KnE Social Sciences

ICESRE 2021
4th International Conference on Education and Social Science Research (ICESRE)
Volume 2022

Knowledge E
enriching | engaging | empowering

Research article

Implementation of a Virtual Laboratory Product as Geometry Learning Media

N Nurmawati*, I Ismartoyo

Department of Mathematic Education, Universitas Terbuka, Indonesia

Abstract.

A virtual laboratory geometry product was developed at the Open University. In 2020, tests to assess this product were carried out by material experts and media experts, as well as online limited tests for students taking geometry courses at the Open University and PGRI Semarang University. The findings showed that the virtual product of the geometry lab was capable of displaying virtual and augmented reality, which could increase student motivation and learning. The product scored 91 and 94 based on the validation of media experts and materials experts, respectively, indicating that the virtual geometry lab product is feasible to use. More than 90% of lecturers and students at the Open University and PGRI University Semarang were very happy to use it. A second year was planned for product implementation with expanded testing in PTN and PTS in Central Java. After being given the application of the virtual geometry lab product, 95% of students agreed with it being used as a supplement to learning media in the classroom, while their learning outcomes also improved. The control class average was 77.45, and the experimental class average was 83.36, after being given the application of the virtual geometry lab product.

Keywords: implementation, virtual geometry lab, virtual reality, independent learning, student spatial ability

Corresponding Author: N Nurmawati; email: EMAIl

Published: 28 September 2022

Publishing services provided by Knowledge E

Selection and Peer-review under the responsibility of the ICESRE 2021 Conference Committee.

1. Introduction

In the educational world today, there have been many learning media circulating in the market, but not yet in accordance with the demands of the times, for example, learning media in mathematics learning in universities, so far the MIPA practicum learning media has not been associated with the application of renewable technologies such as Augmented Reality and Virtual Reality, from this reality, teachers must able to package and create interesting learning media for students and able to improve students' cognitive and spatial abilities, PTN and PTS in the city of Semarang and its surroundings both public and private have not been able to provide a virtual reality-based Mathematics laboratory capable of displaying 3D objects in every application or material. Therefore, it is necessary to create a virtual reality-based virtual lab learning media that can improve students' ability to understand mathematical material in a measurable manner.

Based on interviews with several mathematics lecturers, both PTN and PTS in the city of Semarang, it shows that almost 80% of PTN and PTS campuses still use mathematics and science learning media that have not had a touch of renewable technology such as augmented reality, virtual reality, mathematics, and other scientific software applications. This makes a significant finding for the development of learning media in the form of a virtual lab that is able to accommodate these problems, there are several factors that cause low geometry scores such as 1) the teacher's textbooks are less attractive, 2) students' weak skills in sketching both flat and space, 3) Teachers who teach geometry only use media to make sketches or drawings and there are still a few teachers who use software-based media that facilitates the abstraction of subjects for students, 4) Students are still weak in solving problems related to data geometry and from everyday life [1]. Then strengthened those who have developed e-learning assisted by a virtual laboratory for the Basic Physics II practicum course in the Physics Education Study Program, FKIP UNSRI [2], which showed that the development of a virtual laboratory excretory system was able to increase the learning motivation of high school students by up to 90 percent increasing their learning motivation [3].

According to the results of observations made by researchers at UPPBJJ UT Semarang, the learning process of mathematics is less active and less interesting, this is due to the absence of learning media used by lecturers based on renewable media and the laboratory is not yet connected to renewable computer programs, thus making students fast. bored. Teaching and learning interactions in the laboratory cannot be separated from the influence of the media used by lecturers in delivering lecture material. Computer and mobile media are growing rapidly at this time is a smartphone. The existence of technology, especially smartphones[4], which are now growing, must be addressed wisely. The phenomenon of the high number of smartphone users is certainly a challenge and opportunity in the world of education. The challenge is abuse for negative things.

