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Empowering Teachers with Virtual Art Galleries: Digital Training for Megalithic Heritage Education in Napu Valley Elementary Schools

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ABSTRACT

Background: The Napu Valley Megalithic Site in Central Sulawesi is a historically significant area of high cultural value that has been nominated as a UNESCO World Heritage Site. However, its educational potential has not been optimally utilized in arts and cultural learning at the elementary school level, largely due to limited digital resources and insufficient teacher proficiency in using technology.

Purpose of the Study: This community service program aimed to address these challenges by training 15 teachers at SDN Tamadue to create 3D virtual art galleries using the Artsteps platform.

Methods: The program was implemented in three sequential phases: Preparation, Training, and Implementation & Evaluation, following the ADDIE instructional design model.

Results: Quantitative results demonstrated significant improvement, with the average teacher competency score rising from 52.4 (pre-test) to 85.6 (post-test), representing a 63.4% increase. Ten virtual galleries were successfully created and deployed in classrooms. Post-training evaluation revealed that 100% of teachers were satisfied, 93.3% rated the content as highly relevant, and 80% committed to continuing their use of Artsteps. Classroom observation confirmed increased student engagement and active participation in local arts and cultural learning.

Keywords

Virtual Gallery; Artsteps; Megalithic; Local Arts and Culture Education; Digital Technology

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Introduction

The Napu Valley in Central Sulawesi is a megalithic site of significant cultural value. The area preserves various historical relics in the form of large stones that stand as silent witnesses to ancient civilizations. However, efforts to introduce this site to elementary school students continue to face numerous challenges, particularly in fostering student interest in local history, arts, and culture at a deeper level. These challenges stem from limited digital learning resources and insufficient teacher skills in integrating technology into instruction.

In today's digital era, technological advances offer innovative solutions in education, one of which is the use of virtual art galleries powered by the Artsteps platform. This technology enables teachers and students to access historical information in an interactive three-dimensional (3D) format. Research has shown that the use of virtual reality in cultural education can enhance student engagement and comprehension (Intawong et al., 2025; Lin et al., 2025). This technological integration aligns with the deep learning principles of the Merdeka Curriculum and the 21st-century STEAM-based learning promoted by the Indonesian Ministry of Education, Culture, Research, and Technology. A bibliometric study on local wisdom-based arts learning in elementary schools reveals a significant upward trend in academic publications since 2020, confirming the relevance and urgency of this topic (Zubaidah et al., 2025).

The target group of this program was the teachers of SDN Tamadue, Lore Timur District, Poso Regency, Central Sulawesi. These teachers faced ongoing challenges in teaching local arts, culture, and history particularly regarding the use of digital technology as a learning medium. Pedagogically, instruction remained dominated by lecture methods and textbooks, which tend to be less engaging for students. This situation is consistent with findings that digital technology-based training can significantly improve the effectiveness of arts and cultural teaching (Choeirod, 2025; Shvardak et al., 2024).

From the perspective of the Sustainable Development Goals (SDGs), particularly Goal 4 on Quality Education, virtual reality technology has been shown to contribute to improvements in student motivation, engagement, and digital competency in alignment with SDG 4 (Llanos-Ruiz et al., 2025). Building teacher capacity in leveraging digital technology for cultural education represents a strategic step in supporting the attainment of the SDGs in the field of education.

Several key challenges were identified among the target teachers prior to the program: (1) insufficient digital learning resources, as teachers still relied on textbooks and lectures (Li, 2025); (2) low digital proficiency in creating and managing 3D virtual art galleries (Choeirod, 2025); (3) predominance of conventional approaches that failed to provide immersive learning experiences (González Vargas et al., 2025); (4) insufficiently interactive teaching methods that did not promote active student engagement (Bramayudha & Agustini, 2025); and (5) limited technological infrastructure in rural schools, including unstable internet connectivity and a lack of computer devices (Li & Yang, 2025).

Based on this needs analysis, the program prioritized four areas of intervention: (1) improvement of teachers's digital competency, with a target of at least a 50% increase in competency scores; (2) development of digital learning media, with a target of producing at least 10 virtual gallery products; (3) enhancement of student interest in local history and culture, measured through classroom observation rubrics; and (4) support for achieving SDG 4 through an inclusive, technology-based educational approach.

