



Using Augmented Reality-Based e-Book for Improving Students' Learning Motivation in Analytical Geometry Course

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Abstract: In the development of science and technology in the world of education, students need to be introduced to a variety of varied learning media, one of which is the use of augmented reality-based e-books. The ability to learn analytic geometry requires systematic, logical and critical thinking that can be developed through learning. The purpose of this study is to test the increase in learning motivation using augmented reality based e-book media in analytic geometry course. The method in this study using ADDIE which consists of five stages which include analysis, design, development, implementation and evaluation. The result of the research is that the average result of the questionnaire given by students from various aspects of the assessment is 86%. Meanwhile, based on learning outcomes, there is a difference in learning outcomes between midterm exam score and the e-book score, which is 9.18 and based on the results of the analysis using SPSS on the t-test, it is found that $t_{count} = 4.768 > t_{table} = 2.015$. From these results, it can be concluded that augmented reality-based e-book media in analytic geometry courses can motivate students as a technology based learning medium for students of mathematics study program at Universitas Billfath.

Keywords: augmented reality, geometry analytic, e-book

Abstrak: Dalam perkembangan ilmu pengetahuan dan teknologi di dunia pendidikan, mahasiswa perlu dikenalkan dengan berbagai media pembelajaran yang bervariasi, salah satunya adalah penggunaan e-book berbasis augmented reality. Kemampuan belajar geometri analitik membutuhkan pemikiran yang sistematis, logis dan kritis yang dapat dikembangkan melalui pembelajaran. Tujuan dari penelitian ini adalah untuk menguji peningkatan motivasi belajar dengan menggunakan media e-book berbasis augmented reality pada mata kuliah geometri analitik. Metode dalam penelitian ini menggunakan ADDIE yang terdiri dari lima tahap yang meliputi analisis, perancangan, pengembangan, implementasi dan evaluasi. Hasil penelitian menunjukkan bahwa rata-rata hasil angket yang diberikan mahasiswa dari berbagai aspek penilaian adalah 86%. Sedangkan berdasarkan hasil belajar terdapat perbedaan hasil belajar antara nilai ulangan tengah semester dengan nilai e-book yaitu sebesar 9,18 dan berdasarkan hasil analisis dengan menggunakan SPSS pada uji-t diketahui bahwa $t_{hitung} = 4,768 > t_{tabel} = 2,015$. Dari hasil tersebut dapat disimpulkan bahwa media e-book berbasis augmented reality pada mata kuliah geometri analitik dapat memotivasi mahasiswa sebagai media pembelajaran berbasis teknologi bagi mahasiswa program studi matematika di Universitas Billfath.

Kata kunci: augmented reality, geometri analitik, e-book.

▪ INTRODUCTION

In the last decade the development of technology is so rapid. Many advanced technologies are created according to the needs of an increasingly modern era. In addition to its rapid development, changes also occur rapidly. Keeping up with these developments requires the ability to acquire, manage and utilize science and technology

proportionally. This ability requires systematic, logical and critical thinking which can be developed through learning analytical geometry courses.

Hudojo (1988) suggests that every mathematical concept can be understood perfectly if it is presented in a concrete form. To present the concept concretely, media is needed. One of the concrete media that can be brought as a medium is Augmented Reality, which is an application of merging the real world with the virtual world in two-dimensional and three-dimensional forms that are projected in a real environment at the same time. Augmented Reality is often also referred to as tethered reality. This application is often applied in a game. The results of research from (Wenhung & Rongchi, 2018) resulted in interviews with teachers indicating that the material in digital applications with augmented reality and interactive experience models can increase students' knowledge of the concept of volume and its parts.

Research conducted by (Hendrys et al., 2015), on Augmented Reality Game-Based Learning for Mathematics Skills Training in Inclusive Contexts shows that the teacher's response is that AR and DGBL can improve the understanding of students with needs process special in the learning. Meanwhile, research conducted by (Yuching, 2019) on the Effect of Mobile Augmented Reality on Learning Performance, Motivation, and Math Anxiety in a Math Course which shows that augmented reality users are satisfied with the ease of use, usability, enjoyment, and benefits of exploration. and hands-on experience. In addition, users who are satisfied with the use of augmented reality have higher perceptions of exploration, hands-on experience, and enjoyment.

