Augmented Reality (AR) Press Machine as the application of the latest learning media technology in the XXI Century

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Abstract. The objectives of this study are: (1) creating an augmented reality (AR) application in the form of a press machine; (2) testing the attractiveness of the technology developed; and (3) testing the effectiveness of AR technology in the form of press machines. The method used is research and development (R&D). The final stage of product development is to carry out quasi-experiments. The phase is focused on all vocational students at Malang State University. The findings in this study include: (1) AR-shaped press machine that was developed proved to have a high level of design attractiveness and material; (2) AR shaped press machine that was developed proved effective in increasing student’s basic understanding of the competence in understanding the function of press machine components; and (3) all results in this study are expected to be the main reference in the development of AR technology for learning.

Keyword: Augmented Reality; XXI Century; Basic knowledge; Press Machine

1. Introduction

The development of technology began to spread to the world of education. Entering the XXI century, humans are required to create an educational system that utilizes digital technology in it [1–3]. Utilization of the technology can include the planning, implementation, and evaluation stages. Most developed and developing countries have used digital learning media in their education systems. This education system is considered more effective and efficient. This makes the education activists continue to update each of these learning media. Ironically, especially in the vocational world, there are still many gaps that occur [4–6]. One of them is the learning media in tertiary institutions which are not compatible with technological developments. This will affect the quality of the output produced. It may be that they cannot compete in the world of work in the XXI century [7,8].

The vocational education system does need to be developed. An effective and efficient system is needed to produce quality individual output that can compete in the XXI century. This education system certainly must involve a touch of technology in it. Schematically, before new technology is released into the industrial world, vocational experts must be able to operate it [9,10]. So, when the device circulates
in the industry, there are already people who are able to operate it. Primarily in the field of mechanical engineering.

Various solutions have been tried developed by several experts, but have not shown significant things [11,12]. It is necessary to find the right solution to solve the problem. The technology that is trending in the XXI century is the technology of Augmented Reality (AR). In principle, AR technology can insert certain information into cyberspace and display it in the real world with the help of gadgets such as webcams, computers, Android phones, and special glasses. Users or users in the real world cannot see virtual objects with the naked eye, to identify objects needed by intermediaries in the form of computers and cameras that will later insert virtual objects into the real world [13–15].

Learning in the vocational field, especially in understanding the function of the components of a machine, cannot be imagined. Students must be able to visually see the shape and design of the machine components. One of the problems related to this is in understanding the function of components of the press machine [4,7,16]. Press machine is a machine that is widely used by technicians and all people engaged in machinery. The main problem faced by students, they could not actually bring the machine and dismantle it. That is because of the high price of a press machine makes it impossible to analyze its components in detail [11,17].

Correspondingly, the main concept of AR, which displays real objects into a 3D visual display. This environment is actually an imitation or really a place that only exists in the imagination. Through Augmented Reality, students will know about more detailed specifications about the new object without the institution having the object [18,19]. Researchers develop a technology in the learning system by utilizing augmented reality technology with the form of a press machine to improve student’s basic knowledge of competence in understanding the functions of press components.

2. Method

The method used is research and development (R&D). The stages of development start from given product analysis, literature study, AR product design, AR product validation, AR product testing, product revision, and product effectiveness testing. The validation test was conducted by a team of instructional media experts, and a team of vocational material experts. The effectiveness test was carried out through quasi-experimental and focused on all vocational students at Malang State University. Schematically, the method implemented is presented in Figure 1.

3. Result

The results of the study consisted of three topics. The topics include: (1) augmented reality technology product development in the form of animated press machine; (2) results of validation by media experts and material experts; and (3) product effectiveness test results. Explanation of each topic is explained as follows.

3.1. The results of the development of augmented reality technology

The product developed in this research is augmented reality technology in the form of press machine animation. The product display developed is shown in Figure 2.
In Figure 2 it can be shown that in the main page display the developed product consists of several contents. The content is equipped with buttons to go to other pages/views. Next, the appearance of the AR application when it is run in Figure 3.

