

Development of 3D Animation Learning Media Based on Ngrawan Site to Improve Digital Literacy Skills of Grade VII Students at MTsN 3 Ponorogo

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ARTICLE INFO	ABSTRACT
Keywords: 3D Animation, Digital Literacy, Learning Media, Ngrawan Site, Social Studies Education	Social Studies (IPS) learning, particularly history, is often considered unengaging due to its conventional and abstract presentation. Furthermore, the use of digital technology in learning has not been optimal, resulting in low student digital literacy. Technological advancements demand students' ability to access, understand, and critically evaluate digital information. Therefore, innovative interactive and contextual learning media is needed, one example of which is the development of 3D animation media based on local historical sites such as the Ngrawan Site. This study aims to develop a 3D animation-based social studies learning media for the Ngrawan Site and determine its feasibility and effectiveness in improving the digital literacy of seventh-grade students at MTsN 3 Ponorogo. Furthermore, this media development can be an alternative solution for creating more engaging, interactive, and technologically relevant learning. This study used a Research and Development (R&D) method with a 4D development model, including the define, design, develop, and disseminate stages. The subjects were seventh-grade students at MTsN 3 Ponorogo, with a limited-scale trial. Each stage consisted of identifying learning needs (define), designing a website-based 3D animation prototype (design), validating the product the product through media and material experts (develop), and implementing it on a limited scale (disseminate). Data collection techniques included observation, pretests, posttests, and documentation. Data analysis used quantitative descriptive methods to assess product feasibility, and the N-Gain test was used to measure the increase in students digital literacy scores before and after using the media, thereby determining its

effectiveness. The results showed that the developed 3D animation learning media, the Ngrawan Site, was deemed highly feasible based on validation by material experts and media experts. Furthermore, the N-Gain calculation test yielded a value of 0.6663, which falls into the "moderate" category, with a percentage of 66.63% categorized as "quite effective." Thus, the 3D animation media, the Ngrawan Site, is effective in improving students' digital literacy and can be an innovation in interactive, contextual, and meaningful social studies learning.

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INTRODUCTION

The advancement of digital technology in the twenty-first century has significantly influenced educational practices. Educational institutions are required to adapt to technological developments by integrating digital tools and resources into learning activities. In this context, digital literacy has become one of the essential competencies that students must possess to effectively access, evaluate, utilize, and communicate information through digital media. Digital literacy is not limited to technological skills but also encompasses critical thinking, problem-solving abilities, and ethical use of information.(Belshaw, 2014)

The Indonesian educational curriculum emphasizes the importance of digital competence as part of twenty-first-century skills. However, many learning activities remain teacher-centered and rely heavily on conventional instructional methods.(Lionar et al., 2024) This situation is particularly evident in Social Studies (IPS) learning, where historical materials are often presented through lectures and textbooks, making learning less engaging and reducing students' motivation.

Historical learning requires visualization because many historical objects and events cannot be directly observed by students. Consequently, abstract explanations frequently result in limited understanding. Learning media play a crucial role in transforming abstract concepts into more concrete experiences. One innovative solution is the utilization of three-dimensional animation technology.

Three-dimensional animation media provide visual representations that allow learners to interact with objects from various perspectives.(Riyana & Setiawan, 2023) Such

media can increase students' engagement, motivation, and understanding of learning materials.(Teplá et al., 2022) Furthermore, integrating local historical heritage into digital learning media can enhance contextual learning and foster appreciation for local culture.

The Ngrawan Site is one of the important historical heritage sites in East Java associated with the Gelang-Gelang.(Fuadillah & Soebijantoro, 2016) The site contains valuable archaeological artifacts such as statues, inscriptions, yoni, and architectural remains. Despite its educational value, the Ngrawan Site has not been optimally utilized as a learning resource in schools. Several previous studies have highlighted the effectiveness of animation-based media and digital learning resources in improving learning outcomes. Nevertheless, research focusing on the integration of local historical heritage through interactive 3D animation media to enhance digital literacy remains limited. Therefore, this study seeks to fill this gap by developing and evaluating a 3D animation learning media based on the Ngrawan Site.

RESEARCH METHOD

This study employed a Research and Development (R&D) approach using the Four-D (4D) model developed by Thiagarajan, Semmel, and Semmel (Sugiyono, 2013). The model consists of four stages: Define, Design, Develop, and Disseminate.

The define stage aimed to identify learning needs and problems. Activities included front-end analysis, learner characteristic analysis, concept analysis, task analysis, and the formulation of learning objectives. The results indicated that the use of learning media in the teaching and learning process was not yet optimal, that students experienced difficulties in understanding historical materials, and that students at the junior secondary level tend to be more interested in visual, interactive, and technology-based learning media.

