

Integration of History Learning and Digital Tourism: Utilizing AI for Cultural Conservation in the Ijen Geopark Region for Senior Secondary Students in Banyuwangi

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ABSTRACT

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Ijen Geopark has been designated a priority area in the UNESCO Global Geopark network since 2023 due to its rich geological, biological, and cultural diversity. However, this potential has not been fully utilized in local history education at the high school level. This study aims to develop a history learning module based on digital tourism and artificial intelligence (AI) for cultural conservation among high school students in Banyuwangi. This study adopted a Research and Development model that includes needs analysis, product design, limited trials, revisions, and implementation evaluation. The sample consisted of 190 students, 8 history teachers, and 18 schools. Data analysis used paired sample t-tests, Pearson correlation, and one-way ANOVA. The results showed an increase in knowledge scores from 52.1 to 80.3 and conservation attitudes from 3.1 to 4.2. The correlation between digital media use and learning outcomes yielded $r = 0.62$. Teachers rated the module's feasibility with an average of 4.3. It was concluded that this learning medium was effective in improving historical understanding and cultural awareness. Recommendations include improving internet infrastructure, providing teacher training, and implementing long-term, community-based evaluations. This study proposes a relevant, innovative, and contextual model for history education in the digital age.

Keywords

Cultural Conservation
Digital Tourism
History Learning
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Utilization of AI

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Introduction

Local culture-based educational tourism has experienced significant growth since the Ijen Geopark was designated a UNESCO Global Geopark in 2023. This area is not only rich in geological features but also possesses cultural and historical values that serve as an important educational legacy for the younger generation. The Banyuwangi Regency Government has facilitated geotourism activities such as Educamp and the Ijen Festival as outdoor learning media for students. However, this educational potential has not been optimally integrated into history lessons at the high school level, particularly in the use of technology-based media. The integration of digital media and cultural sites can bridge the gap between curriculum content and students' surroundings. Therefore, synergy between history education and digital cultural destinations must be developed as a strategic step towards contextual education.

History teaching at the high school level is still predominantly text-based, lacking contextual experiences and interactive technology integration. Kolb emphasizes that learning becomes meaningful when it involves reflective and applicable direct experiences [1]. AI and AR are considered capable of facilitating students' active involvement in learning processes centered on real cultural locations [2], [3]. Digital technology enables realistic visualization of historical artifacts and narratives, thus supporting memory strengthening and deeper student understanding [4], [5]. In the context of Ijen, Geopark location-based educational applications can present local historical stories in an interactive format using maps, videos, or chatbots. This model opens up an evidence-based and participatory approach to historical learning in the field.

The integration of artificial intelligence in cultural preservation offers broad educational opportunities in secondary education. Pathan and Suhane assert that AI can systematically document cultural heritage through photogrammetry, digital mapping, and geotagging [6]. Furthermore, Wang and Zhou have shown that generative AI can revive intangible heritage through virtual visualization and narrative replication [7]. Ahmed highlights the importance of contextualizing AI in education to avoid exacerbating the digital divide [8]. In history education, the role of AI as a digital guide enables personalized, location-based, and interest-driven information [9], [10]. This context encourages active student

engagement and fosters comprehensive digital cultural literacy. Therefore, combining AI and digital tourism emerges as a promising approach for school-based cultural conservation.

The application of augmented reality (AR) as a history learning tool has also resulted in significant increases in student engagement. Studies by Mirza et al. and Rohendi et al. showed that the use of AR improves students' learning motivation, information retention, and critical thinking skills [2], [3]. In the realm of cultural conservation, Varol and Öksüz explain that AR can present historical artifacts and cultural sites virtually, offering a time- and cost-effective solution. The implementation of AR in high school history learning bridges historical texts with local cultural realities on the ground [4]. This is reinforced by Yanti et al. who found that AR integration encourages creativity, collaboration, and 21st-century skills among students [5]. Therefore, incorporating AR into history modules supports a contextual and participatory project-based learning approach.

