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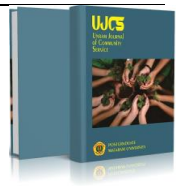

Building Digital Competence among Elementary School Teachers Throughb Training in The Design of Augmented Reality (AR) and Artifial Intelegency (AI) Enhanced Learning Media

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Abstract: This Community Service Program (PKM) focused on enhancing the digital competencies of elementary school teachers through training in the development of learning media assisted by augmented reality (AR) and artificial intelligence (AI) technologies. The objective of this program was to strengthen teachers' digital skills by providing both theoretical and practical training, accompanied by continuous evaluation. The service-learning approach was employed, covering socialization, workshops, hands-on practice, and evaluation. The evaluation results revealed that most teachers experienced significant improvement in designing and creating AR- and AI-assisted learning media. Moreover, their ability to operate and apply AR and AI tools increased substantially. Teachers were also able to produce innovative digital learning products and became more confident in integrating technology into their classrooms. Another notable outcome of this program was the establishment of a teachers' learning community as a sustainable platform for further developing AR- and AI-assisted learning media. Overall, the findings demonstrate that the PKM activities had a positive impact by increasing teachers' competencies in developing AR- and AI-based learning media that can be implemented in the teaching and learning process.

Keywords: Digital Literacy, Augmented Reality, Artificial Intelligence, Learning Media, Community Service.

Introduction

Contemporary developments in information and communication technology have advanced at an accelerated pace. The application of these technologies extends beyond conventional communication and entertainment purposes to encompass various sectors, including education. The integration of information technology in educational settings serves as instructional media to support pedagogical processes in academic institutions (Asikin & Alpindo, 2019).

Instructional media continuously evolves in parallel with technological advancements, transitioning from print-based materials, audiovisual resources, and computer-based technologies to integrated systems combining print and digital components. Current educational media resulting from this integration can be realized through Augmented Reality (AR) technology or utilization of Artificial Intelligence (AI) applications. The progressive development of scientific and technological innovations within education has enhanced technological accessibility through smartphone devices

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equipped with Android operating systems, facilitating application development specifically designed for educational media implementation.

Augmented reality represents an innovative approach to merging physical and virtual environments through computational systems, effectively blurring the boundaries between these domains. Augmented reality (AR) constitutes a specific category of virtual environment (Aripin & Suryaningsih, 2019). This technology enables enriched perceptual experiences through object visualization. The implementation of AR not only facilitates the visualization of complex learning materials but also enhances student interactivity and engagement throughout the learning process (Ambiyar et al., 2024).

Preliminary observations and interviews conducted by the PKM team with Mr. Rusmanuddin, S.pd., Principal, and teaching staff at Batu Bulan State Elementary School identified several fundamental challenges: a) Teacher competency regarding digital technology remains considerably underdeveloped, with educators experiencing difficulties in mastering and applying basic digital skills necessary for contemporary educational demands. The deficiency in technical experience presents a significant barrier despite current digital transformation trends. b) Insufficient training and mentoring programs addressing digital technology implementation in educational contexts. c) Non-interactive learning media resulting from textbook-centric and lecture-based instructional approaches that fail to engage students effectively. Learner participation remains limited due to inadequate visual and interactive elements. d) Underutilization of AR and AI technologies in instructional practices despite their emerging significance in modern education. e) Constrained availability of supporting infrastructure and facilities for technology implementation presents additional challenges for educators.

Based on these identified challenges, the PKM team concluded that implementing a Program for Enhancing Digital Competency of Elementary School Teachers Through Training on Developing Learning Media Assisted by Augmented Reality (AR) and Artificial Intelligence (AI) Technology was imperative. Improving educators' capacity to simultaneously utilize AR and AI technologies constitutes a crucial element in supporting sustainable quality education. Despite substantial teaching workload demands, teachers require expanded knowledge regarding AI applications in pedagogical processes. AR implementation primarily focuses on interactive visualization in learning environments. Educators must prepare instructional materials suitable for technological visualization during teaching processes. Furthermore, teachers need comprehensive understanding of developmental stages involved in creating AR-based media.

