

Development of Augmented Reality Media on PjBL Learning Model of Human Motion Organ Material to Improve Learning Outcomes

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Abstract: This research aims to develop and test the feasibility and effectiveness of AR-based learning media (augmented reality) so that students become more active in following the learning process. This research and R&D (Research and Development) with the ADDIE development model design. The novelty of this research is the development of Human Movement Organs (bones) with interactive edugame evaluations that improve students' cognitive learning outcomes. Analysis of the data obtained after the research stages are carried out. The results showed that AR-based learning media (augmented reality) was successfully developed, feasible, and effective to use as learning media, seen from the results of media validation obtained a percentage of 84.72%, material validation obtained a percentage of 83.30% and student response obtained a percentage of 88.46%. The conclusion of the Augmented Reality media development research on the PjBL learning model of Human Movement Organ material was successfully developed, very feasible, and effective for improving the learning outcomes of Nabaul Ulum Wonorejo students in Pati Regency.

Keywords: Augmented Reality; IPA; Media; PjBL.

Introduction

Education is an effort that is carried out consciously and planned as a form of realization of a learning atmosphere and learning process to help students be more active in developing their potential to have religious and spiritual strength, self-control, personality, intelligence, noble character, and skills needed by themselves, society, nation, and state [1]. Technological advances have run very rapidly in this era. Teachers need to develop learning by using learning media that utilize technological developments. This follows Permendikbud No.22 of 2016, which discusses the basic and secondary education process standards, in one of which discusses the principles of learning used to utilize technology and communication to help increase efficiency and effectiveness in carrying out learning [2].

One of the results of technological development is the emergence of AR (augmented reality) (Alifah et al., 2021). Augmented reality is one of the results of technological development that can interact and combine 2-dimensional or 3-dimensional virtual objects that will be displayed in a natural environment and combine the two to create a mixture of combined space (mixed reality) and project it in real-time. AR has the advantage of being interactive and real, which can be used to show objects to make them look more real in learning materials [3]. Learning methods align with this media's use so that students become active. Using a learning model allows teachers to provide opportunities for educators to control the continuous teaching process fully. The teaching system applied includes project work in the process [4].

Based on observations and interviews in class V MI Nabaul Ulum Wonorejo Pati Regency in the even semester of the 2023/2024 school year, related to learning activities with resource person Istirohkah S.Pd.I. as a fifth-grade teacher, on March 3-4, 2023, information can be obtained that in the learning process at MI Nabaul Ulum Wonorejo Pati Regency there are still many problems. This results in the learning process running less effectively, which decreases the quality of learning.

In managing learning in class V, teachers lack innovation in using learning media. Based on the results of interviews and observations that researchers conducted, teachers mostly explained the material using the lecture method without learning media. Teachers still dominate learning activities, so the involvement of students in learning is still lacking. This is evidenced by the results of the students' questionnaire, which states that students have not used teaching aids at all (0%). Without interactive media in learning activities, students will be passive and only as listeners. This results in boredom, and students cannot correctly capture the concepts conveyed by the teacher.

Based on the results of interviews with sources, the subject content that students have not mastered is the content of science theme one subtheme two material on human organs. In this material, many students have not exceeded the KKM score (72). 17 out of 26 students (65%) have not exceeded the KKM score, and the remaining 9 students have received scores exceeding the KKM score (35%). Based on these values, it can be concluded that learning the theme one subtheme two science lesson material on human motion organs has not gone well.

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Through interviews and observations, researchers obtained various information in the form of data related to the level of activeness of fifth-grade students of MI Nabaul Ulum Wonorejo Pati Regency in the use of technology. The existence of various problems that occur during the learning process makes researchers try to make improvements to support the quality of learning.

Following the questionnaire data on the level of activeness in the use of technology in class V students of MI Nabaul Ulum Wonorejo, it can be concluded that class V students of MI Nabaul Ulum Wonorejo Pati Regency are ready to do technology-based learning. Researchers will develop learning media using AR media, namely technology that can be projected in reality by combining two-dimensional or three-dimensional virtual objects into a real environment. This is done with the aim that teachers and prospective teachers can learn more about things that can be done in overcoming obstacles that occur during the learning process and solutions to the problems found. Thus, learning activities are hoped to run more effectively, and student learning outcomes can improve.