Figure 3 shows the AR application display after pressing the 'play' button. The display is entered in camera mode. In the AR application display, it shows four main contents. First, 3D object content in the form of an animated press machine. The content is in the form of animated machine press machine intact. Second, namely in the form of a 3D form of the press machine which is shown by its components. Third, it is a detailed description of press machines. Fourth, is the exit button to go back to the main page (homepage).

### 3.2. The results of the validation of media experts and material experts
Validation is carried out by two expert teams by their expertise. The team is a team of learning application media experts and vocational education material experts. In detail, the scores of each item validated by the learning media expert team are shown in Table 1.

| No  | Indicator Points                       | Score | %    |
|-----|----------------------------------------|-------|------|
| 1   | Attractive application design           | 3.50  | 87.50|
| 2   | The renewal of the application developed| 3.50  | 87.50|
| 3   | Complete application content            | 3.33  | 83.33|
| 4   | Ease of operation by users              | 4.00  | 100.00|
| 5   | Ease the interface process of the application | 3.50  | 87.50|

Table 1 shows that the average score of learning media validation results was 85%. On one of the indicators get a score of 4.00 (100%), which is on the indicator 'ease of operation by the user'. 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 relevance of the material to the world of vocational education | 3.50  | 87.50 |
| 2  | The updated level of material and information | 3.33  | 83.33 |
| 3  | The suitability of the material with the learning outcomes | 3.80  | 95.00 |
| 4  | The level of complexity of the supporting material | 3.50  | 87.50 |
| 5  | The suitability of the material presented with the level and level of education of the user | 3.80  | 95.00 |

Table 2 shows that the average score/percentage of validation of vocational material experts is 90%. In the five main points, there are two items that have the highest score, namely the item ‘suitability of material with learning achievement’s and ‘suitability of material presented with the level and level of education of the user’.

3.3. Product effectiveness test results

After testing the media and material experts, the effectiveness test through t-test is then performed. At this stage, the process is carried out through quasi-experimental techniques. At this stage, two learning groups (classes) are formed. The class consists of a control class and an experimental class. In the initial analysis, an initial ability test is performed. The results of data processing for initial capabilities are shown in Table 3.

Table 3. Initial Ability Test Results data

| T | Df | Sig | Mean Difference | Std. Error Difference |
|---|----|-----|-----------------|----------------------|
| -1.11 | 57 | .28 | -1.84           | 1.68                 |
| -1.11 | 54.4 | .28 | -1.84          | 1.68                 |

Table 3 shows that the test results in both classes have a significance value of 0.28. It shows that the initial ability in the control and experimental class there is no significant difference. Next, the results of data processing from the final proficiency test are presented in Table 4.

Table 4. Data Process Results End Capability

| T | Df | Sig | Mean Difference | Std. Error Difference |
|---|----|-----|-----------------|----------------------|
| 7.63 | 57 | .000 | 11.99           | 1.58                 |
| 7.60 | 53.17 | .000 | 11.99          | 1.58                 |

Table 4 explains that the results of the final ability tests of the two classes have 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

Based on the analysis of the findings in this study, the discussion can be mapped into two topics. The first discussion is the development of augmented reality (AR) products in the form of press machines as innovative learning media innovations. The second discussion discusses the effectiveness of AR in the form of press machines to improve student’s basic knowledge of competencies in understanding the functions of press machine components.

The development of AR products in the form of press machines shows a fairly high degree of validity. It can be seen from the average results of the assessment score reaching 89%. Of course, it is in accordance with the characteristics and principles of learning media in the form of software. Learning
media in the form of innovative software has three main characteristics. Some experts state that the three characteristics include the novelty of relevant material, the selection of up to date content, and the level of user convenience in operating it [14,20,21]. Empirically, AR products in the form of press machines that have been developed have met the rules of the figure of an attractive and effective learning media. The technology can promote active training both physically and psychologically. It encourages users to have a diversity of perspectives of thinking that can prepare for their other daily activities [19,22].