Method

The implementation methodology for this community service initiative employed a service-learning approach, comprising several stages tailored to PKM team requirements:

1. Preparation Phase
   This initial stage involved coordination with relevant stakeholders to strengthen partner commitment toward program success. The PKM team conducted preparatory activities including task delegation, procurement of necessary equipment and materials, and compilation and reproduction of training resources.
2. Implementation Phase
   This stage conducted training sessions focused on enhancing teacher competency in utilizing Augmented Reality and Artificial Intelligence (AI) technologies for learning media development.
   a) Socialization and Workshop Program
      Initial activities engaged representative participants from partner groups to provide comprehensive overview of PKM activities and introduce applicable technologies. Methodological approaches included lectures, discussions, and demonstrations.
   b) Training, Mentoring, and Technology Application.

   Subsequent sessions involved all partner members (17 teachers) in core PKM activities focusing on AR-assisted learning media development for classroom implementation. Additional training covered AI utilization for creating instructional media and teaching modules, aiming to integrate technological components beyond conventional textbook usage.
3. Evaluation Phase
   Systematic evaluation measured program effectiveness throughout implementation stages. Assessment occurred at each activity phase to determine success levels and inform subsequent interventions. Comprehensive evaluation followed program completion based on participant engagement levels and achievement of solution-based output targets. Post-evaluation activities included reporting and publication as accountability measures, alongside continued media development.
4. Partner Involvement
   Supporting institutions facilitated participant preparation, venue arrangement, supplementary provisions, and ensured availability of technological

resources (laptops/smartphones) and internet connectivity during training sessions.

5. Program Sustainability
   Post-implementation expectations included partner capacity to model AR and AI-assisted media development for peer educators. Sustainability mechanisms incorporated scientific publications, print/online media coverage, activity documentation, and establishment of teacher communities. Program dissemination aims to inspire similar initiatives among practitioners and academic faculty.

Result and Discussion

The Community Service Program entitled "Enhancing Digital Competency of Elementary School Teachers through Training on Developing Learning Media Assisted by Augmented Reality (AR) and Artificial Intelligence (AI) Technology" responded to digital era challenges and Merdeka Curriculum demands. This training addressed the disparity between technological advancements and educators' capacity for pedagogical integration. Preliminary observations identified most teachers as passive technology users, primarily utilizing technology for content consumption (e.g., YouTube videos) and administrative tasks rather than creating interactive learning media. Primary constraints included technical skill deficiencies, time limitations, and perceptions of AR/AI technologies as complex and cost-prohibitive.

Implementation at elementary school Batu Bulan demonstrated considerable success, evidenced by positive teacher engagement in training activities. The service initiative comprised training and mentoring components to enhance digital competencies through AI and AR technologies. Implementation processes included: Preparation Phase, involving institutional coordination for program authorization and school principal approval.

Figure 1. Stakeholder Coordination

Coordination outcomes indicated strong teacher enthusiasm for technology adoption despite limitations in digital media utilization. Educators rarely created technology-based learning media or incorporated technological elements in resource development.

During preparation, the PKM team compiled training modules addressing AR and AI implementation for technology-based evaluation needs. Additional preparations included technological infrastructure provision (laptops, projectors, internet access, supporting applications), program socialization, scheduling, role allocation, and evaluation instrument development.

Figure 2. Socialization of a Program

The implementation phase comprised several components:

1. **Theoretical Introduction and Reinforcement**
   Resource persons delivered material covering AR and AI-assisted media development, generating significant participant enthusiasm due to accessible content presentation. Activities included AR-based media creation training and AI utilization for learning content organization.

Figure 3. Theoretical Introduction by Resource Persons

2. **Training and mentoring sessions**
   During this phase, educators engaged in the direct application of augmented reality and artificial intelligence technologies. Participants had the opportunity to develop digital media tailored to their respective subject areas. Notable enthusiasm was observed when teachers successfully created

implementable learning media for classroom use. The PKM team provided individualized mentoring to participants encountering technical challenges, particularly regarding application utilization. This supportive approach ensured all educators could maximize the training benefits. Overall, the implementation phase proceeded effectively, with teachers demonstrating increased confidence in integrating digital technologies into their instructional practices.

