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# Digital transformation in education: Implementation of augmented reality in learning media by teachers at SMKN 3 Yogyakarta

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**Abstract**
This community service program addressed the limited digital literacy and pedagogical skills among vocational school teachers in developing interactive learning media. The program aimed to enhance teachers' competence in creating Augmented Reality (AR)-based learning materials at SMKN 3 Yogyakarta. A workshop-based approach was implemented, involving direct training, guided practice, and mentoring in designing AR media using user-friendly platforms. Participants were introduced to the principles of AR, its application in education, and the technical steps for creating interactive content. Evaluation was conducted through pre- and post-training assessments, observations, and participant feedback. The results showed a significant improvement in teachers' understanding and ability to integrate AR into their instructional design. Teachers demonstrated increased motivation to adopt innovative technology in the classroom and produced prototype AR media relevant to their teaching subjects. The program successfully fostered digital transformation in teaching practices by equipping educators with practical skills and confidence in utilizing emerging educational technologies.

Keywords: Augmented Reality, Vocational Education, Teacher Training, Digital Learning, Instructional Media

**Abstrak**
Program pengabdian kepada masyarakat ini menanggapi keterbatasan literasi digital dan keterampilan pedagogis di kalangan guru sekolah menengah kejuruan dalam mengembangkan media pembelajaran interaktif. Program ini bertujuan untuk meningkatkan kompetensi guru dalam membuat bahan ajar berbasis Augmented Reality (AR) di SMKN 3 Yogyakarta. Pendekatan yang digunakan adalah berbasis lokakarya, yang melibatkan pelatihan langsung, praktik terpandu, dan pendampingan dalam merancang media AR menggunakan platform yang mudah digunakan. Peserta diperkenalkan pada prinsip-prinsip AR, penerapannya dalam pendidikan, serta langkah-langkah teknis untuk membuat konten interaktif. Evaluasi dilakukan melalui penilaian sebelum dan sesudah pelatihan, observasi, serta umpan balik dari peserta. Hasil menunjukkan adanya peningkatan yang signifikan dalam pemahaman dan kemampuan guru untuk mengintegrasikan AR ke dalam desain pembelajaran mereka. Guru juga menunjukkan peningkatan motivasi untuk mengadopsi teknologi inovatif di kelas dan berhasil menghasilkan prototipe media AR yang relevan dengan mata pelajaran yang mereka ajarkan. Program ini berhasil mendorong transformasi digital dalam praktik pembelajaran dengan membekali pendidik dengan keterampilan praktis dan kepercayaan diri dalam memanfaatkan teknologi pendidikan yang berkembang.

Kata kunci: *Augmented Reality*, Pendidikan Kejuruan, Pelatihan Guru, Pembelajaran Digital, Media Pembelajaran.

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## 1. Introduction

The rapid development of digital technology has significantly influenced the educational landscape, compelling educators to adapt and innovate in their teaching practices. In the context of vocational education, where practical competencies and technology integration are vital, the use of Augmented Reality (AR) has emerged as a promising approach to enhance learning experiences. AR technology enables the integration of virtual objects into the real environment, creating an immersive learning space that supports visualization and interactivity—two essential aspects in vocational training (Afiya, 2024) (Dede et al., 2019).

Numerous studies have highlighted the potential of AR in education, particularly in improving student engagement, understanding of abstract concepts, and motivation to learn. For instance, (Zuo et al., 2025) (Ziden et al., 2022) conducted a systematic review and found that AR applications in education positively affect students' motivation and learning outcomes, especially when used in science and technical subjects. Similarly, a study by (Algarhy, 2025) (Chen et al., 2025) reported that AR can facilitate experiential learning and foster a deeper understanding of complex materials.

Despite its benefits, the implementation of AR in vocational schools in Indonesia remains limited, particularly due to the lack of teacher competence in developing AR-based learning media. Teachers often face challenges such as insufficient training, limited access to appropriate tools, and a lack of confidence in integrating new technologies into the curriculum (Hossain, 2023) (Zahro et al., 2025) (Pacheco-Castillo & Vega-Estrella, 2025). Therefore, there is a pressing need to empower vocational teachers with the necessary skills and knowledge to utilize AR effectively in their classrooms.