Research Methods

This research includes development research (Research and Development). This research requires the development of products that are tested for feasibility and effectiveness [5]. AR-based learning media (augmented reality) uses the ADDIE model in its development. The steps contained in the ADDIE model are analysis (analysis), design (design), development (development), implementation (implementation) and evaluation (evaluation) [6].

The presence of fundamental problems in the learning process leads to the need for learning media development. This is included in the analysis stage. Knowing the feasibility of developing learning media in the learning process at school requires analysis. The design stage in developing this fundamental media is that learning media is shown for grade V elementary school students. AR-based learning media (augmented reality) design aims to make it easier for students to understand learning by showing objects to make it look more real in learning materials—the development stage by realizing the product form in AR (augmented reality) game-based learning media. The importance of adjusting learning objectives and materials on AR (augmented reality) learning media will be realized after obtaining testing from material and media validation experts, followed by revising the product. This stage includes the implementation stage. The evaluation stage is carried out by applying it to the teaching and learning process at school and aims to determine the feasibility of AR-based learning media (augmented reality) [6].

This research was conducted at MI Nabaul Ulum Wonorejo Pati Regency. The research subjects were fifth-grade students, totaling 21 students. There are types of data in this study, namely quantitative data, collected through questionnaire sheets of material and media experts, namely class teachers, and the results of students' pretests and post-tests. Qualitative data can be obtained from observations and interviews with teachers and students. Data collection

techniques were carried out using questionnaires and documentation. Data collection techniques through questionnaires are carried out by presenting questions or written statements to respondents [5]. Written statements in the questionnaire are used to obtain information on respondents' learning process in class V MI Nabaul Ulum Wonorejo [7]. Documentation is intended to obtain the necessary data through physical facilities at school [5].

The feasibility of AR (augmented reality) learning media can be known through data analysis by calculating the percentage results obtained from media expert tests, material experts, and student responses, namely:

$$NP = \frac{R}{SM} \times 100\%$$

Description:

NP : the result score

R : the raw score obtained

SM : the ideal maximum score [8]

Furthermore, the percentage value obtained is converted to the eligibility criteria in Table 1. [9].

Table 1. Product Eligibility Criteria

| Percentage | Criterion |
|--------------|---------------|
| 81 % - 100 % | Very Worthy |
| 61 % - 85 % | Worthy |
| 41 % - 60 % | Pretty Decent |
| 21 % - 40 % | Less Decent |
| 0 % - 20 % | Very Unworthy |

Product effectiveness was analyzed by analyzing all data obtained from pretests and post-tests preceded by normality tests, followed by data analysis with the T and N-Gain tests to determine the final results. The data analysis was assisted by SPSS version 26.

Results and Discussion

AR-based learning media (augmented reality) on the material of human motion organs through the research stage through the ADDIE stage (Analysis, Design, Development, Implementation, Evaluation) [10]:

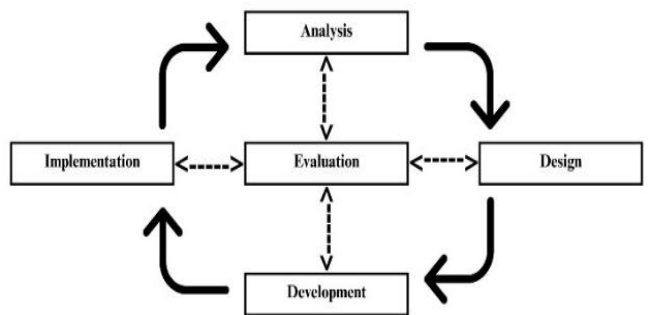


Figure 1. Stages of the ADDIE Model

Analysis

This is the initial stage in analyzing students' needs, materials, and characters. This is done to apply to determine

the content and components of AR (augmented reality) learning media according to the needs at school.