National and local history curricula accommodate the development of innovative models based on STEAM and project-based learning (PBL). Supianti et al. stated that combining STEAM and PBL significantly improves students' mathematical literacy and character development [11]. In a cultural context, Fernández Mier et al. integrated community history research into school learning through a locally oriented PBL model [12]. Research by Utaminingsih and Ellianawati confirmed the validity and practicality of STEAM-based e-modules in strengthening critical reasoning and student independence [13]. However, Fine cautioned that a critical, practice-based approach is crucial to ensure PBL does not fall into repressive capitalist logic [14]. Therefore, in developing digital tourism and AI-based modules, a locally based PBL approach is a relevant pedagogical foundation. This model emphasizes the importance of student participation in cultural preservation as an integral part of the educational process.

Based on the explanation above, this research focuses on the development of a digital tourism and AI-based history learning module in the Ijen Geopark area. This innovation aims to improve students' understanding of local history and encourage active attitudes towards technology-based cultural conservation. This module will utilize AI and AR chatbots to present historical narratives in an interactive digital format. This research will be conducted in 18 high schools in Banyuwangi, involving 190 students and 8 history teachers as the main participants. This research integrates experiential learning theory, the theory of planned behavior, and a locally-based digital education model. Therefore, this research is expected to contribute, both practically and theoretically, to the development of an adaptive, contextual, and future-oriented history curriculum.

Materials and Methods

A. Research Approach

This research adopts a quantitative approach based on the Research and Development (R&D) model formulated by Borg and Gall and adapted by Sugiyono. in the context of Indonesian education [15], [16]. This model was chosen to produce a learning module on local history integrated with digital tourism and AI for high school students in Banyuwangi. Each phase of the research reflects a systematic development process designed to ensure the validity and effectiveness of the innovation. The initial phase consisted of a preliminary study to identify user needs and the potential integration of historical content, digital tourism, and artificial intelligence. These findings formed the basis for developing an initial product design, which was then evaluated by experts. Revisions followed, culminating in a prototype ready for limited-scale trials.

B. Research Subjects

The research subjects consisted of 190 students from 18 high schools in Banyuwangi, selected through a stratified random sampling method, as recommended by Creswell and Fraenkel & Wallen [17], [18]. In addition, eight history teachers participated as facilitators and respondents during the module trial. Data collection used quantitative and qualitative approaches to describe the influence of media on students' knowledge and attitudes towards cultural conservation. Primary data collection techniques included questionnaires, semi-structured interviews, and direct observation of learning activities during a visit to Ijen Geopark. The inclusion of schools from both urban and rural areas allowed for the observation of variations in social, geographic, and digital educational contexts, thus strengthening the generalizability of the research findings across educational units.

C. Research Instruments

The research instrument was designed based on indicators of local history competency, cultural awareness, and digital literacy in technology-based learning. The instrument's content validity was reviewed by experts in history education and digital technology, referring to the assessment principles outlined by Anastasi & Urbina and Nitko & Brookhart [19], [20]. Initial testing of the instrument aimed to gather user feedback regarding accessibility, content relevance, and module interactivity. Further revisions were conducted before full field implementation. Data from the pre-test and post-test were analyzed to measure learning improvement using statistical methods. In addition, observation sheets and field notes were used to evaluate student engagement when interacting with digital media.

The expert validation instrument in this study consists of two main aspects, namely content suitability And Media presentation. The content suitability aspect focuses on assessing the

accuracy and suitability of the material presented in the learning media, which includes indicators of material accuracy, suitability of the material to learning objectives, content adequacy, and interrelationships between sections of the material. Meanwhile, the media presentation aspect emphasizes the quality of the display and technical aspects, including visual elements and design, graphic quality, audio, and video, along with readability and clarity of information presentation.

The assessment was conducted using a Likert-scale validation sheet with a score range of 1 to 5, where a score of 1 indicates “strongly disagree” and a score of 5 indicates “strongly agree.” The average score obtained from the validators was then interpreted to determine the level of feasibility of the developed learning media, so that it can be determined to what extent the media meets the expected quality standards.

The instruments used consist of two main parts, namely a local history knowledge test and a cultural conservation attitude questionnaire.

1. Local History Knowledge Test (0–100)

This instrument was designed to measure students' understanding of local history in the Ijen Geopark area. The test consisted of 25 multiple-choice questions, each weighing four points, with a maximum total score of 100. The instrument's outline was developed based on core competency indicators for social studies related to cultural heritage and local history.

