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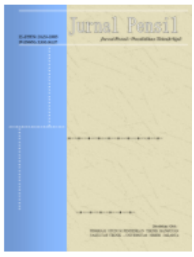

DEVELOPMENT OF VIRTUAL REALITY TEACHING MATERIALS BUILDING MATERIALS PRACTICE COURSES BASED ON INDUSTRIAL NEEDS OF THE SOCIETY 5.0 ERA

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P-ISSN: 2301-8437
E-ISSN: 2623-1085

ARTICLE HISTORY

Accepted:
30 Juli 2023
Revision:
26 September 2023
Published:
29 September 2023

ARTICLE DOI:
10.21009/jpensil.v12i3.37545

Abstract

This research aims to create a collaborative and participatory classroom atmosphere in the use of technology in the world of Education. The era of Society 5.0 makes educators minimize their role as Learning material providers to become educators as an inspiration for the growth of student creativity. This study examines the validity and effectiveness of virtual reality teaching materials for building materials practice courses based on the needs of industry Society 5.0. This research used a research and development (R&D) approach with the ADDIE development model (Analyze et al., Evaluation). This study resulted in media feasibility from several experts where the learning design score was 3.85, learning material expert 3.77, media design expert 3.86; and the increase in student learning outcomes using media with an average pretest score of 41.12 and an average post-test of 74.80 seen from these values, the learning outcomes of students in building materials practice courses using virtual reality media increased by 33.68 or 87.77%.

Keywords: Virtual Reality, Development, Society 5.0

Introduction

The standard of people's lives will increase along with the increasing ability of humans as more professional experts in applying, developing, and disseminating technology. (Maritsa et al., 2021, p. 91). Technology can be created and disseminated through Educational Institutions that produce generations of experts through vocational Education (Maulana & Hamidi, 2020). Vocational Education has different characteristics from other Education, namely: (1) Orientation to individual employability in the world of work; (2) orientation to real needs in the field; (3) The curriculum focuses on cognitive, affective, and psychomotor aspects; (4) Adapt to the development of the world of work; (5) Requires adequate facilities and infrastructure according to the world of work standards; (6) Requires support from various parties (R. Susanti, 2013, p. 2)

Solving social problems of society to face challenges that utilize various technological innovations to improve the quality of human life was born in the era of the Industrial Revolution 4.0. (Supandi et al., 2020) . Complex transformation involving all aspects of production in the industry through the merger of digital technology and internet networks with conventional industries (Al Qardh et al., 2019, pp. 60–75).

The era of the Industrial Revolution will, develop along with the development of the times into the Era of Society 5.0, where in this era, the concept of a human-centered society based on technology. (Mu'minah, 2021). The 5.0 era is defined by a society that grew up in that era in a society whose needs were adjusted to the standard of living of the people who were already of high quality and able to provide a sense of comfort for all aspects (Rahayu & Rahayu, 2021, pp. 87–100).

The era of Society 5.0 is the era of advanced technology and IT, robots, and artificial intelligence. Virtual Reality began to be used in everyday life, in industry, health care, and other fields that are used for the convenience of many people (Kirani & Najicha, 2022, p. 767). Educators play an essential role in improving the quality of human resources in facing the 5.0 Era. Era Society Educators are expected to be able to have life skills in the 21st century which are known for being creative and critical thinking (Supriyadi & Asih, 2020). Able to communicate and collaborate well. For this reason, student need the Internet, the use of artificial Intelligence, and Virtual / augmented reality in the world of Education (Indarta, Jalinus, et al., 2022, p. 3011).

Society 5.0 achieves a high level of convergence between the virtual world and the physical or the real world. In the past, information society 4.0 (SAWITRI, 2019). People access cloud services (databases) in cyberspace through the Internet and search, retrieve, and analyze information or data (Latief, 2020). Cloud Computing technology presented in the world of Education to make it easier for students to overcome the limitations of utilizing ICT infrastructure that previously existed can be overcome (W. Susanti & Putri, 2020, p. 56). Cloud computing is raised for the convenience of accessing networks in demand to unite collection resources ranging from networks, storage media, applications, and services with minimal management effort (Ashari et al. 2011).

