Development of Augmented Reality based Power Spin Learning Media Assemblr 3D PJBL model for Reaction and Timing Pattern Problems

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Article Info

Abstract

This research was conducted to find out how the role of augmented reality technology in solving problems in the field regarding reaction patterns and timing in table tennis power spin shot techniques with the PjBL approach. the final product of this research is in the form of 3D augmented reality assemblr technology that can be applied via smartphone by scanning the barcode. The method used is R&D with the development design used is ADDIE. the stages in the model, namely analysis, design, development, implementation and evaluation. Augmented reality assemblr 3D product in the form of a barcode, which there are 6 main menus on the front display. the results of research on the subject of PJKR students in semester III of class 2023 show that augmented reality learning media can be implemented well with the results of testing Assemblr 3D AR (Augmented Reality) learning media obtained an average score of 90.77% with the category (very good). With an indicator of suitability of 89%, understandability of 93.5%, usefulness of 90%, skill development and learning motivation of 91.75 media functionality and convenience of 90%. Based on the results of the augmented reality test, it can be concluded that AR (Augmented Reality) technology is feasible to use as a learning media feasible to use as a medium for learning table tennis UNUGIRI PJKR students.

INTRODUCTION

The world of education is experiencing rapid development with the support of technological advances. Curriculum changes to answer the challenges of the development of social phenomena in the world of education are needed. The achievement of human resource competencies produced in the educational process at each level undergoes continuous change. Various innovations, creativity, learning imagination and mindset in society become a tight competitiveness not only limited to the delivery of knowledge. To be able to compete in the era of globalization, higher education management has a big task in equipping graduates to produce quality human resources. In the learning process in the field, educators experience conditions where each student has a diverse understanding of both cognitive and psychomotor material. Especially in the sports education clump, each student is required to be able to master pedagogically, master the understanding of theory, use the latest technology effectively and efficiently and master movement skills(Santika et al., 2022)(Suryaman, 2020)(Bennett & Lemoine, 2014).

Efforts to achieve student competence in table tennis courses on power spin material require a learning model approach and learning media along with the latest technological advances. Efforts to overcome the problems in the field for table tennis power spin material in the reaction and timing pattern when welcoming the ball that comes are delayed and too fast in taking the ball. Where this reaction and timing determine the success of the power spin shot. The spirit of curriculum change in preparing superior human resources, able to develop science, technology and produce professional intellectuals facing globalization, then

research on the development of learning media for Augmented Reality Assemblr-based power spin shots combined with the Project Based Learning learning model to overcome less effective Reaction and Timing patterns needs to be done to produce useful products in the form of 3D animated interactive learning media that can be accessed and studied through gadgets anytime, and anywhere either by students or the community at large, and answer the challenges of technological development needs, the development of the industrial era 4.0 and the era of society 5.0. The PjBL learning model can train students to analyze problem solving difficulties in the field in additional learning both individually and in groups to gain knowledge, understanding and practice movement skills about the stages of table tennis stroke techniques that support student competence by obtaining information on the effectiveness of using Augmented Reality Assemblr technology media(Merdeka, 2020)(Zaeriyah, 2022)(Zaeriyah, 2023)(Goel et al., 2023)(Oh et al., 2024).

The application of 3D metaverse in the learning context of research results shows that it increases learner engagement, facilitates collaborative learning, and enriches the learning experience through an innovative approach (Yuda et al., 2024). Metaverse technology develops educational strategies that are more adaptive and responsive to the needs of the digital era. The impact of developing learning media based on metaverse-virtual reality technology with spatial.io model of discovery can increase students' interest and understanding (Rasyida et al., 2023). the discovery model can increase students' interest and understanding. Utilization of Augmented Reality technology using 3D and Vufaria SDK, a learning application for basic futsal techniques to improve and hone skills (Sintaro et al., 2020). Optimizing the

mastery of technology provides a great opportunity in the availability of superior human resources, each educational institution will compete globally based on the quality of education offered (Barlian & Ismelani, 2022). Augmented reality technology can be applied as a medium for learning floor exercise in a more interesting way (Asrori, 2021). Metaverse secara edukatif merancang kelas peserta didik untuk memecahkan masalah atau melakukan proyek secara kooperatif dan kreatif (Kye et al., 2021). Metaverse Digital transformation provides the facility of creating aspects of physical life into animated virtual worlds that provide integrated, persistent, shared and futuristic-looking imagery (Lee et al., 2021).