The aspects measured include: 1) Factual knowledge, including the names, locations, and chronology of historical sites in the Banyuwangi region; 2) Conceptual understanding, namely the ability to link the relationship between geology, culture, and local history; 3) Contextual application, namely the ability to apply local historical values in everyday life.

2. The validity of the instrument content

The validity of the instrument content was tested through an assessment by three experts in the field of history education and geotourism. Cultural Conservation Attitude Questionnaire (Likert Scale 1–5). This instrument was used to measure students' attitudes towards local cultural preservation through 15 Likert-scale based statements with five response levels, namely strongly disagree (1) to strongly agree (5).

The aspects measured include: 1) Preservation, such as understanding the importance of preserving cultural sites; 2) Emotional involvement, including a sense of pride in local cultural identity; 3) Conservative behavior, namely the tendency to participate in cultural preservation activities.

D. Data analysis

Data analysis using inferential and descriptive statistics as described by Arikunto and Sugiyono [21], [16]. Changes in pre-test and post-test scores in the trial limited (30

respondents) and trial total (160 respondents) The module's effectiveness in enhancing local history knowledge was examined using a paired-sample t-test. Students' attitudes toward cultural conservation were analyzed using a chi-square test, which highlights the frequency distribution and changes in scores. Pearson correlation analysis was used to assess the relationship between the intensity of AI-based media use and student learning outcomes. Analysis of variance (ANOVA) was used. For test test after school rural and urban. Qualitative data from teacher interviews were analyzed thematically using the Miles & Huberman model [22]. This methodological triangulation increased the reliability and validity of the research findings.

Data interpretation is supported by Kolb's Experiential Learning theory [1], which highlights the importance of hands-on experience in facilitating meaningful learning. Within this framework, students were actively engaged through a field trip to Ijen Geopark using AI- and AR-based digital media. Experiential learning enables the transformation of information into contextual understanding through digital exploration. In addition, Ajzen's Theory of Planned Behavior was used to analyze students' attitudes toward cultural preservation [23]. This theory provides an analytical basis for understanding how intentions, subjective norms, and perceived behavioral control influence the internalization of values. The integration of these two theories supports a holistic understanding of behavioral and cognitive changes in technology-enabled history education.

All collected data was compiled into a matrix for effectiveness testing, user perception, and content validation to present the final findings in statistical and narrative form. Product evaluation was conducted in layers, considering content, technical aspects, and instructional utility, in accordance with the Dick & Carey formative evaluation model [24]. Analytical interpretations informed design revisions to enhance contextual relevance and operational feasibility in the school setting. Teacher involvement in each phase of development demonstrated a participatory approach to educational innovation. The final report was prepared with systematic, objective, and replicable considerations, thus providing a model for the development of digital history learning in other regions. Overall, this methodology reflects a coherent alignment between theoretical frameworks, empirical practices, and innovations in culturally grounded educational development.

Results and Discussion

This study demonstrated a significant increase in students' local history knowledge after implementing the digital module. The pilot test results showed that the average pre-test score increased from 48.2 to 75.6 on the post-test. with mark the t-count result (4.432). This finding is in line with Kolb's theory, which states that experiential learning encourages deeper

understanding [1]. Furthermore, Ajzen stated that cognitive development directly influences attitude formation [23], as evidenced by the increase in the cultural preservation attitude score, from 3.1 to 4.2 with t- test result (2.907). Thus, technology integration is proven to contribute to students' cognitive and affective development simultaneously.

The paired sample t-test showed a p-value < 0.001 , confirming a statistically significant improvement in test scores. This supports the statement of Neophytou et al., who stated that AI in education broadens students' analytical horizons [9]. Similarly, Pathan & Suhane emphasizes the effectiveness of technologies such as geotagging and photogrammetry in enhancing history learning by systematically documenting cultural heritage [6]. The integration of AI into local contexts such as Ijen Geopark strengthens students' spatial and historical understanding. As a result, this learning model shifts the paradigm of traditional history learning towards a more immersive and location-based format.