Besides being a challenge, the existence of smartphones also brings great opportunities to develop useful technology in the field of education [5]. One of the benefits that can be taken from the existence of this technology is to use it as an effective, creative, and educational laboratory-based learning media [6]. So that educational application media can continue to be developed, one of which is Virtual Reality (VR) technology. this is in accordance with showed that the Virtual Laboratory greatly influences student motivation and behavior in studying chemistry [4]. Based on this background, researchers have developed a virtual laboratory-based learning media using Virtual Reality (VR). then based on the results of the first year of research, the results showed that students

of the Open University and PGRI Semarang University who took geometry courses using this virtual geometry lab product, then more than 90% of lecturers and students at the Open University and PGRI Semarang University were very happy to use it as Renewable learning media based on virtual reality that is able to display augmented reality and virtual reality that is interesting and amazing, therefore it needs to be further developed with expanded testing both public and private campuses in various provinces in Indonesia so that the product is useful for all schools and campuses

2. Research Methods

This type of research is research and development. The population in this study were graduate students of the educational mathematics Education program at Open University. Data collection techniques used are tests validation expert judgment, questionnaires, and documentation. The material in this learning media is geometry learning media and resources especially virtual lab tools Data analysis techniques in this study were analysis questionnaires. The development model used is the ADDIE model which includes analysis, design, development, implementation, and evaluation. **The ADDIE model can be shown in Figure 1.**

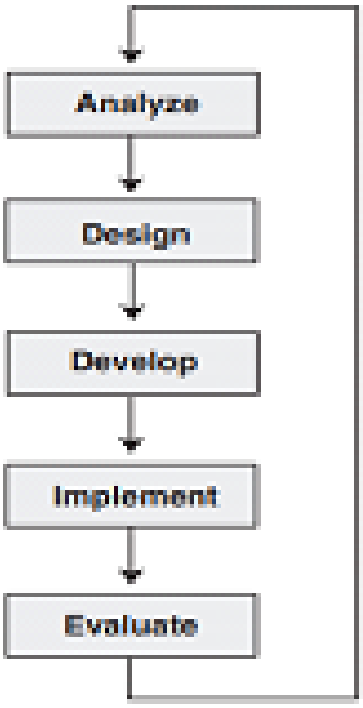

Figure 1: ADDIE Model [11].

3. Results and Discussion

3.1. Analysis

The analysis step consists of two stages, namely performance analysis and needs analysis. The first stage, namely performance analysis, is carried out to find out and clarify whether the performance problems faced requiring solutions in the form of program implementation or management improvements. In the performance analysis, an in-depth study has been carried out on the performance of the Mathematics Education lecturers at UNISSULA Semarang and UIN Walisongo in general who teaches geometry courses.

In the second stage, the needs analysis is a necessary step to determine the abilities or competencies that students need to learn to improve learning achievement [7], What is clear is that learning media is needed that is able to produce virtual geometry lab applications and make students able to learn independently, have fun and increase their spatial abilities.

3.2. Design

This step requires a clarification of the learning program designed so that the program can achieve the learning objectives as expected [8].

In product design, what is done is the next stage of the ADDIE model, namely design. At this step it is necessary to clarify the learning program designed so that the program can achieve its goals, In making the virtual geometry lab application product, the UT research team has made a team and assisted by IT experts outside UT so that there is good collaboration with the UT research team to create a material framework and design that is expected in making geometry course material, then executed by IT experts who are competent in their fields, after revising the virtual geometry lab application design for more than 3 months according to the advice of experts in the first year covering chapters on introduction to geometric shapes, parallels, area and volume, triangles and congruence of triangles, the product continues in the third stage, namely development.