The research conducted by (Sucai, 2019) on Tablet-based AR technology: Impacts on students' conceptions and approaches to learning mathematics according to their self-efficacy shows that the analysis of the results shows that AR applications in the eyes of Mathematics lessons can help students with higher self-efficacy pay more attention to higher-level conceptions. It can also help students with higher levels of self-efficacy to apply more advanced strategies while studying mathematics. This is in line with the research conducted by (Francisco and Gines , 2021) on Application in Augmented Reality for Learning Mathematical Functions: A Study for the Development of Spatial Intelligence in Secondary Education Students shows that spatial ability can be improved by applying new technologies. such as augmented reality, which is able to describe mathematical procedures through pictures and graphs, which greatly helps students to visualize, understand, and master concepts related to mathematical functions. Based on the results of observations of analytic geometry learning in the mathematics study program at Universitas Billfath, many students do not understand about the three-dimensional coordinate and vector system, the obstacles experienced by students are that it is difficult to imagine the shape of three-dimensional space so that researchers combine analytical geometry learning with technology using augmented reality media. as a teaching strategy.

From the background that has been described, this study will discuss the results of using augmented reality-based e-book media as a teaching strategy in the pandemic era. The purpose of this research is to develop an augmented reality-based e-book media to improve students' conceptual understanding skills related to three-dimensional coordinate and vector systems.

▪ **METHOD**

In this study, the product produced is an augmented reality-based e-book in the analytic geometry course. The population in this study were all students of Billfath university mathematics study program and the sample consisted of 4th semester students as many as 22 students of Billfath university mathematics study program. As for the technique of returning the sample using purposive sampling. The research design in this article is to use research and development developed by dick and carry is a model ADDIE. This research is a type of learning media development research (Sugiyono, 2015). The steps of development research using the ADDIE model in this study are presented in the form of a chart as follows:

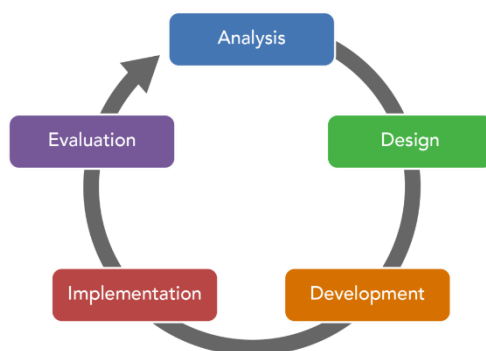


Figure 1. Schematic of addie research design

From Figure 1, the research steps consist of 5 steps, namely the analysis stage, the design stage, the development stage, the implementation stage and the evaluation stage. This research was carried out for 6 months, from April to October 2021. The research instrument used a questionnaire distributed to students. The questions tested used validity and reliability techniques. Augmented reality-based e-book media products were used to test learning motivation, this was done to determine the magnitude of the effect of student learning outcomes of mathematics study program on analytic geometry material. The method of data collection is by conducting tests to get student learning outcomes by using essay questions. The test is carried out by giving questions to students and then students send back the results of their work via google form. After being collected, the results of the work are processed and analyzed using the SPSS application. The statistical technique used is using 3 statistical tests, namely normality test, homogeneity test and t-test.

▪ **RESULT AND DISSCUSSION**

Based on the analysis of student questionnaires that have been collected, several inputs and suggestions were obtained from 22 students. The following are the results of student questionnaires presented in Figure 2.