The devotion activity described in this article is a response to this need. The program was conducted at SMKN 3 Yogyakarta, one of the leading vocational schools in the region, and aimed to enhance the competence of teachers in developing and implementing AR-based learning media. The choice of this school was based on the readiness of its infrastructure and the strategic importance of strengthening digital pedagogy among its teaching staff.

Previous devotion programs related to educational technology have shown encouraging results. For example, a study published by (Salam et al., 2023) ( et al., 2024) reported that digital media training significantly improved teachers' confidence and capability in designing instructional tools. Building upon such findings, this program specifically focused on equipping teachers with practical skills in using platforms such as Unity, Vuforia, and other AR development tools, while also introducing pedagogical strategies to integrate AR meaningfully into vocational learning contexts.

The main purposes of this devotion are: (1) to increase the digital competence of vocational school teachers in the context of Education 4.0; (2) to provide hands-on training on how to create simple but effective AR-based learning media; and (3) to foster innovation and collaboration among teachers in implementing technology-

enhanced teaching methods. By achieving these objectives, this activity contributes to the broader agenda of digital transformation in vocational education and supports the government's efforts in preparing future-ready graduates.

This manuscript is original and has not been previously published, nor is it under consideration elsewhere. The program described herein not only contributes to the professional development of teachers but also serves as a model for similar initiatives in other vocational institutions across Indonesia.

## 2. Method

This community development program adopted a structured Collaborative-Workshop-Based Training Model (CWTM), specifically designed to enhance teachers' competence in creating Augmented Reality (AR)-based learning media. The method emphasizes hands-on practice, peer collaboration, and direct mentoring, ensuring that participants not only understand AR concepts but are also able to apply them independently in their instructional practice. The stages were designed to be replicable, with clear timelines, tools, and outcomes, as detailed in table 1.

Table 1. The Community Development Method Consists of Five Key Stages

| Stages | Description | Output |
|---|---|---|
| 1.Needs Assessment | Conducted pre-program interviews and surveys to identify teachers' digital literacy levels and expectations. | Competency baseline and training syllabus |
| 2.Technical Workshop | Delivered interactive workshops covering AR theory, basic 3D modeling, and use of AR platforms such as Unity with Vuforia. | Teachers understand AR tools and installation procedures |
| 3. Guided Practice | Participants created their own simple AR learning media with one-on-one mentoring. | Prototype of AR-based learning media |
| 4. Implementation Simulation | Teachers tested the AR media in a simulated classroom setting with peer feedback and expert review. | Revised and functional AR products |
| 5. Reflection and Evaluation | Teachers presented their work and reflected on challenges, with a final evaluation of knowledge and skill gains. | Post-training report and digital portfolio |

The CWTM method integrates pedagogical content knowledge (PCK) with digital technology skills, emphasizing iterative learning through project-based tasks. Compared to traditional one-way training models, CWTM offers:

a. Active, context-driven learning tailored to vocational school environments.
b. Sustainable mentoring by involving trained teacher-leaders as co-facilitators.
c. Integration with existing curricula, ensuring AR media is relevant and applicable.

The novelty of this method lies in its blended design approach, which combines AR development skills with curriculum mapping exercises, making it adaptable for various

subjects taught at SMK (vocational schools). Moreover, the entire process is documented in a digital module to allow replication in other institutions.

## 3. Results

The community development activity titled *"Enhancing Teacher Competence in Developing Augmented Reality (AR) Learning Media at SMKN 3 Yogyakarta"* was carried out in three main stages: needs assessment, training implementation, and post-training evaluation.

### Needs Assessment

Prior to the implementation of the training, a survey was conducted to assess the teachers' initial knowledge and skills related to digital media, particularly Augmented Reality. The findings indicated that 80% of the participants had never created AR-based learning media, and only 10% were familiar with AR tools such as Unity and Zappar. This data confirmed the necessity of providing targeted training to increase digital competence.