Design

The continuation of product development after going through the analysis stage is the design stage, which determines the form, content, and components of AR (augmented reality) learning media according to the material and needs of students. The design of AR (augmented reality) game-based teaching media in the form of learning media on Human Movement Organ material (bones); in the media, there are images, videos, animations, and audio designed so that learning is more exciting and interactive by determining the framework, content, and aspects of education.

Development

This stage is to realize the AR-based learning media (augmented reality) that has been designed. After the media is successfully developed, the feasibility of validation by media experts and material experts will be determined based on the assessment in the questionnaire that has been resolved. The results of validators for material experts obtained a percentage of 83.30% in the feasible category. However, AR-based learning (augmented reality) and media expert validation obtained 84.72% without any revisions in the very feasible category.

Implementation

This stage applies to media that has been successfully developed and has undergone validation tests from media and material experts. Furthermore, the media was tested on a small group of 6 students during classroom learning.



Figure 2. Cover of AR (augmented reality)-based learning media



Figure 3. Concept map of AR (augmented reality)-based learning media



Figure 4. AR (augmented reality) based learning media material

Evaluation

The study's results stated that AR-based learning media (augmented reality) was feasible by media and material experts. The feasibility test was carried out by giving a validation questionnaire to material experts and media experts [11]. The media expert validation questionnaire has several aspects of assessment, including Media Design, Media usage, and Media suitability. The assessment elements in the material expert validation questionnaire include Accuracy of objectives, Appropriateness of students' level of thinking, evaluation, and stimulus content. The accuracy of the content of lessons, which includes facts, concepts, principles, and generalizations. Assessment of the feasibility of AR-based learning media (augmented reality) in science subjects of Human Movement Organ material (bones) using a media and material expert validation questionnaire. The results of validation from media experts obtained a score of 84.72% in the category of very feasible to be tested in the field without revision, and validation from material experts obtained a percentage of 83.30% in the category of very feasible to be tested in the field with minor revisions for adjustment.

Table 2. Validator Assessment of Feasibility Aspects

| Validator | Assessment Percentage (%) | Criterion |
|---------------|---------------------------|-------------|
| Media Expert | 84.72 % | Very Worthy |
| Materi Expert | 83.30 % | Very Worthy |
| Average | 84.01 % | Very Worthy |

Terakhir, hasil penilaian media pembelajaran berbasis AR (augmented reality) berupa respon guru dan peserta didik setelah menggunakan dapat dilihat dalam tahap evaluasi melalui angket kelayakan media pembelajaran berbasis AR (augmented reality) yang dinilai oleh guru dan peserta didik. Aspek penilaian dalam angket respon guru dan peserta didik meliputi : Isi; Bahasa; Penyajian.

Table 3. Results of Teacher and Learner Response Questionnaires

| Respond | Assessment Percentage (%) | Criterion |
|------------------|---------------------------|-------------|
| Class IV teacher | 90.38 % | Very Worthy |
| Learners | 88.46 % | Very Worthy |
| Average | 89.42 % | Very Worthy |

The effectiveness of AR-based learning media (augmented reality) material on Human Movement Organs (bones) is determined based on students' learning outcomes by analyzing students' pretest and post-test scores. The effectiveness test is carried out by giving pretest and post-test questions [12]. The design uses a one-group pretest-posttest design model, which has not received treatment by doing the pretest and after getting it by doing the post-test. The results of the pretest and post-test tests are presented in Table 4.

Table 4. Pretest and Posttest Results

| Aspects | Pretest Score | Post-test Score |
|--------------|---------------|-----------------|
| Average | 50.4 | 83.15 |
| Top Value | 76 | 96 |
| Lowest Value | 16 | 72 |

Table 4 shows that the average cognitive learning outcomes have increased from a pretest value of 50.4 to 83.15 on the post-test value. The increase occurred because of the interaction between students and teaching media. Novelty is applied in the learning process using AR-based learning media (augmented reality) material on Human Movement Organs (bones) with interactive edugame evaluations to improve students' cognitive learning outcomes.