The strategy to achieve student competence in table tennis courses on power spin material requires a learning model approach and learning media along with the latest technological advances. To overcome problems in reaction patterns and timing the use of Augmented Reality 3D animated visualization can analyze finding errors in basic power spin techniques when welcoming and taking the ball that comes with the right accuracy. In realizing the quality of learning and the achievements of college graduates, research on the development of learning media for Augmented Reality-based power spin shots Project Based Learning Learning Model to Overcome Reaction and Timing Patterns that are Less Effective needs to be done to obtain information on the effectiveness of using Augmented Reality (AR) technology media. combined with the PjBL learning model where students create a project to make table tennis learning media animated 3D Augmented Reality video Assemblr by analyzing the movement of power spin shots that can be seen, analyzed in various sides and slow motion slow motion regarding power spin stroke techniques. a

project-based learning model is learning that uses projects to achieve learner competencies. Sport science is a reference in the effort to approach science (Rohendi & Rustiawan, 2020). The mandate for the development of science and technology is carried out through research, assessment, which has a specialization in sports science (Ramadhan et al., 2020). The results of Augmented Reality (AR) media development research in anatomy courses in the form of products developed that show satisfaction with the results of the media (Hasibuan & Chairad, 2023). Research on the operation of 3D character models to verify the effects of learning outcomes, motor skills, and learning motivation with Augmented Reality realizing sports skills (Chang et al., 2020). The research of Augmented Reality techno pedagogical methods is efficient in getting better performance of learners' involvement in sports (Liu et al., 2022). Excellence in the metaverse in solving problems or completing projects. AR creates new challenges, offering new learning opportunities for educators. Outlining technological, pedagogical, and learning issues in education (Wijayanto, 2022).

Research that will be developed in solving problems in the field regarding the theory and practice of table tennis courses in the sub-material of mastering power spin stroke techniques, namely reaction patterns and timing. With a scientific approach in the field of science and technology, the use of Augmented Reality Assemblr in the form of developing 3D learning video media to analyze errors and accuracy in making decisions on good and correct power spin shot techniques.

METHODS

This research is an R&D study with the development design used is ADDIE. ADDIE is short for the stages in

the model, namely analysis, design, development, implementation and evaluation (Rustandi, 2021). The subjects in this study were students, material experts, namely table tennis coaches and learning media validation experts. The object of research

is table tennis learning media power spin material.

Table.1 Research Stages ADDIE

Research stages	Activities	Activity details	Objectives	Description
Pre-research	Analysis	Needs analysis	Outcomes of learning competencies of the course table tennis	discreet
		Analysis of target users (students)	The target of third semester students taking table tennis	discreet
		Analyse competency outcomes	Competency achievement Learning material sub CPMK of power spin punch table tennis course	discreet
Research	Design	Develop learning objectives, concepts and form of media	Learning objectives, concepts and forms of media	discreet
		Identify targets and needs 3D video Arrange the competencies to be achieved, the stages of learning basic techniques table tennis power spin shot	Implementation plan for making learning video product specifications	discreet
		Compile a script or storyboard of storyline material that will be included in the 3D video media Assemblr Augmented reality	Storyline script 3D video product table tennis power spin material	discreet
	Development	Creation of 3D video objects, characters or environments	forming objects, characters or 3D video environment	discreet
		The 3D animation model creates interaction or movement of table tennis power spin technique.	Animations, table tennis power spin technique movements and interactions formed	discreet
			spin tenis meja dan interaksi	
		Integrate the 3D model into the real environment	Integrated 3D model in	discreet
		Implement planned interactions and	real environment	discreet
		Test media 3D video learning media thoroughly to ensure performance as expected to answer pattern problems reaction dan timing	Implemented 3D video learning media test with a project-based learning model approach in the problem of reaction pattern and timing	discreet
	Implementation	Expert Validation Field validation to test the effectiveness of using 3D augmented reality video products	Validation results that are followed up in the form of product revisions to the effectiveness of the product	discreet
	Evaluation	Test the effectiveness of using learning media	Media effectiveness	discreet