In the realm of material validation for vocational education, AR products in the form of press machines are quite good. That’s because AR that was developed was integrated with 3D animation in the form of press machines. In vocational education material, the study of the function of press machine components is one of the materials that require in-depth understanding. In essence, the components of a press machine have many types. This makes it difficult for students to understand the function of each component if they do not have a picture of the form of the component [22,23]. Thus, through this AR product in the form of a press machine students will have a real and relevant stimulus of imagination. On the other hand, some experts explain that the development of AR technology in the industry can be used in various development sectors. A real example from the world of work is that project management in construction and construction can be easier and safer if managers can see and monitor work virtually [23,24].

In principle, AR has the goal of taking the real world as a basis for the integration of many virtual technologies and adding conceptual data in order to understand humans as users and become increasingly clear. The results of the effectiveness test conducted concluded that AR products in the form of press machines that were developed were able to improve student’s basic understanding of the competence in understanding the functions of press machine components. Some experts claim that the function of AR is to increase one’s perception of the world around them and to make several virtual and real-world new interfaces [24,25]. In addition, through AR will be able to show relevant information and can help in the fields of education, training, repair or maintenance, manufacturing, military, games and all kinds of entertainment. This is possible because the AR system combines objects in the real world with virtual objects so as to present a positive image, both in terms of appearance to hearing in the viewpoint of students [25,26]. This is in accordance with the demands of the quality of the learning process carried out in vocational education.

5. Conclusions
Conclusions in this study were mapped into three items. The three items include: (1) AR-shaped press machine that was developed was proven to have a high level of design attractiveness and material; (2) AR shaped press machine that was developed proved effective in increasing student’s basic understanding of the competence in understanding the function of press machine components; and (3) all results in this study are expected to be the main reference in the development of AR technology for learning.

6. Acknowledgement
Thank you profusely for LP2M (Lembaga Penelitian dan Pengabdian kepada Masyarakat) Universitas Negeri Malang which provides support. Thanks to the scheme DRPM dan PNBP 2019 funded this research.

7. References
[1] Henritius E, Löfström E and Hannula M S 2019 University students’ emotions in virtual learning: A review of empirical research in the 21st century Br. J. Educ. Technol. 50 80–100
[2] Chai C S, Koh J H L and Teo Y H 2019 Enhancing and Modeling Teachers’ Design Beliefs and Efficacy of Technological Pedagogical Content Knowledge for 21st Century Quality Learning J. Educ. Comput. Res. 57 360–384
[3] Hu J, Hu J, Liu H, Chen Y and Qin J 2018 Strategic planning and the stratification of Chinese higher education institutions International Journal of Educational Development Strategic planning and the stratification of Chinese higher education institutions Int. J. Educ. Dev.
[4] Zulkarnaen R H, Setiawan W, Rusdiana D and Muslim M 2019 Smart city design in learning science to grow 21st century skills of elementary school student IOP Conf. Series: Journal of Physics: Conf. Series pp 1–7

[5] Schietroma E 2019 Innovative Stem Lessons, Cil And Ict In Multicultural Classes J. e-Learning Knowl. Soc. 15 183–93

[6] Putra A B N R, Mukhadis A, Poerwanto E E, Irdianto W and Sembiring A I 2019 Edmodo-Based Makerspace as E-Learning Technology to Improve the Management Project of Vocational Students in the Disruptive Technology Era 3rd Int. Conf. Sustain. Inf. Eng. Technol. SIET 2018 - Proc. 302–7

[7] Primasaty N and Jatmiko 2018 Implementation of Geometry Multimedia Based on Van Hiele ‘ s Thinking Theory for Enhancing Critical Thinking Ability for Grade V Students Int. J. Trends Math. Educ. Res. 1 56–9

[8] Putra A B N R, Mukhadis A, Poerwanto E E, Irdianto W and Sembiring A I 2019 LMS Technology by Using Makerspace Approach on Unique Experiments-Based through MOOCs in Improving the Professional Competence of Vocational Students Paper 3rd International Conference on Sustainable Information Engineering and Technology, SIET 2018 - Proceedings IEEE (IEEE) pp 312–6

[9] Lin M 2019 Challenges and Opportunities for Technical and Vocational Education and Training in the local communities : Education and Labour Market for Young People Int. J. Soc. Sci. Stud. 7 1–15