In the era of Society 5.0, much information originating from the real world accumulates in cyberspace (Siddiq Sugiono, 2020). In cyberspace, this big data is analyzed with artificial intelligence (AI), and the analysis results are fed back to humans in the physical world in various forms. AI technology is a form of technological communication to users or users (E. A. Sari, 2019, pp. 64–73).

In the Industrial Revolution 4.0 society, an everyday activity is to collect information through networks and be analyzed by humans (Ghufron, n.d.). However, in Society 5.0, people, things, and systems are all connected in cyberspace, and AI data processing results that can exceed human capabilities are fed back to the real world (Yasa et al., 2021, pp. 27–42). Educational institutions utilize this

technology to adapt distance learning that utilizes information technology as a medium. This process brings new value to industry and society in ways that were not possible before (Mumtaha & Khoiri, 2019, p. 4).

The new value for the Education industry is to connect and combine the real world and the virtual world, commonly called metaverses. (Sulistiani et al., 2023). Experiential-based learning is not maximal only by reading and seeing, but must also feel, meaning it must be accompanied by sufficient simulation (Kye et al., 2021, p. 18). Metaverse can represent who a person is, and the avatar will engage with social, economic, and cultural activities to create a value that can be taken meaning (Endarto & Martadi, 2022, pp.37-51).

Figure 1. Virtual reality class University of Cundinamarca Cundinamarca (Indarta, Ambiyar, et al., 2022, p. 3351)

Most humans choose to do activities or work in virtual space. One that is relatively high in addition to art performances and investment, Education is also one of the biggest desires of today's society to do metaverse technology, where metaverse is a virtual space technology innovation, one of which is Virtual Reality media (A. K. Sari et al., 2020).

Virtual Reality is a technology that allows users or users to interact with the environment in a virtual world simulated by a computer (Jamil, 2018, p. 99). So virtual Reality, of course, dramatically supports practical learning in the Building Engineering Education study program. (Ratnawati, 2020) The use of Virtual Reality can help lecturers and students to practice easily and conduct discussions or FGDs without having to meet face to face (Kumala Dewi et al., 2021, pp. 33–38)

Learning building materials practice in the Building Engineering Education study program has been doing direct practice in the laboratory. In addition, inadequate equipment in the laboratory significantly affects the teaching and learning process students. Building materials practice is a simulation course equipped with Jobsheet or printed teaching materials used as a reference for doing a practicum in the laboratory (Lukad Perdana Sutrisno, 2016, pp. 116–120).

Therefore, our perspective on the needs of the world of Education today needs to be oriented. The industrial revolution used technology or networks as a space for information search and then analyzed and able to solve problems. However, the era of society 5.0 combines network components, technology and the results of dictionary analysis are poured into the virtual world in natural form, namely by realizing it through Virtual Reality.

Virtual Reality is a regional learning and Susana is real to learning where users feel events or events that occur in the media (Darojat et al., 2022). Virtual Reality is the answer to the issue of learning loss, where learning loss is a setback in Education due to a prolonged gap or non-continuity of the educational process that creates the situation of students losing skills and knowledge. (Pendidikan, 2021). Online learning is the answer in the lively era of the COVID-19 pandemic (Nurhayanti et al., 2021). This indeed triggers technological developments in Education to upgrade all educational needs, especially in the field of technology. (Nurriza, et al., 2023)

Practical learning can continue to be carried out in virtual form whereas vocational Education oriented to practical learning can certainly visualize practical learning in virtual form (Masnu'ah et al., 2023). Thus, face-to-face and virtual teaching and processes can be adequately realized (Rosma Aryani et al., 2019, pp. 90–101).

Research Methodology

This research is development research using the ADDIE model, namely Analysis, Design, Development or Production, Implementation or Delivery, and Evaluations (Rezi, n.d., 2023). Development research is a type of research that is in its application is very successive, and researchers are free to work with the results (Puspasari et al., 2019). Based on the stages of development in the ADDIE model, research procedures can be seen in the research flow diagram as follows:

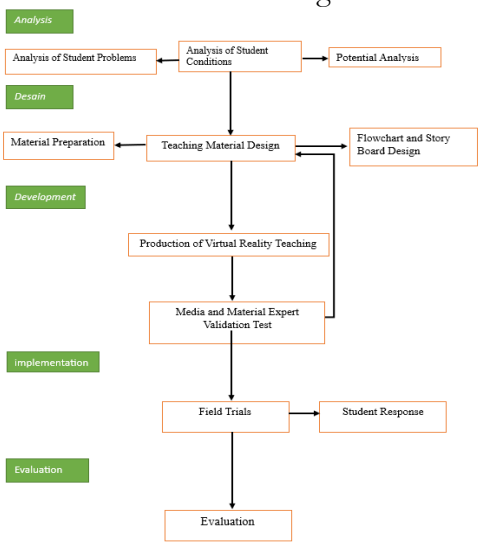

Figure 2. Research flow chart

Participants in this study were students in the Building Engineering Education Study Program who taught building materials practice courses. This research was carried out for one semester or even semesters. The data collection technique used is the distribution of questionnaires or questionnaires to respondents. The media development stage uses instruments that will be tested for feasibility first, and several experts are tested for validity, namely learning design experts, material experts for building materials practice courses, and learning media experts. Data analysis techniques to determine the feasibility of learning media are descriptive statistical analysis. The results of the questionnaire were analyzed using the Likert scale. Furthermore, implementing the media will be carried out three types of trials, namely, one-to-one trials, small group tests, and field trial tests. From the data obtained by students, the results of the feasibility assessment will be analyzed with descriptive analysis techniques (RIA, 2023).

Research Results and Discussion

Analysis Stage

This research begins with the analysis stage in the form of observation in the Department of Building Engineering Education, State University of Medan, to find out the natural learning process, building materials practice courses in the Department of Building Engineering Education, State University of Medan, and to obtain physical data on learning supporting facilities and infrastructure. An overview of the current ongoing learning conditions and required learning conditions can be seen in the following table:

Table 1. Learning conditions analysis stage

No	Past learning conditions	Required learning conditions
1	No competencies have been found that are by the learning objectives	Learning objectives and competencies are adjusted to the needs of students in the era of Society 5.0
2	Learning materials are challenging to understand and inadequate because they are incomplete, and there are no conclusions	Provide complete and interesting learning media
3	Learning activities have no introduction, presentation, or closing	Learning activities are adjusted to the learning strategy, namely introduction, presentation, and closing
4	The initial test of student ability is not carried out	Conduct an initial test of the student's ability
5	Students and lecturers stated that developing learning media for building materials practice courses was necessary.	The development of virtual reality media for building materials practice courses was carried out.

Design and Development Stage

The teaching media development stage is divided into two teaching media, practicum guides, building materials practice courses, and virtual reality media development, building materials practicum courses.

Media Development Stage Building Materials Practice Guide

For the first stage, researchers developed a building materials practice guidebook, which contains learning content according to the learning objectives of the building materials practice course. The building material practice guide media was validated by two validators, namely Learning Design Experts and Material Validation experts, for building material practice guidelines.

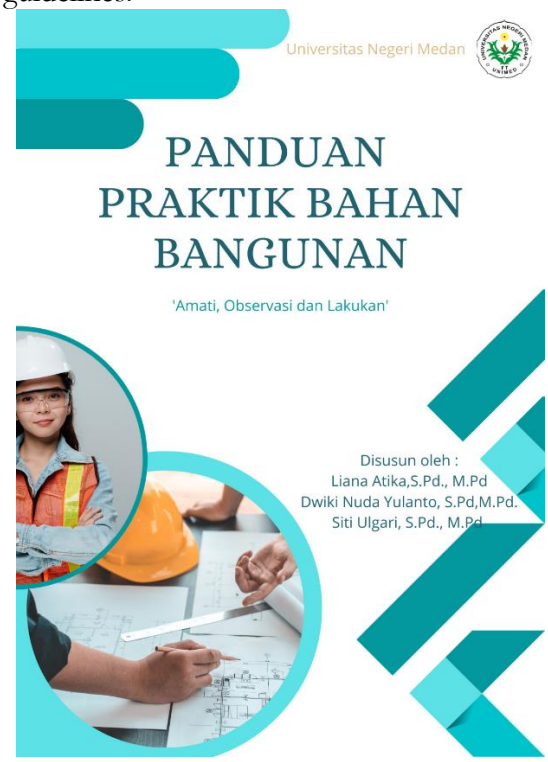

Figure 3. Development of building materials practice manuals

Virtual Reality Media Development Stage of Building Materials Practice

Virtual reality media displays a three-dimensional display engineered by developers using computer media that makes users feel real when viewing the media (Thuan To Saurik et al., 2019). At this stage, designing Virtual Reality media using the licensed Millea Lab application and entering assets according to the needs of developing building materials practice courses, choosing display materials according to learning content that aligns with the learning objectives of building materials practice. Here is how virtual reality media looks using the Milea Lab application.

