

In addition to having a direct impact in the form of increasing pedagogical capacity and digital literacy of teachers, this activity also opens up wider development prospects. First, the modules, digital lesson plans, and project teaching materials produced can be replicated by other schools, thus expanding the impact of usefulness. Second, the digital learning community that is formed has the potential to become a sustainable forum for technology-based learning innovation while strengthening collaboration between teachers. Third, the use of AI in learning can still be explored so that its use is more ethical, effective, and in accordance with the local context of schools.

The prospects for further research application can be directed towards the development of similar training models for schools in other remote areas, by adapting to the local needs of each region. In addition, deeper integration between *deep learning pedagogy* and artificial intelligence technology can be researched to optimize 21st-century learning strategies. Thus, the results of this research do not only stop in the context of SMP Negeri 2 Lambu, but also have the potential to become a national reference in strengthening teacher capacity in the digital era.

5. ACKNOWLEDGMENTS

The author expresses his deepest gratitude to the Directorate of Research and Community Service (DPPM) under the auspices of the Ministry of Higher Education, Science, and Technology (Kemdiktisaintek) of the Republic of Indonesia for full support in the form of 100% financial assistance so that this service activity can be carried out properly. Thank you are also addressed to all research members who have worked hard, supported each other, and contributed in every stage of the activity, from planning, implementation, to reporting. Not to forget, appreciation is given to school partners, teachers, students, and all parties who have played an active role and provided moral and material support so that this program can run smoothly and provide real benefits for improving the quality of education at SMP Negeri 2 Lambu.

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