3D augmented reality video products		
Character revision animation	Final product	discreet
Revised sound effects		
Language revision		
Visual revision movement		

A. Augmented reality Assemblr 3D

Berdasarkan rancangan tahapan penelitian pengerjaan produk pengembangan augmented reality menggunakan website assemblrword.com. dalam website assemblrword.com sudah disediakan banyak marker yang dapat dibentuk dan dan diatur berdasarkan analisis kebutuhan. tahapan awal analisis kebutuhan, analisis target dan analisis capaian pembelajaran tenis meja pada mahasiswa semester III. Tahapan kedua design menyusun tujuan pembelajaran, konsep dan bentuk media kebutuhan video 3D Menyusun kompetensi yang akan dicapai, tahapan pembelajaran teknik dasar pukulan power spin tenis meja.
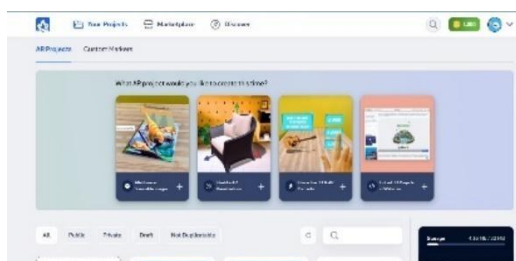

Figure 1. Assemblrword.com

B. Storyboard

Storyboard is a stage activity in a user interface design. The design of the storyboard also aims to facilitate the design of this learning media. Storyboards are made based on the needs of reaction pattern 1, reaction pattern 2, timing 1, timing 2 and the final movement of the follow through table tennis power spin shot. Perancangan storyboard juga bertujuan untuk mempermudah dalam

pembuatan rancangan media pembelajaran ini. Storyboard yang dibuat berdasarkan kebutuhan yaitu pola reaction 1, pola reaction 2, timing 1, timing 2 dan gerakan akhir pukulan power spin tenis meja follow through.

C. User interface design

The design of the user interface or user interface of the virtual world animation displays into the real world by scanning the barcode using a gadget / mobile phone. The 3D augmented reality animation display is adjusted to the storyboard design that has been made before.

Figure 2 . Augmented Reality Products

Figure 3 Product barcode assemblr 3D Augmented Reality

Figure 4. Table tennis learning with the PJBL model

D. Material collection

At this stage the material needed by the author related to the construction of basic table tennis technique applications on power spin punch material such as animation images, backgrounds, menus and others. The materials obtained are obtained from various sources which are collected and designed according to the needs of the learning material. Materials needed in building augmented reality table tennis in the form of files, text, images and others. Here are the details in the material that will be used.

Tabel 2 Augmented Reality

No	Menu display	Source
1	Teks	http://assemblrword.com
2	Table tennis image	https://www.youtube.com/watch?v=zYOwkAb302k&t=594s
3	Menu button	https://www.google.com/search?q=pngtree-back-glossy green
4	Animatio n	http://assemblrword.com

Participants

The participants in this study were third semester students who were taking table tennis courses in the health and recreation physical education study programme. The age range of participants is 18-21 years old with male and female gender.

Sampling Procedures

The sampling procedure uses a purposive sample technique. Sampling is based on problems that occur in third semester students in classes A and B in table tennis courses in power spin material. The location of data collection in the sports laboratory of the health and recreation physical education study programme, faculty of teacher training and education, nahdlatul ulama sunan giri university. The research period is September-November 2024.

Procedures

Research data collection in the development of augmented reality 3D assemblr researchers provide material first in table tennis lectures. The material given to students about the basic techniques of playing table tennis. Especially on power spin material. Researchers provide a 3D augmented reality assemblr technology approach in the form of barcodes that are scanned through gadgets / mobile phones. Students in groups with a PJBL approach students understand through 3D augmented reality products that appear. Students analyse movement errors through 3D augmented reality products. Patterns of reaction, timing and followthrough in determining the success of table tennis power spin shots. The research started from meeting 5 to meeting 9. In meetings 5-9, material experts, media experts and table tennis experts were present in testing 3D augmented reality assemblr products. Filling out the instrument questionnaire by media experts, table tennis experts and users, namely students. The data collected was analysed to get the results of the development of learning media using augmented reality assemblr 3D technology.