Figure 4. Virtual reality media building materials practice course with App Millea

The Millea lab application is a virtual reality media maker application that is developing in the world of Education, which is now the Millea Lab application in collaboration with 1,500 schools and has proven to be able to increase students' positive emotions in learning (budianto dkk, 2023). Furthermore, it was reviewed again by learning media experts consisting of three aspects, easy of use, layout, and assessment tools.

The results of Learning Design Expert validation, Expert Validation of building materials practice guide material, and virtual reality media validation of building materials practice courses using Likert scale scoring with a score scale of 1 to 5.

The validated learning design is in the form of a building materials practice guide. Expert validation Learning design is carried out by media experts who are competent in their fields, namely the S3 (Doctoral in Educational Technology) Education level, Mrs. Dr. Enny Kristiana Sinaga, S.Pd., M.Si. The following data from the validation of design experts.

Table 2. Learning design experts' validation

No.	Assessment aspect	Number of Value Scores	Average Score	Category
1	Learning Objectives	20	4	excellent
2	Learning Strategy	12	3	good
3	Preparation of Learning Materials	15	3.75	good
4	Assessment Tools	11	3.66	good
	Average score		**3.85**	**good**

The following validation is expert validation of building material practice guides, which a lecturer in Building Materials practice courses in the Building Engineering Education study program validates. Material experts validate the following data:

Table 3. Materials experts' validation

No.	Assessment Aspect	Number of Value Scores	Average Score	Category
1	Material Preparation	19	3.8	good
2	Presentation of Material	31	3.87	good
3	Assessment Tools	11	3.66	good
	Average score		**3.77**	good

Validation is continued with Expert Validation of Virtual reality learning media, which is validated by a Virtual Reality Media development in Educational technology. The following is the data from VR media validation by experts.

Table 4. Learning media experts' validation

No.	Assessment Aspect	Number of Value Scores	Average Score	Category
1	Ease of Use of VR Media	19	3.8	Good
2	Grammar in VR	19	3.8	Good
3	Visual Illustration/Layout	12	4	Excellent
	Average score		**3.86**	**Good**

The average results of expert eligibility scores can be seen in the following figure.

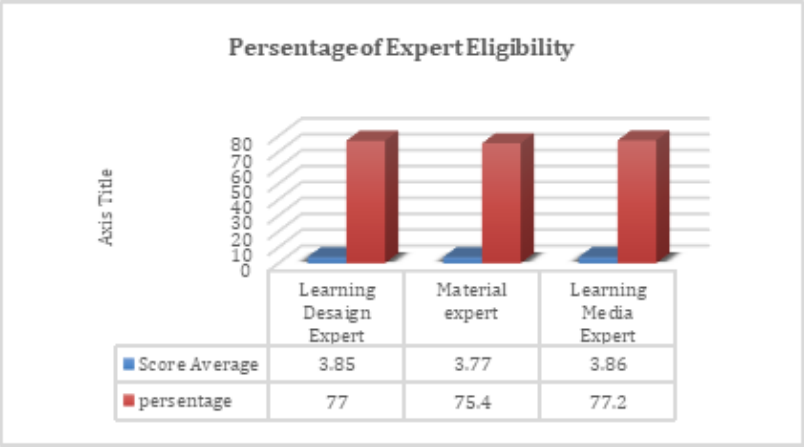

Figure 5. Expert eligibility score presentation

Implementation Stage

The implementation stage is to apply virtual teaching materials for building materials practice in courses analyzed, designed, and designed. The virtual reality teaching materials are used offline, where the Millea Lab application is installed on each Android device by sharing the classroom code listed on the Millea Lab application. At the implementation stage, it is carried out with two steps, namely one-to-one trials and

small group tests. The one-to-one test was represented by three students, whereas the selected students were students who represented low achievement, medium achievement, and high achievement. Student achievement indicators are seen from the GPA of students. The one-to-one test for three students obtained an average score of 4.48 in the excellent category with a percentage of 89.73%. For one-to-one test data collection can be seen in the following table.