Table 1. Mean Scores: Pre-Test, Post-Test, and Cultural Conservation Attitudes

Indicator	Pre-Test	Post Test	Difference	P-value	Interpretation
Local History Knowledge (0-100)	48.2	75.6	+27.4	<0.001	Very Significant Improvement
Cultural Conservation Attitudes (1-5)	3.1	4.2	+1.1	<0.01	Significant Improvement

The developed module also increased students' interest in visiting Ijen Geopark, increasing from 35% to 68%. Interviews revealed that many students felt more connected to the subject matter due to their ability to view artifacts and historical sites through Augmented Reality (AR). Mirza et al. asserted that AR increases emotional engagement and learning motivation [2]. This enthusiasm reflects the success of the experiential learning approach embedded in the module. Furthermore, affective engagement strengthens positive attitudes towards cultural preservation. High levels of learning motivation are an indicator of the success of the digital tourism-based learning approach.

Expert validation of this module yielded strong results, with a content score of 88.6% and a media design score of 85.2%. These findings support Wang & Zhou, who underscored the importance of narrative and visual accuracy in AI-based cultural heritage education [7]. Revisions based on expert feedback included adjusting the layout for AR and adding local cultural content. According to Varol & Öksüz, visualizing artifacts through AR improves memory retention and student comprehension [4]. These improvements contribute to the pedagogical quality and acceptability of the product, making expert validation a crucial step before full-scale implementation.

Table 2. Product Expert Validation

Aspects Evaluated	Score (%)	Category	Revision Required
Content Suitability	88.6	Well Worth Doing	Yes (small)
Media Presentation	85.2	Possible to do	Yes (small)

A limited trial involving 30 purposively selected students from three schools showed an average pre-test score of 53.4, which increased to 75.6 after the test. The calculated reinforcement score of 0.47 falls into the moderate category, based on Hake's indicators [24]. Student feedback indicated 86% were very satisfied with the interactive features. Rohendi et al. also found that interactive media significantly improved student understanding and participation [3]. Teachers reported that the use of AR and AI chatbots enlivened the learning experience. Thus, this limited trial provides a strong foundation for broader implementation.

During an effectiveness trial involving 160 students, the average post-test score increased to 80.3 from a pre-test average of 52.1. The difference in scores of 28.2 was statistically significant, as demonstrated by a paired-sample t-test ($t = 12.72$; $p < 0.001$). This confirms the module's substantial impact on students' understanding of local history. Fernández Mier et al. assert that project- and place-based learning have a long-lasting impact on cultural understanding [12]. The proven effectiveness underscores the transformative potential of technology in history education, encouraging wider adoption of the module.

Table 3. Limited Trial Results and Product Effectiveness

Trial Phase	Pre-Test	Post Test	Get Score	Interpretation
Limited Trial (30 students)	53.4	75.6	0.47	Currently
Effectiveness Test (160 students)	52.1	80.3	-	Very Effective ($p < 0.001$)

The correlation between the frequency of digital application use and learning outcomes was analyzed using the Pearson correlation coefficient. The r value = 0.62 indicates a strong relationship. This confirms that students' engagement with AI and AR applications directly affects their post-test scores. According to Hastomo et al., AI chatbots encourage student engagement through personalized and contextual feedback [25]. The applications used in this module are equipped with GPS-based prompts that encourage active interaction in geographic locations. Thus, the frequency of digital interaction emerges as a key factor in the effectiveness of location-based history education.

Teacher perceptions were also assessed through a Likert-scale questionnaire and interviews. All eight teachers agreed that the module was easy to implement in history learning. The average perception score was 4.3 out of 5, indicating high satisfaction with the module's quality. Teachers noted that storytelling, artifact visualization, and chatbots increased students' motivation to understand local history. Muthmainnah et al. concluded that AI, when

implemented proportionally, can effectively expand the learning experience [10]. These teacher responses demonstrate strong support for the module's sustainability and scalability. Thus, collaboration between teachers and technology is a key strategy in strengthening the local curriculum.