[10] Kintu D, Kitainge K M and Ferej A 2019 An Exploration of Strategies for Facilitating Graduates ’ Transition to the World of Work : A Case of Technical , Vocational Education and Training Graduates in Uganda Int. J. Vocat. Educ. Train. Res. 5 1–9

[11] Mukhadis A, Putra A B N R, Nidhom A M, Dardiri A and Suswanto H 2018 The Relevance of Vocational High School Program With Regional Potency Priority in Indonesia J. Phys. Conf. Ser. 1028 1–8

[12] Putra A B N R, Irdianto W, Mukhadis A and Suhartadi S 2016 Pocket Book Learning : Learning Methods to Train Students Productive and Creative using ‘ BRANO ’ as an Effective Learning Recorder AIP Conference Proceeding vol 1778 pp 1–7

[13] Elyakim N, Reychav I, Offir B and Mchaney R 2019 Perceptions of Transactional Distance in Blended Learning Using Location-Based Mobile Devices J. Educ. Comput. Res. 57 131–69

[14] Chan E Y M 2019 Blended Learning Dilemma : Teacher Education in the Confucian Heritage Culture Aust. J. Teach. Educ. 44 36–51

[15] Owston R, York D and Malhotra T 2018 Blended learning in large enrolment courses : Student perceptions across four different instructional models Blended learning in large enrolment courses : Student perceptions across four different instructional models Australas. J. Educ. Technol. 35 29–45

[16] Chidiac R S and Ajaka L 2018 Writing Through the 4Cs in the Content Areas – Integrating Creativity , Critical Thinking , Collaboration and Communication Eur. Sci. J. August 7881 95–102

[17] Putra A B N R, Irdianto W, Mukhadis A and Suhartadi S 2016 Pocket Book Learning: Learning Methods to Train Students Productive and Creative Using ‘BRANO’ as an Effective Learning Recorder Proceedings of the International Mechanical Engineering and Engineering Education Conferences (IMEEC-2016) vol 1778 (Indonesia: AIP Conference Proceedings) pp 030034–1-030034–7

[18] Reuter R, Hauser F, Muckelbauer D, Stark T, Antoni E, Mottok J and Wolff C 2019 Using Augmented Reality in Software Engineering Education? First insights to a comparative study of 2D and AR UML modeling Proc. 52nd Hawaii Int. Conf. Syst. Sci. 6 7798–807

[19] Depape A-M, Barnes M and Petryschuk J 2019 Students’ Experiences in Higher Education With Virtual and Augmented Reality: A Qualitative Systematic Review Innov. Pract. High. Educ. 3 22–57

[20] Barac M A P, Fernandez J M, Cruz M M A and Cruz J Dela 2019 Assessing the impact of e-learning system of higher education institution ’ s instructors and students IOP Conf. Series: Materials Science and Engineering

[21] Leeuwen A Van, Bos N, Ravenswaaij H Van and Oostenrijk J van 2019 The role of temporal patterns in students ’ behavior for predicting course performance : A comparison of two blended learning courses Br. J. Educ. Technol. 50 921–33

[22] Karakus M, Ersozlu A and Clark A 2019 Augmented Reality Research in Education: A Bibliometric Study Eurasia J. Math. Sci. Technol. Educ. 15 1–12

[23] Chen R W and Chan K K 2019 Using Augmented Reality Flashcards to Learn Vocabulary in Early Childhood Education J. Educ. Comput. Res. 57 1812–1831

[24] Barrow J, Forker C, Sands A, O’Hare D and Hurst W 2019 Augmented Reality for Enhancing Life Science Education Vis. 2019-The Fourth Int. Conf. Appl. Syst. Vis. Paradig. 1 1–7
[25] Diao P H and Shih N J 2019 Trends and research issues of augmented reality studies in architectural and
civil engineering education-A review of academic journal publications Appl. Sci. 9 1–19

[26] Bacca Acosta J L, Baldiris Navarro S M, Fabregat Gesa R and Kinshuk K 2018 Framework for designing
motivational augmented reality applications in vocational education and training Australas. J. Educ.
Technol. 35 102–17