Table 5. One-to-one test

No	Respondent	Average score	%	Category
1	1	4.28	85.6	good
2	2	4.43	88.6	good
3	3	4.75	95	excellent
	Average score	**4.48**	**89.73**	**good**

After that, revisions were made according to the scores obtained from students; then a tiny group trial was carried out by 11 students who contracted building materials practical courses. Four students represent low achievement, four students represent medium achievement, and three people represent high achievement. The small group trial aims to get input to revise practicum guidelines and virtual reality teaching materials for building materials practice. The results of the Small Group test obtained in the 3.93 category were quite good, with a presentation of 78.65%. The results of the small group test can be seen in the following table.

Table 6. The results of the small group test

Respondent	Average score	%	Category
1	3.85	77	Good enough
2	3.78	75.6	Good enough
3	3.66	73.2	Good enough
4	3.6	72	Good enaogh
5	4	80	Good
6	3.91	78.2	Good enaogh
7	4.08	81.6	Good
8	4	80	Good
9	3.7	74	Good enough
10	4.7	94	Very good
11	3.98	79.6	Good enough
Average score	**3.93**	**78.65**	**Good enough**

Evaluation Stage

Evaluation is the final stage in the development research model, namely to measure the media being developed (Dewi pertiwi, n.d, 2023). Virtual reality teaching materials for this building materials practice course are evaluated by measuring the level of effectiveness in student learning outcomes. Students are given a pretest before using virtual Reality teaching materials building materials practice and a posttest after using virtual reality teaching materials building materials practice. Students tested for effectiveness amounted to 28 students because the students who contracted the building materials practice course amounted to 28 people. The acquisition of pretest and post-test scores of 28 students will be compared to measure student learning outcomes before and after using virtual reality teaching materials for building materials practice courses through field trial trials. From the field trial test, an average pretest score of 41.12 was obtained, and after learning using virtual reality teaching materials, a post-test result of 74.8 was found. From the pretest and posttest results, virtual reality teaching materials can improve student learning outcomes.

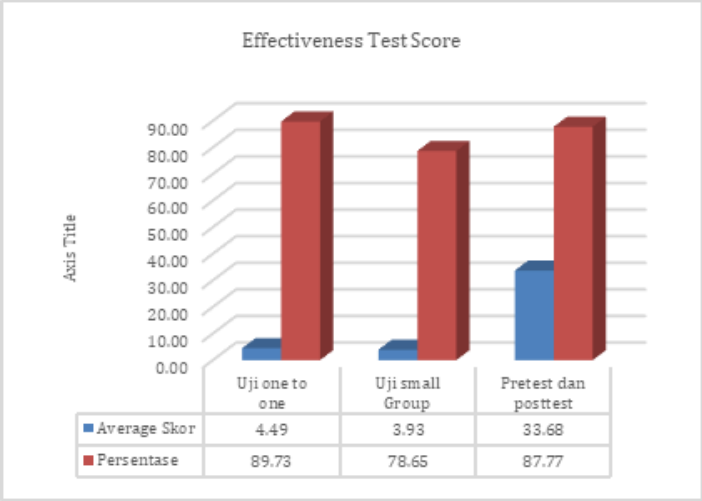

Figure 6. Effectiveness test score

Conclusion

From the preliminary research, namely the analysis stage, there is a need to develop virtual reality teaching materials, considering the absence of practice-based teaching materials in the form of practice manuals and virtual media for building material practices. The development of virtual reality teaching materials provides output in the form of virtual reality media that can be accessed using VR devices or Millea applications on Android. Virtual Reality teaching materials are suitable for students with an average score of learning design experts, material experts, and learning media experts, sound conclusions, and are worthy of use. From the results of the research, virtual reality teaching materials are practical because there is an increase in the average pretest and post-test. Virtual Reality teaching materials for building materials practical courses can be used as rule models for other courses and can be collaborated with the development team so that educators can be motivated to prepare learning resources that have appeal and can be applied well.

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