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The technology of Augmented Reality Based 3D Animation with Grinding Machine Forms to Improve Vocational Student's Understanding Skills in the Era of Educational 4.0

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This research aims to (1) develop augmented reality technology based on 3D animation with a grinding machine; (2) test the level of product attractiveness; and (3) test the effectiveness of the product being developed. In this study, the method used is research and development (R&D), followed by quasi-experimental experiments to test its effectiveness. The findings in this study include: (1) augmented reality technology based on 3D animation with a form of grinding machine that was developed to have a relatively high level of attractiveness and completeness of vocational material; (2) augmented reality technology based on 3D animation with a form of grinding machine that was developed proved to be able to improve the skills of understanding vocational students in the era of education 4.0; and (3) the results of research and development in this article can be used as an alternative reference for developing the next learning technology.

Keywords: *Augmented Reality, 3D animation, education 4.0, vocational education*

1. Introduction

The world of education is moving forward. Entering the era of education 4.0, humans are directed towards the utilisation of digital technology. The rapid development of various aspects [1–3]. Starting from the aspects of planning, implementation, to evaluation. In the planning aspect, the use of instructional media uses almost entirely digital media. Some developing countries in the world, the level of use of digital learning media has entered the figure of 85% [4,5]. That, of course, will require education activists to keep up to date with every technological development. Ironically, especially in the vocational world, there are still many gaps that occur. One of the discrepancies that learning media facilities in higher education cannot always be updated following technological developments [6–9].

The system of vocational education should be synchronised with the latest technological developments. Whereas before the new technology appears in the industrial world, citizens in vocational education institutions must be able to understand and operate it [10,11]. So, when the device circulates in the industry, there are already people who are able to operate it. This is what has not been able to be fully carried out by vocational education institutions. This has an impact on the relatively low absorption of vocational student graduates in the world of work. Especially in the field of mechanical engineering, where technological development is in the global realm. New technologies in the manufacturing industry have a relatively high acceleration rate of 80% to 95% [12–15]. This is certainly a serious challenge for vocational education institutions to start thinking about ways to overcome them.

One way that is able to overcome these big problems is through the use of Augmented Reality technology. Augmented Reality (AR) is a digital technology that combines the real world and the virtual world [16–18]. AR technology has the principles of displaying images in 2D in reality and detail. Not only that, AR is able to display objects that cannot be brought directly to the front of its users. This technology allows users to interact in an environment that is simulated by a computer (computer-simulated environment). This environment is actually an imitation or place that only really exists in the imagination. The basis of virtual reality work is a coding language known as VRML (virtual reality modeling language). This language can create a series of images to determine what type of interaction you want to display. In the world of vocational education, a lecturer needs Augmented Reality to display the results of a new object significantly to his students. Through Augmented Reality, students will know about more detailed specifications about the new object [19–21].

In this study, researchers developed 3D animation-based augmented reality technology with a form of grinding machine to improve vocational student understanding skills in the educational era 4.0. The development of this technology is intended to overcome the delay in vocational education institutions in updating knowledge for their students.

2. Methodology

In this study, the method used is research and development (R&D). This method was chosen because the focus of this research is to develop technology and test effectiveness. The stages of development start from the need's analysis, literature study, product design, product validation, product trials, product revisions, and product effectiveness tests. The validation test was conducted by two expert teams. The team consists of a learning media expert team and a vocational material expert team. Schematically, the method implemented is presented in Figure 1.

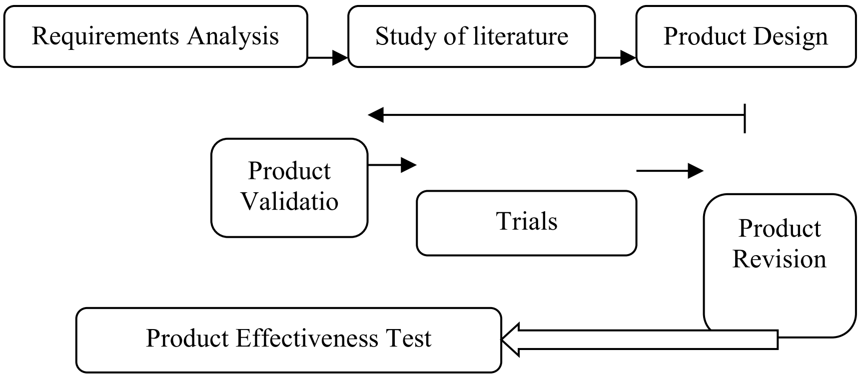

Figure 1. Scheme of Development Stages

3. Results

In this study, the results of the study consisted of three topics. These topics include: (1) the results of the development of 3D animation-based augmented reality technology with a grinding machine; (2) results of validation by media experts and material experts; and (3) product effectiveness test results.

3.1 The results of the development of augmented reality technology

The results of the development of this research are 3D animation based augmented reality technology with a grinding machine. Display application developed products are presented in Figure 2.

Figure 2. Display of the developed product homepage

In Figure 2, it can be shown that on the homepage the application of 3D animation-based augmented reality technology consists of several components. These components include the marker image, application name, 'play' button, 'close' button, developer name, and copyright statement. Next, the AR display, when pressed the 'play' button, is shown in Figure 3.