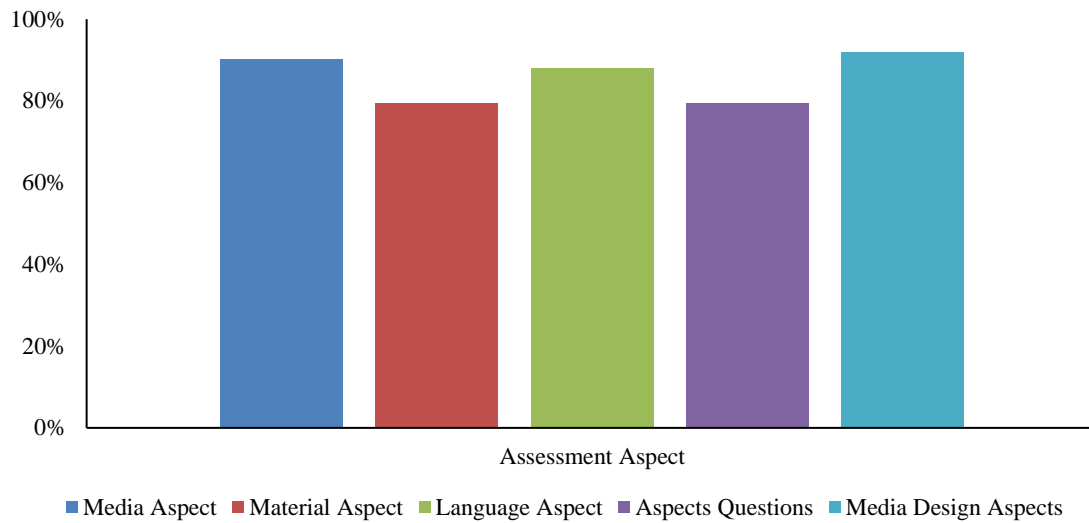


Figure 2. Student questionnaire percentage

The diagram above shows that the student response to the media aspect is 90%, the material aspect is 80%, the language aspect is 88%, the question variety aspect is 80%, and the media design aspect is 92%. Of the 5 aspects, the average aspect of the assessment is 86%. Meanwhile, based on student comments and suggestions, in general, augmented reality e-books can better understand spatial structures and are very helpful when learning online, the material in the e-book is added to make the material wider. Learning media like this are very interesting, fun and easier to understand because they use interactive e-books during the online process during the covid-19 pandemic. Then for the suggestion, maybe add audio so that you can understand the material more clearly. For the application, it is sometimes difficult to detect in the e-book.

From the assessment of questionnaires and suggestions from students, it can be concluded that augmented reality-based e-book media is very helpful for students in understanding analytic geometry material as a distance learning medium. The results of the effectiveness of student assessments of augmented reality-based e-book media, there are several criteria, namely normality test, homogeneity test, and t test. Based on case processing summary, it can be concluded that the valid midterm exam value is $n = 22$ and missing $n = 0$. So the total for midterm exam value is $n = 22$ with a percentage of 100%. The valid e-book values are $n = 22$ and the missing e-book values are $n = 0$. Therefore, the total value for e-books is $n = 22$ with a percentage of 100. Based the normality test, it can be seen that the df value for midterm exam value is 22 and the df value for the e-book value is 22, so the number of samples is 22 and it can be concluded that the number of data samples for each group is less than 50 so using Shapiro-Wilk. It can be seen that the significance of midterm exam value is 0,078 and the significance of the e-book value is 0,248. Because the significance value of the two groups is greater than 0,05 it can be concluded that the data on midterm exam scores and e-book learning outcomes are normally distributed.

The following is a histogram diagram of midterm exam values that have been analyzed using the SPSS application

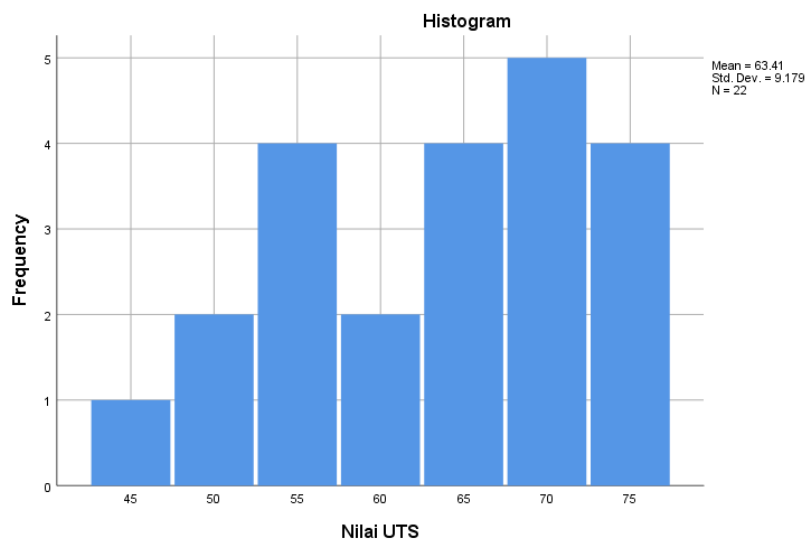


Figure 3. Histogram diagram of the results of the value midterm exam

From the histogram diagram above, it can be seen that the mean value is 63,41 with n as much as 22 and the standard deviation is 9,18. Furthermore, the results of the e-book value can be seen in the histogram diagram below.