3.3. Development

This development step includes creating, buying, and modifying learning media to achieve predetermined learning objectives. The development step, in other words,

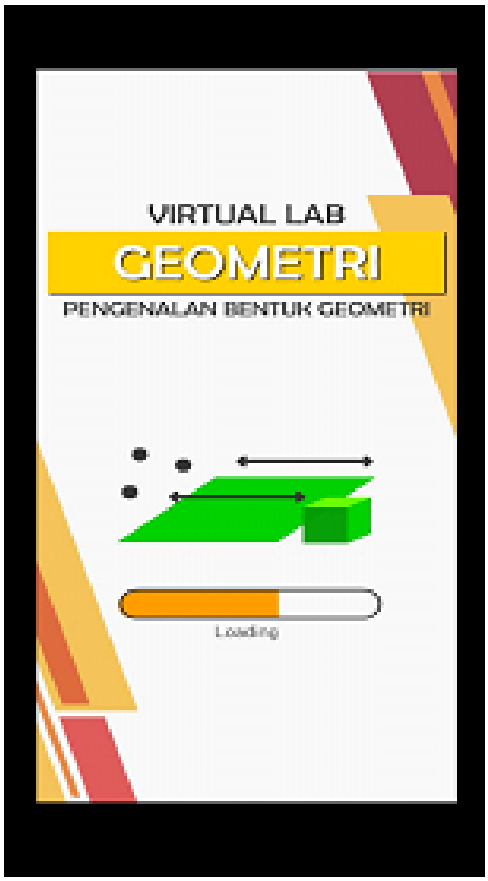

Figure 2: Design of Virtual Laboratory geometry tools material after revision.

includes the activity of selecting and determining the appropriate methods, media, and learning strategies used in delivering personal material [9], In this development stage, the framework that has been designed will be realized so as to produce a product that can be implemented. In this development stage, VR-based virtual lab application products in media courses and kindergarten learning resources are validated first by experts, namely material experts and media experts, so that virtual reality-based virtual lab application products in media courses and kindergarten learning resources are truly suitable for use before limited testing at UT and PGRI University Semarang At the stage of product development of virtual reality-based virtual lab applications in media courses and Kindergarten learning resources will be made according to the material, after the virtual lab application media is complete it will be validated by media experts and material experts by validators to get input and evaluate according to the input given by validators. Furthermore, the android-based media is revised according to the input given by the validator to improve the product.

Based on 2 validators who are experts in the field of elementary school children's education, namely Dr. Abdul Basir, M.Pd. (Head of S1 Mathematics Education Study

Figure 3: Product validation of VR-based virtual lab applications by experts.

Program, Unissula Semarang) and learning media expert, namely Dr. Achmad Buchori, M.Pd. as a learning technology expert at PGRI Semarang University, the following data were obtained:

TABLE 1: Validation of learning media experts.

Media expert	Application aspect	Creative aspect	Innovative aspect	Communication visual aspect
Score validation	90%	86%	88%	88%

From the table above, an average score of 88% means that this virtual geometry lab application media is very suitable for use in learning geometry courses at PTN and PTS.

Then continued with the validation of learning media experts, data obtained that the virtual geometry lab application media was feasible to use so that the virtual lab media product for geometry courses could be used optimally.

TABLE 2: Validation of learning material experts.

Material expert	Material substation aspect	Language aspect
Validation score	93%	87%

From the table above, an average score of 90% is obtained, meaning that the material in this virtual geometry lab application media is very suitable for use in learning geometry courses in universities.

3.4. Implementation

Implement learning programs by applying the design or specifications of learning programs. The main objective of the implementation phase, which is the design and development realization step, is to guide students to achieve learning objectives, ensure solutions to address gaps in learning outcomes faced by students, and ensure that at the end of the learning program students need to have knowledge, skills, and competence competencies. attitude needed [9]. In the implementation phase, the researcher plans to apply a virtual geometry lab application media that has been carried out in an expanded test at UNISSULA Semarang to find out the responses of lecturers and students online at the University.