Design or Data Analysis

Qualitative data was analysed by reducing data, the results of data reduction were then presented and concluded. After qualitative data was collected, data reduction was carried out by selecting the suitability of the data with the specific product expected. After that, the data was presented in tabular form to make it clearer to analyse. Finally, the data was summarised. Quantitative data analysis consists of data analysis of questionnaire results and field test results. The questionnaire data is the validity test data of media experts in the aspects of media display, media functionality, content feasibility and technical feasibility. The material expert validity test is the suitability of the material to the problem, the accuracy and correctness of the material, the understandability of the material and the relevance of the material to table tennis learning. Table tennis expert test the suitability of the media to the curriculum, understandability and student involvement, the usefulness of the media in learning and technical and functional aspects. User test aspects of ease of use, involvement and motivation to learn, understanding of the material and the usefulness of the media. While the data from the field test is the reliability data of the scorers. Data analysis of the questionnaire results using the formula adapted from (26).
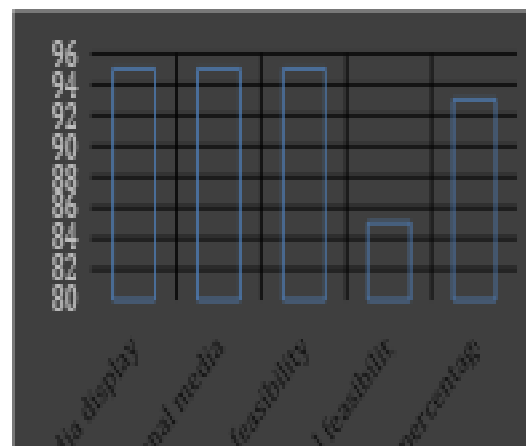
RESULT

This stage is the stage of research results of Augmented Reality Assemblr 3D learning media products that have been made and applied in solving problems of reaction patterns and timing of power spin material for PJBL model table tennis courses.

Media Validation Test result
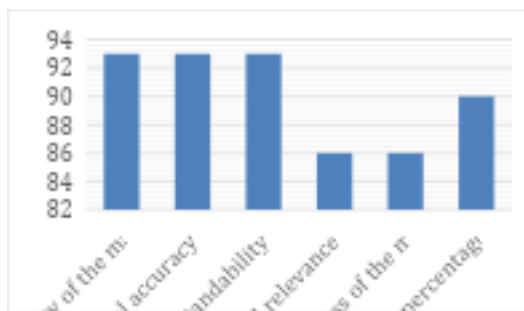
Table 3. Conclusion Of Media Expert Results

Category	Eligibility	Indicators
Media display	95%	Very good
Functional media	95%	Very good
Content feasibility	95%	Very good
Technical feasibility	85%	Very good
Average percentage	92.5%	Very good

Grafik 1. Analysis Result

Table 4. Conclusion Material expert results

Category	Eligibility	Indicators
Suitability of the material	93%	Very good
Material accuracy	93%	Very good
Understandability	93%	Very good
Material relevance	86%	Very good
Usefulness of the material	86%	Very good
Average percentage	90.2%	Very good

Grafik 2. Analysis Result
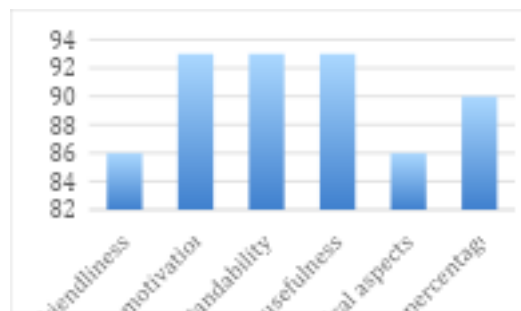
Diagram 4. Analysis Result

Table 5. Tennis expert result conclusion

Category	Eligibility	Indicators
Media suitability	93%	Very good
Understandabi lity	93%	Very good
Usefulness	86%	Very good
Functional	86%	Very good
Skill development	93%	Very good
Average percentage	90.2%	Very good