Figure 3. Display 'play' AR

Figure 3 shows the AR application display in camera mode. In the AR display consists of three main parts. The first part is the 3D object animation grinding machine. This section includes intact objects and objects of each component.

3.2 The results of the validation of media experts and material experts

In this study, validation was carried out by two expert teams. The results of the validation data from the learning media team are shown in Table 1.

Table 1. Results of the validation of learning media experts

No	Indicator Points	Score	%
1	The appropriate appearance of the results (click)	4.00	100.00
2	Attractive design and compatibility with the parent material	3.50	87.50
3	Ease in the process of reading content and content by users	3.33	83.33
4	Harmonize designs, icons, and menus according to theme	3.33	83.33
5	Easy understanding of the toolbar and navigation menu	3.50	87.50

In Table 1, it can be interpreted that there are five main components of validation by learning media experts. Furthermore, the results of the validation processed by the vocational material expert team are shown in Table 2.

Table 2. Results of the validation of vocational material experts

No	Indicator Points	Score	%
1	The suitability of the material with the competency target	3.80	95.00
2	The level of novelty of the material displayed	3.33	83.33
3	Completeness of images, graphics, and videos	3.80	95.00
4	The relevant level of material matches the valid reference	4.00	100.00
5	Material compatibility with indicator achievements	3.80	95.00

In Table 2, it can be interpreted that there are five main components of validation by vocational material experts. In indicator four (the relevant level of material according to valid references) the score obtained is 4.00 (100%).

3.3 Product effectiveness test results

The next process is carried out experimentally to test the effectiveness. The initial stage is the results of the initial abilities of the two classes. The results of the initial capability analysis are shown in Table 3.

Table 3. Summary of Initial Ability Test Results

T-test for Equality of Means				
T	Df	Sig.	Mean Difference	Std. Error Difference
-1.11 -1.11	57 54.356	.2756 .2774	-1.840 -1.840	1.6833 1.6753

Table 3 shows the results of the initial ability tests of the two classes before using augmented reality based on 3D animation. The summary of these results shows a significance value of 0.275. It shows that the initial ability of the two classes where there is no significant difference. Final test results are presented in Table 4.

Table 4. Summary of Final Capabilities Results

T-test for Equality of Means				
T	Df	Sig.	Mean Difference	Std. Error Difference
7.632	57	.000	11.9852	1.5798
7.602	53.167	.000	11.9852	1.5758

Table 4 explains the results of the final ability tests of both classes. Based on these results, a significant value of 0.00 (sig. 0.00). It shows that there are significant differences between the results of the final ability tests of the two classes.

4. Discussion

In this session, the discussion is divided into two topics. These topics include the development of AR technology as a learning medium for educational era 4.0 and AR technology to improve vocational student skills.

In this development research, the product developed has a high attractiveness value. This is evidenced by the average percentage value of learning media experts and vocational material experts by 90%. At the validation stage, there are ten main indicators that have a fairly good acceptance value. In principle, the meaning of learning technology is everything that can be used as a tool in order to support efforts to implement the teaching and learning process that focuses on achieving learning objectives [22–24]. In online learning technology, some experts state that the form of online learning media must be concise, simple and limited to the things that are important. The concept must be clearly illustrated and easily understood. The writing is quite clear, simple and easy to read. This is in accordance with the characteristics of the AR technology that has been developed. In this technology, graphics are designed to accurately illustrate the purpose of visualisation and the meaning of messages. That is because in the era of education 4.0 all are required to be able to be used in a simple but complex way [1,3,25,26].

In essence, AR learning media plays an integral part in the overall learning process and learning media. In its use, it must be relevant to the competencies to be achieved and the content of the learning. Learning media does not function as entertainment, but has a function to improve the learning process [5,27]. That is certainly in accordance with the main objective of this technology which is to improve the skills of vocational students. The results of the analysis of the development of learning technology, that technology have six main roles. These roles include: (1) tools to create effective teaching and learning situations; (2) an integral part of the whole teaching-learning situation; (3) laying down concrete foundations of abstract concepts so as to reduce verbal understandings; (5) arousing student's learning motivation; and (6) enhance the quality of teaching and learning [28–30].

From the six functions, the improvement of vocational student skills will automatically increase. Then the function of the AR technology media, which is able to encourage the focus of student-centered learning. The technology can provide an opportunity for lecturers to spend more time diagnosing and correcting learning problems. Not only that, the lecturer will reflect, dialogue with students, and provide special assistance individually [31,32]. On the other hand, the AR technology that was developed actually helps lecturers to become creative managers in providing meaningful learning experiences not just for delivering information. So, it can be understood that learning will not run effectively if there are no innovative learning media. Learning media is one component of teaching and learning [23,33,34]. Problems in conveying subject matter and information in learning can be helped and overcome by using innovative learning media so that it will help the achievement of learning objectives.

5. Conclusion

In this study, the conclusions are divided into several components. First, augmented reality technology based on 3D animation with a form of grinding machine developed has a relatively high level of attractiveness and completeness of vocational material. Secondly, augmented reality technology based on 3D animation with a form of grinding machine that was developed proved to be able to improve the skills of understanding vocational students in the era of education 4.0. Third, the results of research and development in this article can be used as an alternative reference for developing the next learning technology.

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