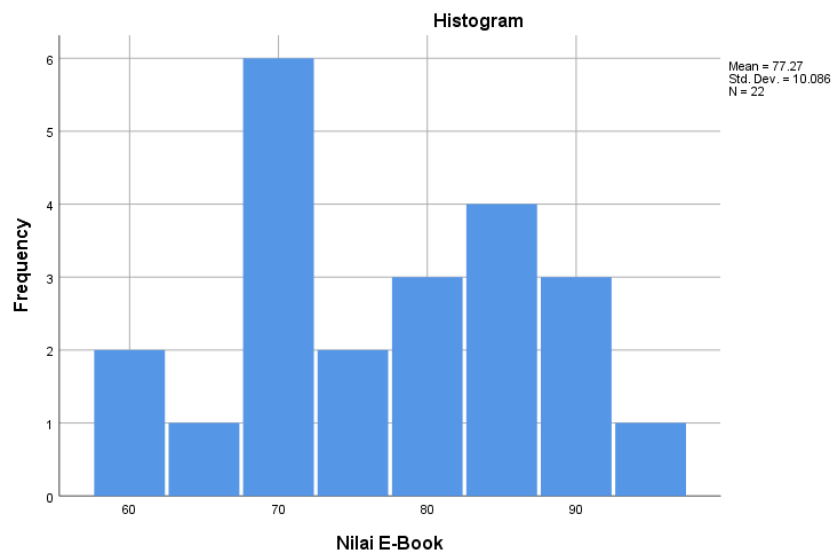


Figure 4. Histogram diagram of the results of the value of the e-book

In the histogram diagram above, it can be seen that the mean value is 77,27 with n as much as 22 and the standard deviation of 10,09. Furthermore, based on the homogeneity variances with the means test using SPSS, the significance value is 0,554. This means that $0,554 > 0,05$ so it can be concluded that the variance of midterm exam value and the media value is homogeneous.

Furthermore, the last step is to test using a t-test which is carried out to determine the effectiveness of augmented reality-based e-book media. From group statistics that

the mean value of midterm exam score is 63,41 with a standard deviation of 9,179 while the mean value of the e-book value is 77,27 with a standard deviation of 10,086. It can be concluded that there is a difference in the mean value of 13,86 which means that there is a difference in the increase in learning outcomes between midterm exam scores and grades using e-book media.

Based on the independent samples test table, it can be seen that the t-count is 4,768 with a df of 42, the t-table is 2,015 and the t-test value is significant (2-tailed) of 0,00. By using the significance value of the t-test significance (2-tailed) obtained $0,00 < 0,05$ and $t_{\text{count}} = 4.768 > t_{\text{table}} = 2,015$ from the two results from the t-test through comparison it can be concluded that H_0 is rejected and H_a is accepted, which means that it means that there is a difference in the average learning outcomes between midterm exam scores and the value of using the e-book media. This means that the augmented reality-based e-book media in the analytical geometry course is effectively used for students of mathematics study program at the Universitas Billfath.

The following is a display of the product and the results of student work related to the augmented reality based e-book trial.

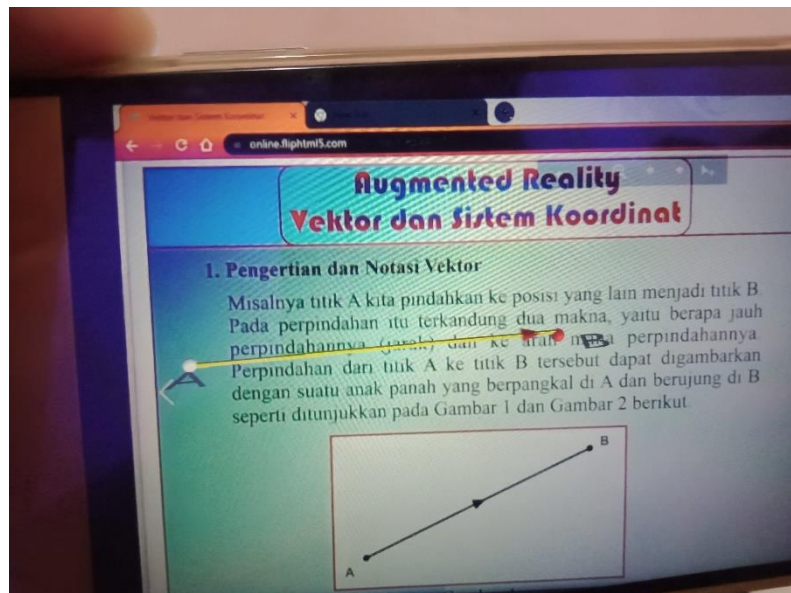


Figure 5. Display of e-book contents material definition and notation of vectors

Figure 5 is content of the e-book, which contains pictures and material definition and notation of vectors. Augmented reality animation on material definition and notation of vectors can improve motivation students.