Grafik 3. Analysis Result

Table 6. Conclusion Media user results

Category	Eligibility	Indicators
User-friendliness	93%	Very good
Learning motivation	93%	Very good
Understandabi lity	86%	Very good
Usefulness	86%	Very good
Technical aspects	93%	Very good
Average percentage	90.2%	Very good

Based on the results of the Assemblr 3D AR (Augment Reality) learning media test, the average score is 90.77% with a category (very good). With indicators of suitability of 89%, understandability of 93.5%, usefulness of 90%, skill development and motivation to learn 91.75 media functionality and convenience of 90% and it was found that all indicators were in the excellent category.

DISCUSSION

The role of AR media has been research conducted by safadel & white on gymnastics material aspects of front rolls and back rolls(Safadel & White, 2017). In line with various studies that this research has a role in facilitating and helping students in developing students' motor skills, this was identified based on the results. The use of Augmented Reality (AR) for students is concluded as follows, (1) students who are assisted by AR media during the learning process can increase their understanding of floor exercise movements, this is because the AR media learning process is combined with animated images or videos that have 3. Educators' involvement in using augmented reality technology shows that augmented reality can help educators explain, provide examples and build new understanding of learning (Calabuig-Moreno et al., 2020). A new augmented reality (AR) system, avaTTAR, for table tennis stroke training allows users to visualize target strokes and correct their

attempts effectively with dual perspective settings(Ma et al., 2024). Sports professionals are increasingly using Virtual Reality (VR) for skills-based sports training and assessment. findings support the idea that complex skills can be learned in VR and the skills acquired can be transferred to the real world(Oagaz et al., 2021). The results of the 3D augmented reality table tennis assemblr product research provide a solution to the problem of power spin techniques for student learning. With the PjBL learning approach, students in groups try to solve the problem of failure in practicing table tennis power spin techniques. By displaying virtual world 3D objects into the real world makes something interesting for students. students are very enthusiastic in learning 3D augmented reality assemblr products in the learning process.

CONCLUSION

This should clearly explain the main conclusions of the work highlighting its importance and relevance.

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All Acknowledgments (If Any) Should Be Included At The Very End Of The Paper Before The References And May Include Supporting Grants, Presentations, And So Forth.

REFERENCES

Asrori, N. (2021). Media Pembelajaran Olahraga Senam Lantai Dengan Augmented Reality Berbasis Android. Jurnal Informatika Dan Rekayasa Perangkat Lunak, 2(4), 559–569.

Barlian, U. C., & Ismelani, N. (2022). Metaverse Sebagai Upaya Menghadapi Tantangan Pendidikan Di Masa Depan. JOEL: Journal of Educational and Language Research, 1(12), 2133–2140.

Bennett, N., & Lemoine, J. (2014). What VUCA really means for you. Harvard Business Review, 92(1/2).

Calabuig-Moreno, F., González-Serrano, M. H., Fombona, J., & Garcia-Tascon, M. (2020). The emergence of technology in physical education: A general bibliometric analysis with a focus on virtual and augmented reality. Sustainability, 12(7), 2728.

Chang, K.-E., Zhang, J., Huang, Y.-S., Liu, T.-C., & Sung, Y.-T. (2020). Applying augmented reality in physical education on motor skills learning. Interactive Learning Environments, 28(6), 685–697.

Goel, R., Baral, S. K., Mishra, T., & Jain, V. (2023). Augmented and Virtual Reality in Industry 5.0 (Vol. 2). Walter de Gruyter GmbH & Co KG.

Hasibuan, S., & Chairad, M. (2023). The Development of Augmented Reality (AR) in Anatomy Course. International Journal of Education in Mathematics, Science and Technology, 11(3), 744–754.

Kye, B., Han, N., Kim, E., Park, Y., & Jo, S. (2021). Educational applications of metaverse: possibilities and limitations. Journal of Educational Evaluation for Health Professions, 18.