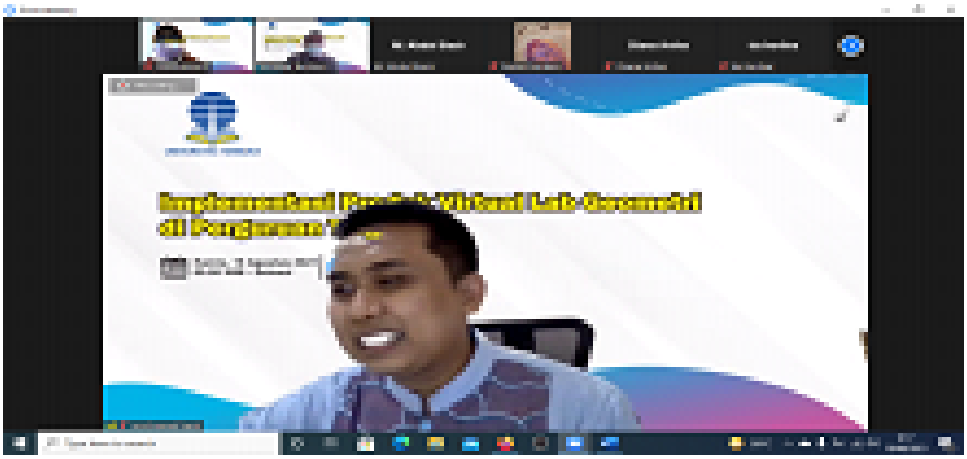

Figure 4: Extended Test at Sultan Agung Islamic University Semarang by the research team.

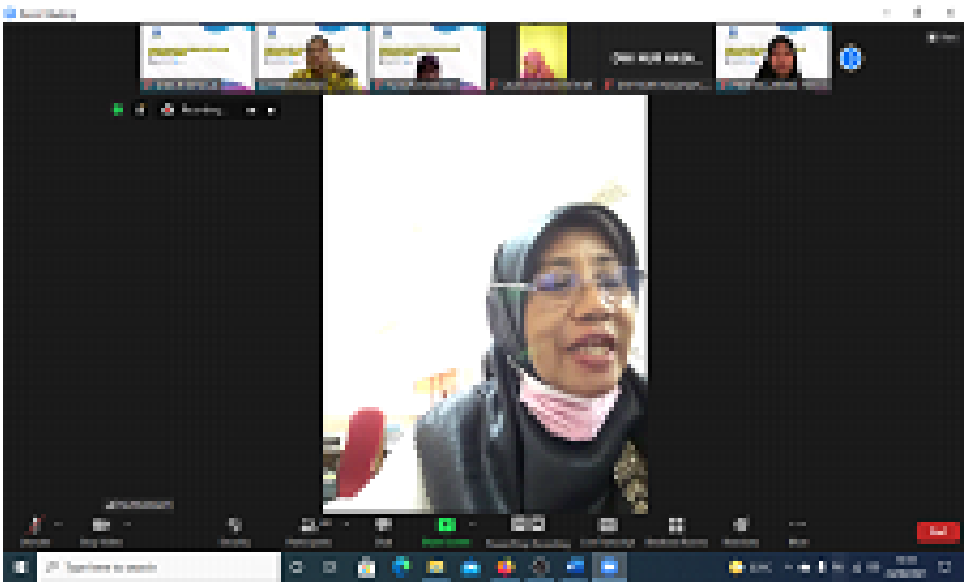

Figure 5: Extended Test at Sultan Agung Islamic University Semarang by the research team.

4. Conclusion

a. A virtual geometry lab application product has been produced that can be used on public and private campuses, especially in the Semarang city area

b. The product has been validated by experts and received a very good response from users including lecturers, teachers, students, media experts, and learning material experts

c. The virtual geometry lab application product is ready to be tested and expanded, especially in the Semarang and surrounding areas because it is expected to be able to increase the motivation, learning outcomes, and learning independence of mathematics students.