Method

This community service program employed the ADDIE instructional design model (Analysis, Design, Development, Implementation, Evaluation) (Branch, 2009), implemented

through three sequential phases: Preparation, Training, and Implementation & Evaluation. The use of the ADDIE model in the context of digital teacher training is supported by systematic reviews identifying it as an effective framework for developing instructional technology competency (Sintonen & Kynäslähti, 2024).

Preparation Stage

The preparation stage began with a structured needs assessment administered to all 15 target teachers at Tamadue Elementary School using a validated questionnaire. The instrument measured three dimensions: (a) current digital competency level (scale 1-5), (b) perceived challenges in arts and culture teaching, and (c) availability and access to technological resources. Results indicated that 86.7% of teachers reported low confidence in using digital technology for arts and culture learning, and 93.3% had never used a virtual gallery platform such as Artsteps. A pre-test measuring baseline digital competency was also administered at this stage, yielding an average score of 52.4 out of 100. Based on these findings, a structured training module was developed, covering theoretical foundations and a step-by-step practical guide to creating 3D virtual galleries using Artsteps.

Training Stage

The training stage consisted of two integrated sessions. The theoretical session introduced participants to the concept of virtual galleries, their pedagogical potential in cultural heritage education, and a demonstration of the Artsteps platform's features. The practical session provided guided, hands-on experience in which each teacher independently created a virtual gallery featuring photographs of the Napu Valley megalithic sites. Facilitators provided intensive individual mentoring to ensure technical difficulties were resolved in real time. Each participant was guided through three core tasks: uploading curated images, designing the gallery layout and spatial arrangement, and publishing the gallery for online access.

Implementation & Evaluation Stage

In the implementation phase, teachers applied their newly acquired skills by deploying their virtual galleries in actual classroom settings. Structured classroom observations were conducted using a five-point rubric to measure student engagement, participation level, and interaction with the digital content. The evaluation phase involved both quantitative and qualitative instruments: a post-test identical in structure to the pre-test, a satisfaction questionnaire with Likert-scale items, and semi-structured observation notes from the facilitators.

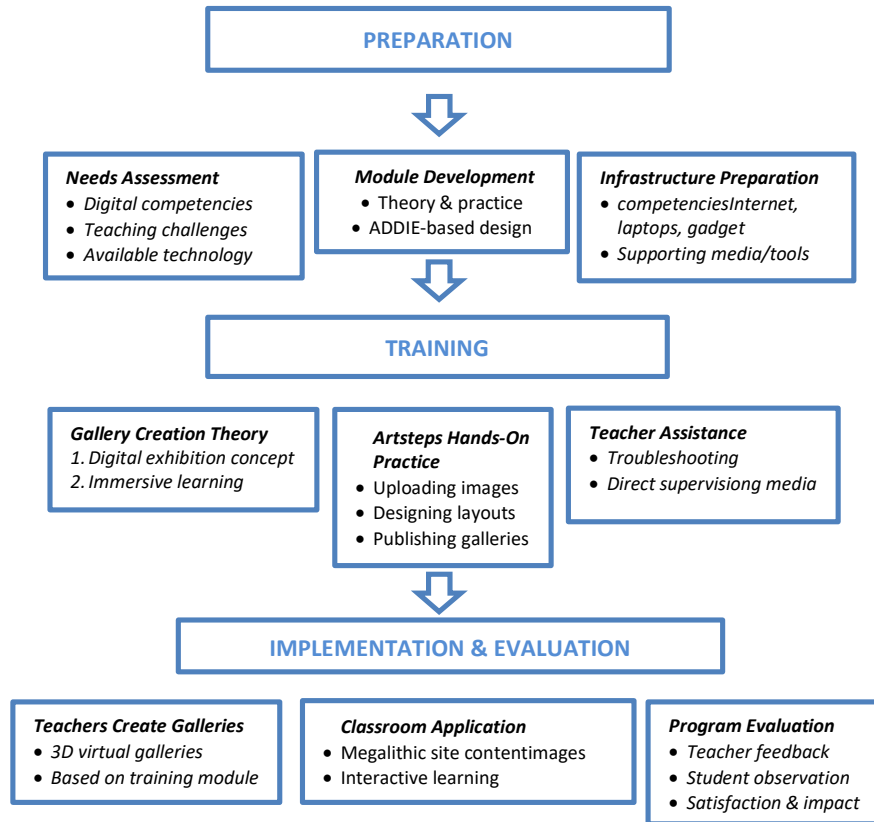


Figure 1. Flowchart of Training Program for Developing 3D Virtual Galleries Using Artsteps