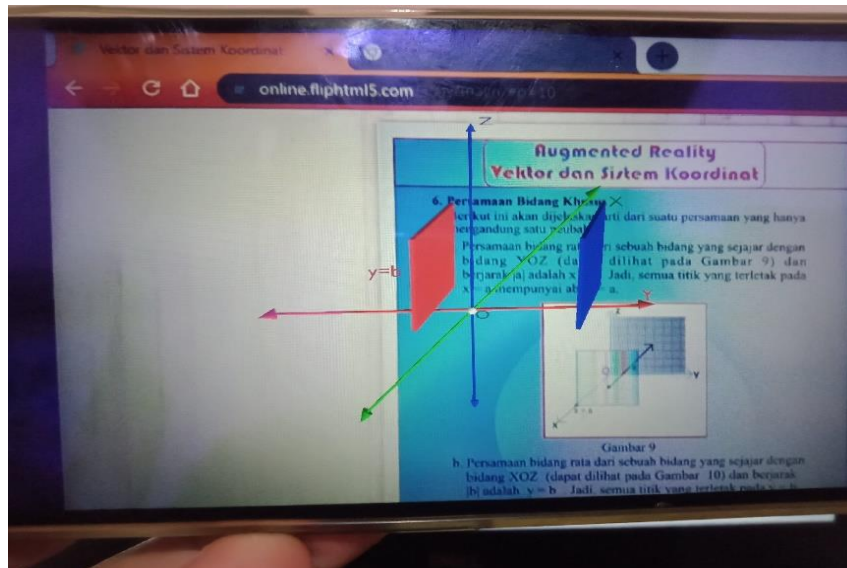


Figure 6. Display of e-book product contents material special sign equation

Figure 6 is content of the e-book, which contains pictures and material special sign equation. Augmented reality animation on material special sign equation can improve students' spatial abilities. Figure 7 is an example one of student work done on student answer sheets. Each students presented and explain answer with random method.

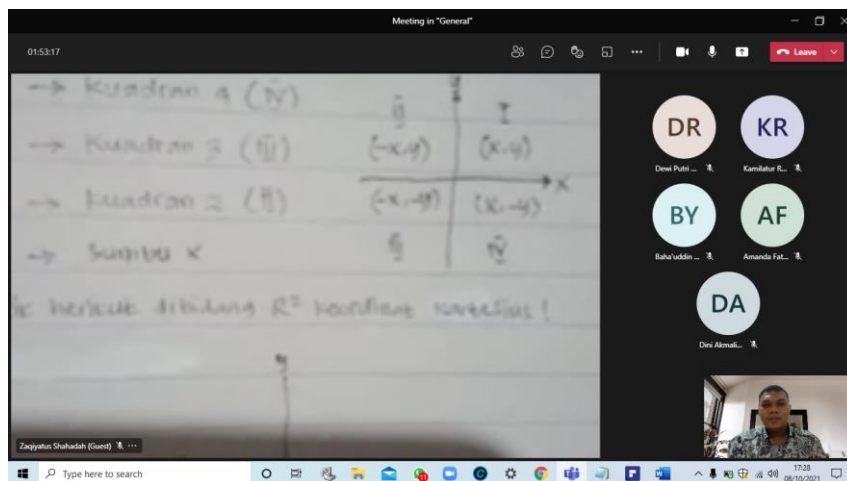


Figure 7. Display of student work

CONCLUSION

Based on the description of the results and discussion of the research, from impact of the research augmented reality based e-book media can be used as a medium for analytical geometry courses in mathematics study programs at Universitas Billfath because it can increase student learning motivation. While the disadvantage of this research is that augmented reality books are still available in the form of e-books so you need an internet connection to access augmented reality books. According to the questionnaire, the students' responses to the average assessment were 86%. Meanwhile, according to student learning outcomes using SPSS analysis, there is a difference in

learning outcomes between midterm exam score and the e-book value, which is 9,18 and by using the t test the significance value (2-tailed) is obtained $0,00 < 0,05$ and $t_{\text{count}} = 4.768 > t_{\text{table}} = 2.015$ of both the results of the t-test by comparison we can conclude that H_0 is rejected and H_a accepted, which means there is an average difference in learning outcomes between midterm exam value of media use e-book. This means that the augmented reality-based e-book media in the analytical geometry course is effectively.

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