### Training Implementation

The training was conducted over two days and involved a combination of theoretical and practical sessions. Participants were introduced to:

a. The concept and potential of Augmented Reality in education
b. Tools and platforms for developing AR content (e.g., Assemblr EDU, Zapworks)
c. Step-by-step guidance on designing simple AR learning modules

The training was attended by 20 teachers from various departments at SMKN 3 Yogyakarta. They were grouped into five teams to collaboratively design AR content relevant to their respective subjects.

Table 2. Training Schedule and Content Overview

| Day | Session | Content Covered | Duration |
|---|---|---|---|
| 1 | 1 | Introduction to AR in Education | 2 hours |
| | 2 | Tools and Platforms for AR Development | 2 hours |
| 2 | 1 | Hands-on AR Media Creation | 3 hours |
| | 2 | Presentation and Feedback | 2 hours |

The two-day training program was systematically structured to enhance teachers' conceptual understanding and practical competencies in developing Augmented Reality (AR)–based learning media. On the first day, the opening session introduced the foundational principles of AR within the educational context. Participants were guided to comprehend the definition and technological underpinnings of AR, as well as its distinctions from related immersive technologies such as Virtual Reality and Mixed Reality. This session also highlighted the pedagogical value of AR, particularly its potential to increase student engagement, facilitate the visualization of abstract concepts, and support interactive, student-centered learning. Several illustrative examples of AR integration across different subject areas were presented to strengthen teachers' awareness of its instructional relevance.

The second session continued with an overview of digital tools and platforms commonly used for AR development. Participants were familiarized with a range of AR applications suitable for classroom use, including platforms designed for beginners and those offering more advanced authoring capabilities. The session provided demonstrations on core development workflows, such as selecting templates, inserting and manipulating 3D objects, and embedding multimedia components including text, images, audio, and video. Considerations regarding device compatibility, technical requirements, and the suitability of each platform for specific learning objectives were also discussed. By the end of the first day, participants had gained a solid conceptual foundation and an understanding of the technological landscape necessary for AR development.

Figure 1. Teachers collaboratively develop AR learning content using the Uforia platform.

The second day emphasized experiential learning through hands-on AR media creation. During the practical workshop session, teachers collaborated in small groups to design AR learning materials aligned with their respective subject areas. Guided by facilitators, participants engaged in constructing AR scenes, incorporating interactive elements, integrating 3D models, and testing their prototypes on mobile devices to ensure functional performance. This session enabled participants to translate conceptual knowledge into tangible instructional products through iterative design and experimentation.

The final session of the training involved presentation and evaluation of the AR products developed by each group. Participants articulated the pedagogical rationale underlying their designs, explained the targeted learning outcomes, and discussed the potential classroom implementation strategies. Constructive feedback was provided by peers and trainers, focusing on media accuracy, usability, creativity, and alignment with curriculum standards. This reflective process allowed participants to critically evaluate their work, identify opportunities for refinement, and strengthen their capacity to integrate AR into instructional practice. By the conclusion of the program, teachers

had not only produced preliminary AR learning media but also deepened their pedagogical and technological readiness for adopting AR in educational settings.

### Post-Training Results

After the training, participants were asked to submit one AR learning product prototype per group. The results showed significant improvements in their confidence and skills. Based on a self-assessment questionnaire, 95% of participants rated their competence in AR media creation as "improved" or "highly improved", as shown in Table 3.

Table 2. Post-Training Self-Assessment Results

| Competency Area | Percentage of Participants Reporting Improvement |
|---|---|
| Understanding of AR concepts | 100% |
| Skills in using AR tools | 90% |
| Ability to design AR-based content | 85% |
| Motivation to use AR in teaching | 95% |

Additionally, feedback from participants indicated that the training was relevant, engaging, and applicable to classroom settings. Many expressed interest in further developing AR-based lesson modules for their students.

## 4. Conclusion

The service activity has successfully increased teachers' competence in developing augmented reality (AR)-based learning media at SMKN 3 Yogyakarta. The training enabled teachers to understand and apply AR technology in the learning process, making lessons more interactive and engaging. This activity also fostered a positive attitude towards digital innovation in education. A new insight gained is that with proper guidance and hands-on practice, vocational school teachers can become active creators of immersive educational content, not just users. This shows the potential of AR to transform conventional teaching methods into more innovative and student-centered learning experiences.

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