Result

Preparation Stage Results

The needs assessment questionnaire distributed to all 15 teachers at Tamadue Elementary School revealed a significant gap in digital competency. The pre-test results established a baseline average score of 52.4 out of 100. Qualitative responses from the questionnaire identified three primary barriers: unfamiliarity with virtual gallery platforms (reported by 93.3% of teachers), limited access to digital devices at school (reported by 80%), and insufficient training opportunities in educational technology (reported by 100%). Field visits to the Napu Valley megalithic sites were also conducted during this stage to gather high-quality photographs of the Watu Palindo statues and other megalithic artifacts at the Pekasele Cultural Heritage Site, ensuring the content uploaded to the galleries was historically accurate and contextually rich.



Figure 2. Data collection at Megalithic Sites in the Preparation Stage for the creation of PKM modules

Table 1. Pre-Training Needs Assessment Results (n = 15)

Indicator	n (Teachers)	Percentage (%)
Low confidence in using digital technology for learning	13	86.7
Never used a virtual gallery platform	14	93.3
Limited access to digital devices at school	12	80.0
Never received educational technology training	15	100.0
Average Pre-Test Score	52.4 / 100	—

Training Stage Results

All 15 teachers completed both the theoretical and practical training sessions. During the practical session, each participant successfully created at least one virtual gallery featuring photographs of the Napu Valley megalithic sites. The mentoring process was documented through facilitator observation notes, which recorded the type and frequency of technical assistance provided to each participant. The most common technical challenges encountered were (1) difficulty in uploading high-resolution images (encountered by 9 teachers), (2) confusion in arranging gallery room layout (7 teachers), and (3) issues with gallery publishing and link sharing (5 teachers). All challenges were resolved through real-time peer and facilitator support.



Figure 3. Session Training Activities

Implementation & Evaluation Stage Results

Following the training, teachers deployed their virtual galleries in classroom settings. A total of 10 virtual galleries were successfully published and made accessible online. Classroom observations, scored using the five-point engagement rubric, indicated a marked increase in student active participation and exploratory behavior compared to prior conventional lessons. The

pre- and post-test comparison demonstrated a statistically meaningful improvement in teacher digital competency (Table 2).

Table 2. Pre-Test and Post-Test Results of Teacher Digital Competency (n = 15)

Measurement	Min Score	Max Score	Mean Score
Pre-Test	35	70	52.4
Post-Test	70	100	85.6
Gain Score	—	—	+33.2 (+63.4%)

Table 3. Post-Training Satisfaction Questionnaire Results (n = 15)

Item	n	Percentage (%)
Satisfied with overall training	15	100.0
Rated material as highly relevant to teaching needs	14	93.3
Committed to continuing use of Artsteps	12	80.0
Virtual galleries created and published online	10 galleries	—

The 10 virtual galleries produced are publicly accessible. One example can be accessed at: <https://www.artsteps.com/view/6895bf020e4bc880a01d033f>. The galleries display curated photographs of the Napu Valley megalithic sites in an interactive 3D environment, enabling students to explore the exhibition independently, zoom in on artifacts, and read contextual descriptions.

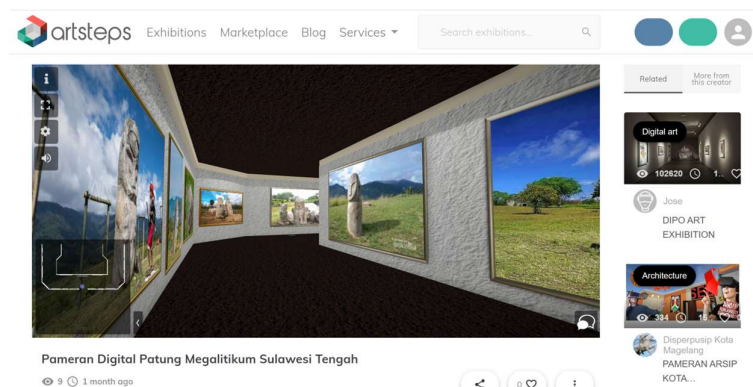


Figure 4. Virtual Megalithic Fine Art Gallery product results

Discussion

The significant improvement in teacher competency scores from an average of 52.4 to 85.6 (a gain of 63.4%) demonstrates the effectiveness of the ADDIE-based training model in developing teachers' digital skills. This finding is consistent with Intawong et al. (2025), who established that virtual reality and gamification in museum contexts can enhance the hedonic and eudaimonic dimensions of cultural heritage learning. The meta-analysis by Zhou et al. (2022), covering more than 40 studies, further confirms that VR and AR consistently enhance museum learning experiences compared to conventional methods. The applied learning-by-doing approach enabled teachers not only to grasp theoretical concepts, but also to produce ready-to-use digital artifacts a deeper form of professional learning (Choeirod, 2025).