Furthermore, data analysis was preceded by a normality test, followed by data analysis using the T-test and N-Gain test to determine the final results. This study used the help of the SPSS version 26 program to analyze the initial and final data. Knowing whether the data is normally distributed or not, a normality test is conducted. The normality test in this study was carried out with the help of the SPSS version 26 program with Shapiro-Wilk. The results of the normality test are presented in Table 5.

Table 5. Normality Test Result

| Shapiro-Wilk | | |
|--------------|------------|-------------|
| | Sig. value | Information |
| Pretest | .166 | Normal |
| Posttest | .111 | Normal |

Data is normally distributed if the Sig value is used. > 0.05 and not normally distributed if the Sig value is. < 0,05 [13]. Based on Table 5. known Sig value referring to Shapiro-Wilk pretest data .166 and post-test data .111. The Sig. value in both normality test results is known to be more than 0.05, obtaining the final result that the pretest and post-test data are typically distributed. After finding the results, the normal distribution can be continued with the Paired T-test using SPSS version 26 to determine the effectiveness of Interactive E-Modules based on Inquiry Learning. Paired T-test results are presented in Table 6.

Table 6. Paired T-test Results

| Paired Samples | | |
|--------------------|---------|-----------------|
| test | Mean | Sig. (2-tailed) |
| Pretest - Posttest | -33.905 | .000 |

In the Paired T-test test, it is stated that there is a significant difference in the pretest and post-test results if the Sig (2-tailed) value is <0.05 [13]. Based on Table 7.

(2-tailed) <0.05, namely 0.000, this shows that between the pretest and post-test results, the difference in improvement is shown as 33.905%, so it can be seen that there is a significant difference. It can be concluded that AR-based learning media (augmented reality) material on Human Movement Organs (bones) effectively improves science learning outcomes.

The average pretest and post-test can be determined through the N-Gain Test. This study used the SPSS version 26 program to conduct the N-Gain test. The results of the N-Gain test are presented in Table 7.

Table 7. N-Gain Test Results

| Action | Average | N-Gain | Criterion |
|----------|---------|--------|-----------|
| Pretest | 48.76 | 0.63 | Sedang |
| Posttest | 84.57 | | |

The results of the N-Gain test show that the cognitive learning outcomes of IPAS fourth-grade students of SD Negeri Tambahagung 03 Pati Regency using AR-based learning media (augmented reality) material on Human Movement Organs (bones) have increased the average N-Gain score of 0.63 with a moderate category [13]. The results of the average increase in the medium category while the product developed got a very decent category from material and media experts and teacher and student responses. The external factor that influences this is the readiness of students' learning, where the teacher has never developed technology-based learning media with AR-based learning media (augmented reality) material on Human Movement Organs (bones) so that students' learning readiness must be appropriately considered. In addition, it is also necessary to pay attention to students' learning styles. Learning readiness and style significantly increase students' average learning outcomes [14]. This follows previous research, the development of AR (Augmented Reality) Media is effective in learning students are excited to participate in learning and arouse curiosity [15-17]. Supported research, the PjBL learning model on learning outcomes effectively improves learning outcomes [18-20]. The advantage of AR (Augmented Reality) media developed by researchers is to create material-based Human Movement Organs using the PjBL learning model. Data analysis in the study obtained the results of the feasibility test, which shows a very feasible and practical category. N-Gain test results show a moderate category. Based on data analysis, it is concluded that using AR-based learning media (augmented reality) material, such as human movement organs (bones), is feasible and effective as a learning resource in the classroom.

Conclusion

AR-based learning media (augmented reality) material Human Movement Organs (bones) in science lessons grade V SD that was successfully developed can make the learning atmosphere enjoyable, active, and enthusiastic students follow fun learning. The percentage of media experts is 84.72%, material experts 83.30%, and student response 88.46%, so the average overall assessment results are 90.38% with the category "very feasible" so that AR-based learning media (augmented reality) material

Human Movement Organs (bones) can be said to be feasible to use in learning.