At the design stage, the learning media prototype was developed as an educational website integrating 3D animation technology. The choice of a website-based platform was based on its accessibility and flexibility, as it can be accessed on various devices, such as laptops and smartphones, without additional installation. Storyboards, navigation structures, visual layouts, and learning materials were prepared in accordance with the curriculum objectives.

The development stage involved media production and validation. The media underwent expert validation by media and material experts to ensure the product met feasibility criteria for both content and appearance. Revisions were conducted based on

suggestions and feedback from validators. Subsequently, the media were tested in two stages: a limited trial and a main trial, involving Grade VII students at MTsN 3 Ponorogo. The last in the disseminate stage was the introduction and distribution of the final product on a limited scale within the school environment at MTsN 3 Ponorogo, as a digital learning resource that can be sustainably used in subsequent learning activities.

The subjects of this study were 32 Grade VII students of MTsN 3 Ponorogo. Data were collected using observation, Interviews, Documentation, Expert validation questionnaires, and Pretest and posttest instruments. Feasibility data obtained from expert validation were analyzed using percentage-based techniques and categorized according to a Likert-scale interpretation. Before testing the media's effectiveness, normality was assessed using the Shapiro-Wilk test. Since the pretest and posttest data were not normally distributed ($\text{Sig.} = 0.000 < 0.05$), the effectiveness of the media was further examined using the nonparametric Wilcoxon Signed-Rank Test and the N-Gain analysis.

RESULT AND DISCUSSION

Product Development

The developed product is a website-based learning media integrating Social Studies materials with interactive 3D representations of historical artifacts from the Ngrawan Site. The website consists of several menus: Home, Learning Materials, History of Ngrawan Site, Educational Videos, 3D Object Visualization, and Profile. The 3D visualization feature allows students to rotate objects, zoom in and out, and examine historical artifacts from multiple perspectives. Artifacts included in the media consist of: Ngrawan Gate, Dewi Parwati Statue, Mula Malurung Inscription, Yoni, Umpak (stone pedestal), Ukel (ornamental fragment), and Pottery fragments. This feature provides a more immersive learning experience than conventional methods, allowing students to observe historical objects that cannot be accessed in real life.

Media Feasibility

The development phase is carried out after the design phase is completed. This process involves validation by media and subject matter experts, followed by product trials with students.

Media Expert Validation

Media expert validation assessed software engineering, visual communication design, and functionality/literacy aspects of the developed learning media. The results are presented

in Table 1.

Table 1. Media Expert Validation Results

Aspect	Item Number	Score
Software Engineering	1	4
	2	5
	3	5
Visual Communication Design	4	5
	5	5
	6	5
	7	4
Functionality and Literacy	8	4
	9	5
Total		42
Percentage		93%
Category		Very Feasible

Based on Table 1, the media expert validation obtained a total score of 42 with a percentage of 93%, which falls into the “very feasible” category. The validator also provided comments and suggestions as a basis for product improvement, particularly regarding the website’s navigation menu and homepage layout, which were subsequently revised by the researcher.

Material Expert Validation

Material expert validation assessed content feasibility, content presentation, and digital literacy aspects embedded in the learning media. The results are presented in Table 2.

Table 2. Material Expert Validation Results

Aspect	Item Number	Score
Content Feasibility	1	5
	2	5
	3	5
	4	5
	5	5
Content Presentation	6	5
	7	5
	8	5
	9	3
	10	4
Digital Literacy	11	5
	12	5
	13	5
Total		62
Percentage		95%

Category	Very Feasible
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Based on Table 2, the material expert validation obtained a total score of 62 with a percentage of 95%, which also falls into the “very feasible” category. The validator suggested adding more supporting materials and images on the learning material page, which were incorporated in the revised version of the product.

These results indicate that the 3D animation learning media based on the Ngrawan Site has fulfilled the feasibility standards in terms of both content and appearance, and is therefore suitable to be implemented in the teaching and learning process.

Effectiveness Test

Prior to testing the effectiveness of the media, a normality test was conducted on the pretest and posttest data using the Shapiro-Wilk method. The results showed significance values of 0.000 for both the pretest and posttest data (Sig. < 0.05), indicating that the data were not normally distributed. Consequently, the effectiveness analysis proceeded using the non-parametric Wilcoxon Signed Rank Test rather than a parametric t-test.

The Wilcoxon Signed Rank Test yielded a Z value of -4.886 with an Asymp. Sig. (2-tailed) of 0.000 ($p < 0.05$), indicating a statistically significant difference between the pretest and posttest scores of the 32 students. The posttest scores were found to be higher than the pretest scores, demonstrating an improvement in students’ digital literacy after using the 3D animation learning media.