The 100% participation rate and high satisfaction scores reflect the unmet need for digital technology training among teachers in this region. This is consistent with Li (2025), who highlighted the still-limited adoption of VR in cultural heritage education. Shvardak et al. (2024),

in their research on digital training for elementary school teachers, found that hands-on practice-based programs significantly enhance teachers' professional competency a finding that strongly corroborates the outcomes of this program.

Teachers' success in creating functional virtual galleries demonstrates the accessibility of the Artsteps platform, supporting [González Vargas et al. \(2025\)](#), who emphasized that educational technology must be user-friendly to achieve broad adoption among non-technical educators. Studies on the psychological dimensions of AR in museum education have also shown that information quality and content richness have significant positive effects on immersiveness and academic achievement ([Cheng et al., 2025](#)).

The classroom implementation phase revealed meaningful changes in student behavior. Observations documented students independently navigating virtual gallery spaces, engaging in peer discussions about megalithic artifacts, and demonstrating curiosity that extended beyond the scope of facilitator instructions behaviors not observed during conventional lecture-based instruction. These results are consistent with [Zhong et al. \(2025\)](#), who demonstrated that VR can enhance student motivation and learning outcomes in elementary-level history lessons, and with [Wang et al. \(2025\)](#), who showed that multisensory interaction in VR environments supports the sustainability of cultural heritage education.

From a curriculum alignment perspective, the integration of virtual galleries supports the Merdeka Curriculum's emphasis on differentiated and project-based learning. [Fathurrochman et al. \(2025\)](#), in their research on rural elementary schools in Indonesia, found that integrating local wisdom into the local content curriculum positively affected student learning outcomes and cultural identity consistent with this program's objective of introducing the Napu Valley megalithic site through digital media. The review by [Sapta et al. \(2025\)](#) on AR media based on local wisdom further reinforces the relevance of immersive technology for regional cultural learning in the Indonesian educational context.

Infrastructure limitations particularly unstable internet connectivity were the most significant operational challenge. This was addressed through the provision of portable broadband connections prior to training days, confirming the findings of [Li & Yang \(2025\)](#) regarding the technology infrastructure gap in rural educational settings and the importance of adaptive technical solutions.

In terms of sustainability, 80% of teachers committed to continuing the use of Artsteps for developing learning media in other subjects. The training module has been registered for intellectual property protection (HAKI). This participatory dimension in which teachers become producers of digital learning content reflects the empowerment principles in community service research and aligns with [Deckker & Sumanasekara \(2025\)](#), who emphasized participatory approaches in technology-assisted cultural education.

Overall, this program made a tangible contribution to achieving SDG 4 (Quality Education) by enhancing teacher capacity, producing replicable digital learning media, and demonstrating that technology-based cultural education can be realized even in rural contexts with limited resources. This is consistent with systematic reviews indicating that VR has the potential to improve student motivation, engagement, and digital competency in support of SDG 4 ([Llanos-Ruiz et al., 2025](#)).

Conclusion

This community service program successfully achieved its objectives of improving the digital competency of 15 elementary school teachers at Tamadue Elementary School through intensive training in creating 3D virtual art galleries using the Artsteps platform. The program

produced measurable outcomes: a 63.4% increase in average teacher competency scores (from 52.4 to 85.6), the creation of 10 operational virtual galleries now accessible online, a 100% satisfaction rate among participants, and documented improvements in student engagement during classroom implementation. The approach demonstrates that even in rural, resource-limited contexts, structured digital technology training grounded in the ADDIE model can produce significant and sustainable improvements in teacher capacity and learning quality. This program aligns with SDG Goal 4 by advancing inclusive, innovative, and technology-mediated education, while simultaneously supporting the preservation and dissemination of local cultural heritage.

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Conflicts of Interest

The authors declare that no personal, professional, or financial interests may influence the objectivity, representation, or interpretation of the results reported in this article.

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