References

- [1] Undang-Undang No.20 Tahun 2003 tentang Sistem Pendidikan Nasional. Jakarta: Depdiknas.
- [2] Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia No. 22 Tahun 2016 tentang Standar Proses Pendidikan Dasar dan Menengah.
- [3] Alifah, R. Megawaty, D.A., Satria, M.N.D. (2021). *Pemanfaatan Augmented Reality Untuk Koleksi Kain Tapis* (Study Kasus: UPTD Museum Negeri Provinsi Lampung). *Jurnal Teknologi dan Sistem Informasi*, 2 (2), 1.
- [4] Anggraini, P.D., Wulandari, S.S. (2021). *Analisis Penggunaan Model Pembelajaran Project Based Learning Dalam Peningkatan Keaktifan Siswa*, 9(2).
- [5] Sugiyono, (2021). *Metode Penelitian Kuantitatif, Kualitatif dan R&D*. Bandung : Alfabeta.
- [6] Tegeh, M dkk. (2015). *Model Penelitian Pengembangan*. Yogyakarta: Graha Ilmu.
- [7] Arikunto, S. (2019). *Prosedur Pendidikan*. Yogyakarta: PT Rieneke Cipta.
- [8] Purwanto. (2017). *Metode Penelitian Kuantitatif*. Yogyakarta: Gava Media.
- [9] Wulandari, Y., & Purwanto, W. E. (2017). *Kelayakan Aspek Materi Dan Media Dalam Pengembangan Buku Ajar Sastra Lama: Gramatika STKIP PGRI Sumatera Barat*, 3(2), 162-172.
- [10] Sugiyono. (2019). *Metodelogi Penelitian Kuantitatif dan Kualitatif Dan R&D*. Bandung: ALFABETA.
- [11] Eriska, L., Hetilaniar, H., & Kuswidianarko, A. (2022). Pengembangan E-Modul Berbasis Inkuiri Materi Suhu Dan Kalor Siswa Kelas V Sekolah Dasar. *Jurnal Pendidikan Dan Konseling (JPDK)*, 4(4), 1797–1801.
- [12] Susanti, Y., Islami, S., Ningrum, W. W. K., Nuryadin, & A., Alim, M. A. b. A. (2023). Development of Interactive E-Module on Learning IPAS. *Jurnal Pendidikan*, 24(2), 51 – 60.
- [13] Ghozali, I. (2015). *Aplikasi Analisis Multivariate dengan Program SPSS*. Semarang: Badan Penerbit Universitas Diponegoro.
- [14] Nihaya, S. S., dkk. (2020). Pengaruh Kesiapan dan Gaya Belajar terhadap Prestasi Belajar Siswa. *Jurnal Pendidikan Manajemen Perkantoran*, 5(2), 267-280.
- [15] Makhrus, M., Rokhmat, J., Kosim, K., & Harjono, A. (2022). Development of learning media and online test based smartphone android in physics learning on work and energy topic. *Jurnal Pijar Mipa*, 17(3), 420-423.
- [16] Setyawan, B., A.P., dkk. (2019). Augmented Reality dalam Pembelajaran IPA bagi Siswa SD. *Jurnal Teknologi Pendidikan*, 7(1).
- [17] Hanika, S., & Guspatni, G. (2023). Development of learning media powerpoint-iSpring integrated with prompting questions on stoichiometry topics. *Jurnal Pijar Mipa*, 18(1), 57-64.
- [18] Andini, S., & Rusmini, R. (2022). Project-based learning model to promote students critical and creative thinking skills. *Jurnal Pijar Mipa*, 17(4), 525-532.
- [19] Surya, A.P., dkk. (2018). Penerapan Model Pembelajaran Project Based Learning (Pjbl) untuk Meningkatkan Hasil Belajar dan Kreativitas Siswa Kelas III SD Negeri Sidorejo Lor 01 Salatiga. *Jurnal Pendidikan Dasar dan Humaniora*, 6(1).
- [20] Anggraini, M., & Yusmaita, E. (2023). Design a simple distillation project-based on chemical literacy on the topic of the alcohol phase F. *Jurnal Pijar Mipa*, 18(3), 386-391.