Authors' Contributions

The author hopes that the results of this study can be an alternative for lecturers to use virtual laboratory geometry media. So it is expected to improve motivation college student learning outcomes.

showed if virtual laboratories for education in science, technology, and engineering, this product is very important to improve the knowledge student [10], and then seam the real with the virtual: a review of augmented reality showed students very happy to learn with virtual reality. [11], so the recent developments in game-based virtual reality educational laboratories make students can study with games every lesson in the class [11], and then the impact of the virtual laboratory on students' attitude in a general physics laboratory is very significant about 60% student have good attitude to goal material [12], so virtual reality for learning fish types in kindergarten make a student happy with material fish with animation product [13], finally exploring chemistry using virtual instrumentation-challenges and successes for the student to get good knowledge about chemistry material [14].

Acknowledgments

Thank you to those who were involved and helped, namely mathematic education open university, mathematic education at Sultan Agung Islamic University Semarang, and the ministry of education, culture, and technology research

References

[1] Buchori A, Setyosari P, Dasna IW, Ulfa S. Mobile augmented reality media design with waterfall model for learning geometry in college. International Journal of Applied Engineering Research. 2017;12(13):3773-3780.

[2] Agustine D, Wiyono K, Muslim M. Pengembangan e-learning berbantuan virtual laboratory untuk mata kuliah praktikum fisika dasar II di program studi pendidikan fisika FKIP UNSRI. Jurnal Inovasi dan Pembelajaran Fisika. 2014;1(1):33-42.

[3] Adi WC, Suratno S, Iqbal M. Pengembangan virtual laboratory sistem ekskresi dalam meningkatkan motivasi belajar siswa SMA. Jurnal Pendidikan Sains. 2016;4(4):130-136.

[4] Tüysüz C. The effect of the virtual laboratory on students' achievement and attitude in chemistry. International Online Journal of Educational Sciences. 2010;2(1); 37-53

[5] A.K. Triatmaja and M. Khairudin, "Study on Skill Improvement of Digital Electronics Using Virtual Laboratory With Mobile Virtual Reality.," *Journal of Physics: Conference Series*. vol. 1140, no. 1, pp. 1–10, 2018

[6] Dyrberg NR, Treusch AH, Wiegand C. Virtual laboratories in science education: Students' motivation and experiences in two tertiary biology courses. Journal of Biological Education. 2017;51(4):358-374. https://doi.org/10.1 080/00219266.2016.1257498

[7] Prof.Dr.Sugiyono, *METODE PENELITIAN KUANTITATIF, KUALITATIF DAN R&D*. *Penerbit Alfabeta*, 2016..

[8] Sunandar S, Rahmawati ND, Wibisono A, Buchori A. Development of game education basic virtual augmented reality in geometry learning. Test Engineering & Management. 2020;82(1):1471-1479.

[9] Shulman L. Knowledge and teaching: Foundations of the new reform. Harvard Educational Review. 1987;57(1):1-23.

[10] Potkonjak V, Gardner M, Callaghan V, Mattila P, Guell C, Petrović VM, Jovanović K. Virtual laboratories for education in science, technology, and engineering: A review. Computers & Education. 2016;95:309-327.

[11] R. Zheng, D. Zhang, and G. Yang, "Seam the Real with the Virtual:a Review of Augmented Reality.," *Proceedings of the 2015 Information Technology and Mechatronics Engineering Conference*. vol. 7, pp. 77–80, 2015

[12] G. Aşıksoy and D. Islek, "The Impact of the Virtual Laboratory on Students' Attitude in a General Physics Laboratory,." *International Journal of Online Engineering (iJOE)*. vol. 13, no. 04, pp. 20–28, 2017

[13] G.T. Angga Kusuma, I.M.A. Wirawan, and I.K.R. Arthana, “Virtual Reality for Learning Fish Types in Kindergarten.,” *International Journal of Interactive Mobile Technologies (iJIM)*. vol. 12, no. 8, pp. 41–50, 2018

[14] Gheorghiu LM, Gorghiu G, Alexandrescu T, Borcea L. Exploring chemistry using virtual instrumentation – Challenges and successes. Research, Reflections and Innovations in Integrating ICT in Education. 2009;1(1):371-375.