Lee, L.-H., Braud, T., Zhou, P., Wang, L., Xu, D., Lin, Z., Kumar, A., Bermejo, C., & Hui, P. (2021). All one needs to know about metaverse: A complete survey on technological singularity, virtual ecosystem, and research agenda. ArXiv Preprint ArXiv:2110.05352.

Liu, Y., Sathishkumar, V. E., & Manickam, A. (2022). Augmented reality technology based on school physical education training.

Computers and Electrical Engineering, 99, 107807.

Ma, D., Hu, X., Shi, J., Patel, M., Jain, R., Liu, Z., Zhu, Z., & Ramani, K. (2024). avaTTAR: Table Tennis Stroke Training with Embodied and Detached Visualization in Augmented Reality. Proceedings of the 37th Annual ACM Symposium on User Interface Software and Technology, 1–16.

Merdeka, M. B. K. (2020). Buku Panduan Merdeka Belajar-Kampus Merdeka. Direktorat Jenderal Pendidikan Tinggi Kementerian Pendidikan Dan Kebudayaan.

Oagaz, H., Schoun, B., & Choi, M.-H. (2021). Performance improvement and skill transfer in table tennis through training in virtual reality. IEEE Transactions on Visualization and Computer Graphics, 28(12), 4332–4343.

Oh, S., Yoon, B.-J., & Park, H. (2024). Location-based electrotactile feedback localizes hitting point in virtual-reality table tennis game. Biomedical Engineering Letters, 1–12.

Ramadhan, M. G., Ma'mun, A., & Mahendra, A. (2020). Implementasi Kebijakan Olahraga Pendidikan sebagai Upaya Pembangunan Melalui Olahraga Berdasarkan Undang-Undang Sistem Keolahragaan Nasional. JTIKOR (Jurnal Terapan Ilmu Keolahragaan), 5(1), 69–80.

Rasyida, R., Nurdin, E. A., & Rasim, R. (2023). Pembelajaran Berbasis Metaverse–Virtual Reality Menggunakan Spatial. io dengan Model Discovery Learning untuk Meningkatkan Minat dan Pemahaman Siswa. Jurnal Pendidikan Tambusai, 7(2), 15875–15882.

Rohendi, A., & Rustiawan, H. (2020).

Kebutuhan Sport Science Pada Bidang Olahraga Prestasi. Journal Respecs, 2(1), 1–16.

Rustandi, A. (2021). Penerapan model ADDIE dalam pengembangan media pembelajaran di SMPN 22 Kota Samarinda. Jurnal Fasilkom, 11(2), 57–60.

Safadel, P., & White, D. (2017). A comparative analysis of augmented reality and two-dimensional using molecular modeling on student learning. Society for Information Technology & Teacher Education International Conference, 1774–1776.

Santika, I. G. N., Suarni, N. K., & Lasmawan, I. W. (2022). Analisis perubahan kurikulum ditinjau dari kurikulum sebagai suatu ide. Jurnal Education and Development, 10(3), 694–700.

Sintaro, S., Surahman, A., & Khairandi, N. (2020). Aplikasi pembelajaran teknik dasar futsal menggunakan augmented reality berbasis android. TELEFORTECH: Journal of Telematics and Information Technology, 1(1), 22–31.

Suryaman, M. (2020). Orientasi Pengembangan Kurikulum Merdeka Belajar. Seminar Nasional Pendidikan Bahasa Dan Sastra, 1(1), 13–28.

Wijayanto, A. (2022). Teknologi Metaverse dalam Ilmu Keolahragaan.

Yuda, U. W., Rhamadani, M., Pratama, M. B., & Sutabri, T. (2024). Implementasi Metaverse pada Proses Pembelajaran. IJM: Indonesian Journal of Multidisciplinary, 2(1), 115–121.

Zaeriyah, S. (2022). Peningkatan motivasi belajar menggunakan Project Based Learning (PJBL) melalui media vlog materi senam aerobik. Ide Guru: Jurnal Karya Ilmiah Guru, 7(1), 40–

46.

Zaeriyah, S. (2023). Peningkatan Motivasi dan Hasil Belajar Siswa Menggunakan Model Project Based Learning (PjBL) Berbasis Tik-Tok. Ide Guru: Jurnal Karya Ilmiah Guru, 8(1), 106–111.