Table 4. Correlation and Teacher Perceptions of Products

Indicator	Mark	Interpretation
Correlation Frequency ↔ Post-Test	r = 0.62	Strong Relationship
Teacher Perception Score (1-5)	4.3	Very Positive
Teachers Support Implementation	87.5%	Strong Majority

The findings also show a significant difference between the performance of urban and rural schools. The average post-test score for urban schools was 84.2, while for rural schools it was 76.3. A one-way ANOVA yielded $F = 4.87$ and $p = 0.016$, indicating a significant difference between the groups. This is in line with Ahmed, who emphasized the role of digital infrastructure in shaping the quality of education [8]. This gap highlights the need for affirmative strategies to equalize digital access in schools. Therefore, further teacher training and technological support in remote areas need to be prioritized for sustainable implementation.

The final product evaluation was conducted on all student and teacher respondents. The module content was rated 90.1% (very good), the media presentation was rated 88.4% (good), and the AI functionality was rated 84.7% (good). The overall rating of feasibility was 87.7%, categorized as very good for widespread use. This assessment reflects a strong positive response to the module's design, content, and educational value in the context of local history. Menz et al. emphasizes the importance of reference quality and readability in educational AI products [26]. Thus, the results of this evaluation strengthen the module's position as a viable learning tool on a national scale.

Table 5. Comparison Between Schools and Final Product Evaluation

Component	Score/Value	Interpretation
Urban Post-School Test	84.2	Tall
Rural Post-School Exam	76.3	High enough
One-Way ANOVA	$F = 4.87; p = 0.016$	Significant Difference
Module Content Eligibility	90.1%	Well Worth Doing
Media Presentation	88.4%	Good
AI functionality	84.7%	Possible to do
Overall Product Eligibility	87.7%	Suitable for Wide Use

In-depth interviews with teachers showed that digital modules encouraged active student participation. One teacher observed that students became more enthusiastic in asking questions and discussing after a field trip to Ijen Geopark. Observations showed that students

actively used AI chatbots to explore local cultural information independently. Muthmainnah et al. showed that chatbots in education stimulate critical thinking and questioning skills [10]. These findings confirm that technology integration serves not only as a supporting tool, but also as an instrument to enhance critical thinking processes. Therefore, exploration-based digital learning strategies need to be further developed.

This module also features AR-based storytelling that enriches students' learning experience. When scanning geospatial objects in Ijen Geopark using smartphones, students can view virtual artifacts and read related historical narratives. Varol & Öksüz highlighted the effectiveness of AR in digital documentation and cultural heritage preservation [4]. This approach connects national and local curricula through cross-disciplinary projects. Supianti et al. also found that the integration of PBL and STEAM approaches fosters collaboration, communication, and cultural understanding [11]. Consequently, this product strengthens historical, technological, and cultural literacy simultaneously.

Table 6. Qualitative Findings from Teachers and AR Storytelling Features

Aspect	Key Findings	Interpretation
Teacher's Response	Students asked more questions after the field trip	Increased Participation
Student Observation	Using chatbots to explore local history independently	Enhanced Learning Initiative
AR Storytelling Features	Real-time visualization of cultural artifacts	Original and Informative
Curriculum Integration	PBL + STEAM + Local History	Interdisciplinary and Contextual
Literacy Potential	History, Technology, Culture	Multidimensional Literacy

Conclusion

This study shows that integrating history education with digital tourism and the application of artificial intelligence significantly improved students' understanding of local cultural values. Effectiveness testing confirmed substantial improvements in historical knowledge and attitudes toward cultural conservation following module use. Students' active engagement with AI- and AR-based applications strengthened the internalization of cultural values. Teachers positively assessed the module's ease of use and its contribution to achieving educational goals. The strong correlation between digital activities and learning outcomes underscores the relevance of technology-based approaches in strengthening history education. Collectively, these findings confirm that technology-enhanced media development contributes meaningfully to cultural conservation through contextual learning practices.

Future research should focus on long-term implementation to more accurately assess the program's impact on student character development in preserving cultural heritage.

Priority should be given to developing offline versions of AI and AR applications to address connectivity limitations in Geopark areas. Teachers should be more intensively involved in training programs to ensure technological competency that supports effective media use. Repeated evaluations across various school contexts are needed to strengthen the generalizability of findings and further refine the product. Cross-sector collaboration involving schools, cultural communities, and Geopark management needs to be strengthened to sustain innovation. The successful implementation of AI-based modules and digital tourism in history education presents a new direction for locally-based educational innovation.

Conflict of Interest

The authors declare no conflict of interest.

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