Figure 4. Technology Transfer and Instructional Mentoring

From the PKM activities that have been carried out, the following data was obtained:

Table 1. PKM Achievement Indicators

No	Achievement Indicator	Activity Target	Result Achieved	Keterangan
articipant Numbers	16 teachers	Full participation in all activities	Exceeded	articipant Numbers
Training Module	1 module	AI-compiled teaching module	Achieved	Training Module
AR/AI Products	Minimum 1 per teacher	16 AI/AR-assisted media	Achieved	AR/AI Products
Pedagogical Competence	≥70% improvement	85% demonstrated enhancement	Exceeded	Pedagogical Competence
Digital Application Skills	80% proficiency	90% technological competence	Exceeded	Digital Application Skills
Program Sustainability	Established community	Community formation	Achieved	Program Sustainability
Participant Satisfaction	≥80% satisfaction rate	90% expressed satisfaction	Achieved	Participant Satisfaction

The evaluation phase was conducted throughout the activity by observing teacher engagement, the smoothness of digital practices, and their ability to develop learning materials. The evaluation results showed that most teachers successfully participated in the training even after the activity concluded, through interviews and analysis of the resulting learning products. Based on the evaluation, the following findings were obtained:

1. Improved Competence: Teachers are better able to design augmented reality-based media and learning modules.
2. Most teachers have successfully mastered the use of artificial intelligence and augmented reality technology.
3. Teacher Motivation: Teachers feel more motivated to use technology and demonstrate a high level of motivation to continue innovating in developing learning materials.

In addition to the interviews and product analysis conducted by the team, the success of this PKM was also assessed by the results of the pretest and posttest. The results are as follows:

Table 2. Pre-test and Post-test Evaluation Results for AR Technology

Aspect	*Pre-test*	*Post-test*
Knowledge of AR tech	40%	90%
Application of AR tech	30%	85%
Benefits of AR tech	40%	100%

Table 3. Pre-test and Post-test Evaluation Results for AI Technology

Aspect	*Pre-test*	*Post-test*
Knowledge of AI tech	50%	100%
Application of AI tech	40%	95%
Benefits of AI tech	50%	100%

Based on the pretest and posttest results regarding knowledge, application, and benefits of AR and AI technologies, a significant increase in competency percentages was observed following the training and mentoring activities on AI and AR technologies.

Through these training and mentoring sessions, elementary school teachers, who were initially unfamiliar with the use of technology in learning—especially augmented reality and artificial intelligence (AI)—gained relevant knowledge on the application of these technologies. This was marked by high enthusiasm among teachers in seeking suitable content to be implemented using these tools.

The success of this program lies in the enhancement of elementary school teachers' digital competencies through training in developing learning media assisted by augmented reality (AR) and artificial intelligence (AI). This significantly improved teacher competency, as evidenced by post-test results showing that 85% of teachers understood the use of AI and AR technologies, along with the quality of media products produced by several teachers. Through this training,

teachers not only grasped conceptual theories but also gained hands-on experience in media development. Each participant was required to produce an AR- or AI-based media project that could be directly applied in their teaching materials.

The utilization of Augmented Reality (AR) technology successfully acted as a catalyst for creating innovative and interactive learning. Through AR, teachers can create 3D objects that appear when scanned using a smartphone, making abstract concepts concrete. AR's ability to visualize abstract concepts into concrete forms is highly relevant to the learning characteristics of elementary school students, who are still in the concrete operational stage (Suryanto et al., 2021). This not only enhances student comprehension but also stimulates their motivation and curiosity.