To further determine the magnitude of this improvement, an N-Gain analysis was conducted, as summarized in Table 3.

Table 3. N-Gain Test Results

N	Mean N-Gain Score	N-Gain (%)	Category
32	0.6663	66.63%	Moderately Effective

As shown in Table 3, the mean N-Gain score was 0.6663, which falls within the “moderate” category, with a percentage of 66.63%, categorized as “moderately effective.” These findings confirm that the 3D animation learning media based on the Ngrawan Site is effective in improving the digital literacy of Grade VII students.

Discussion

The development of the 3D animation-based Social Studies learning media followed the four stages of the 4D model: define, design, develop, and disseminate. In the define stage,

front-end analysis revealed that learning media utilization in the classroom was not yet optimal, which limited the effectiveness of material delivery. This finding is in line with Azhar Arsyad's argument that learning media can help teachers convey materials while stimulating students' attention and learning interest.(Arsyad, 2019)

Learner characteristic analysis indicated that junior secondary students tend to be more interested in visual, interactive, and technology-based learning media, consistent with Piaget's formal operational stage, in which abstract thinking begins to develop but still requires visual support for deeper understanding.(Qur'ani et al., 2024) Concept analysis further revealed that Social Studies materials are relatively complex and abstract, requiring media capable of presenting concrete visualization, in accordance with Abdul Karim's view that the selection of learning media should be adjusted to students' competencies, ease of use, and school facilities.(Karim, 2015)

Based on these findings, the researcher developed a website-based 3D animation media. This is consistent with Rosmiati et al., who stated that three-dimensional objects can be observed from various perspectives, allowing students to gain a more direct learning experience.(Rosmiati et al., 2022) A website platform was selected for its accessibility and flexibility, as it can be accessed via laptops or smartphones without additional installation, in line with Marinu Waruwu's view that research and development activities should produce innovations that are practically applicable and scientifically testable.(Waruwu, 2024)

In the develop stage, the media obtained a validation score of 93% from media experts and 95% from material experts, both categorized as "very feasible." These results indicate that the developed media has met the feasibility standards and can be implemented in the learning process. The testing process was carried out gradually, beginning with expert validation, followed by a limited trial and a main trial, consistent with the procedure suggested by Jasmine Riani Johan et al.(Johan et al., 2023)

Regarding effectiveness, the N-Gain score of 0.6663 (66.63%), categorized as "moderately effective," supports Paul Gilster's theory of digital literacy, which underlies this study, showing that students' ability to access, understand, evaluate, and construct digital information improved after using the 3D animation learning media.(Gilster, 1997) This improvement is attributable to the media's capacity to present learning materials more concretely and attractively, making previously abstract concepts easier to understand, in line with Arsyad's assertion that learning media can clarify the delivery of material and enhance students' attention and motivation.

These findings reinforce previous research by I Dewa Gede Agus Kusuma Yoga and I Made Tegeh, who found a significant difference in students' understanding before and after using 3D Augmented Reality media.(Yoga & Tegeh, 2024) While the previous study focused on conceptual understanding, the present study extends this line of research by demonstrating that 3D animation media can also be effective in improving students' digital literacy. Therefore, the 3D animation learning media based on the Ngrawan Site offers a viable innovation to address the limitations of conventional Social Studies instruction, while simultaneously introducing local historical heritage to students through an interactive and contextual learning experience. Nonetheless, the media still has room for further development to achieve a higher level of effectiveness.

CONCLUSION

This study concludes that the 3D animation-based Social Studies learning media featuring the Ngrawan Site was successfully developed through four stages of the 4D model: Define, Design, Develop, and Disseminate. The define stage identified the need for a more interactive and visual learning medium, the design stage produced a website-based 3D animation prototype, the develop stage involved expert validation and revision, and the disseminate stage introduced the product on a limited scale at MTsN 3 Ponorogo.

The developed media was found to be very feasible, with validation scores of 93% from media experts and 95% from material experts. In terms of effectiveness, the Wilcoxon Signed Rank Test indicated a significant difference between pretest and posttest scores, while the N-Gain analysis showed a score of 0.6663 (66.63%), categorized as moderately effective in improving students' digital literacy.

These findings confirm that integrating local historical heritage into interactive 3D animation media can serve as a viable innovation to overcome the limitations of conventional Social Studies instruction. However, this study is limited to a single school context and a relatively small number of subjects, and the effectiveness achieved was only at a moderate level. Future studies are recommended to expand the scope of research subjects, extend the implementation period, and explore additional features to further increase the media's effectiveness in enhancing students' digital literacy.

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