On the other hand, the introduction of Artificial Intelligence (AI) provided solutions to challenges related to time efficiency and creativity. Through training in the use of tools such as ChatGPT, Gemini, and others, teachers realized that AI can serve as a powerful assistant in generating learning content. Teachers can create story illustrations, design quiz questions with varying difficulty levels, and generate innovative ideas for classroom activities simply by providing appropriate prompts. Importantly, teachers can also utilize AI to develop teaching modules. The use of AI significantly reduces administrative and preparatory burdens, allowing teachers to focus more time and energy on pedagogical interactions with students in the classroom. These findings reinforce the research by Baker & Smith (2019), which states that AI serves as a teacher's aid in creating more personalized and effective learning. This aligns with the study by Goksu et al. (2020), indicating that AI can be an effective tool for teacher professional development. AI can be used to analyze student performance data, provide personalized feedback, and recommend training materials tailored to individual teacher needs. Setiadi and Wibowo (2020) place AI and AR within a broader spectrum, demonstrating that both technologies are key to creating immersive learning experiences in the 21st century. The use of AR can create a more dynamic and responsive learning environment, helping students better understand and retain information (Litts & Lewis, 2019).

Program implementation was not without challenges. The main technical obstacles included unstable internet connections and variations in participants' smartphone specifications, which affected the speed of operating applications. Solutions implemented included providing backup internet networks, grouping participants based on initial competency levels to facilitate mentoring, and focusing on lightweight tools accessible via browsers. Additionally, initial psychological resistance from some teachers who felt technologically inexperienced was overcome through motivational approaches, showcasing simple success examples, and creating a supportive, non-judgmental learning environment.

Overall, this program demonstrated that with the right approach, materials, and facilitation, elementary school teachers are capable and willing to adapt to cutting-edge technologies. It is hoped that this enhancement of digital competencies will not cease after the training concludes but will have broad implications for improving the quality and meaningfulness of classroom learning processes. Moving forward, closer collaboration with local education authorities is essential to scale this program, reaching more teachers and integrating it with existing teacher training initiatives.

Participants found this community service activity highly beneficial, as they recognized the need to utilize available learning media to support the teaching process. Furthermore, teachers acquired new skills related to preparing and designing learning processes using media through the training activities. Activities such as training and mentoring are crucial for teachers, particularly to support their professionalism and competencies in line with the evolving demands of education, including the use of IT in learning processes and the development of media and teaching materials to support instruction.

Based on post-activity evaluation, there is a need for ongoing programs to help teachers better understand the creation of technology-enhanced learning media. This will enable teachers to independently develop learning materials. The establishment of teacher working groups to delve deeper into the use of technology in learning is also necessary. This is consistent with the research by Saputra et al. (2020), which found that teacher communities (such as MGMP or KKG) can serve as effective platforms for sharing knowledge and experiences regarding the use of AI and AR.

Conclusion

The community service program on training elementary school teachers in developing learning media assisted by Augmented Reality (AR) and Artificial Intelligence (AI) has proven effective in enhancing teachers' digital competence. Teachers who were initially unfamiliar with technology-based instructional tools gained both theoretical knowledge and hands-on experience in creating AR- and AI-assisted media. The program not only improved their technical proficiency but also increased motivation to innovate in classroom learning. The integration of AR helped make abstract concepts more concrete and

engaging for students, while AI provided efficiency and creativity in preparing teaching materials. Despite challenges such as limited infrastructure and varying digital literacy levels, the training demonstrated that with proper guidance and mentoring, teachers are capable of adopting advanced technologies. Moving forward, sustained support, follow-up training, and the establishment of teacher communities are essential to ensure long-term application and scalability. Ultimately, this initiative contributes to the development of innovative, interactive, and meaningful learning experiences aligned with the demands of 21st-century education.

Acknowledgments
Based on the outcomes of this community service initiative, several conclusions can be drawn. Participants demonstrated high enthusiasm for the program, as evidenced by the positive responses from teachers who actively engaged in activities aimed at enhancing their individual competencies. Educators who were initially unfamiliar with IT-based learning media gained greater awareness of various types of such media and developed a deeper understanding of their applications. Teachers have now acquired a functional understanding of how to utilize AR- and AI-assisted learning media, although some still exhibit limited proficiency in operating these technologies. In relation to these findings, the following recommendations are proposed: It is essential to conduct follow-up programs to further improve teachers' skills in developing IT-based learning media. Additionally, teachers should engage in continuous independent practice to reinforce the competencies acquired during the training sessions.

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