# Augmented Reality and Problem-Based Learning in Physical Education and Sport Learning: A Literature Review

Awaluddin[1], Samsudin[2], Wahyuningtyas Puspitorini[3], Firmansyah Dahlan[4]

1 Doctoral Program, Universitas Negeri Jakarta, Indonesia
2 Faculty of Sports Science, Universitas Negeri Jakarta, Indonesia
3 Universitas Muhammadiyah Palopo, Indonesia
Awaluddin_9904920010@mhs.unj.ac.id

**Abstract.** this literature review aims to describe the role, function, and benefits of augmented reality and problem-based learning (PBL) in physical education and sports learning. Secondary data collection systematic literature review (SLR) method, through the Preferred Reporting Items for Systematic Reviews and Meta Analysis (PRISMA) approach. Results; AR and PBL very clearly help the learning process of physical education and sports to be more creative and innovative, and in accordance with the times.AR is highly recommended for use in physical education and sports learning to be more creative and innovative but with various additional features.AI, VR, and Educational Robotics are far more developed than AR, but the advantages of AR are efficiency, easy, and cheap for all groups. Simultaneously, no journals describe the advantages and disadvantages of PBL compared to other learning methods, but PBL is more effective than traditional learning (teacher-centered learning). It was also found that PBL is very relevant to be implemented in universities because it is in accordance with the age level of students to learn with a critical situation of a problem.

**Key Words:** *Learning Methods, Learning Media, Physical Education and Sports.*

## 1. Introduction

The use of renewable learning resources results in better learning outputs [1]. Learning implemented through innovative technology will result in interesting and varied learning [2]. The creativity of teaching staff enhanced by a positive personality results in better learning outputs [3]. The development of the times requires teaching staff to be able to implement the latest and newest learning [4]. Teachers in modern times are required to be able to integrate traditional and modern methods for learning effectiveness [5]. Various explanations related to the demands of creative and innovative physical education and sports learning require teaching staff to innovate more. The classic problem in the process of physical education and sports, both those held in educational units and universities in

developing countries (one of which is Indonesia), is always related to the imbalance between the number of students and the facilities and infrastructure prepared, so that learning is needed that can be done anywhere and anytime by students, secondly, learning that is still teacher center learning so that the learning process is very monotonous and students are not active in it.

Practitioners and researchers use augmented reality (AR) as a solution to the first problem. AR has been adopted as a powerful tool to improve the teaching and learning experience in many classrooms [6]. AR can be utilized in the field of education because it is 3D and more realistic or concrete than 2D media [7]. The second problem solution uses Problem-Based Learning (PBL). PBL as a teaching method in the New Era in the teaching process of various subjects [8]. PBL can be used by physical education lecturers and teachers in order to help students solve problems that are deliberately created, so it is hoped that these problem-solving skills will have implications in their future lives [9] [10] [11]. The application of the PBL model in learning can improve higher order thinking skills (analysis, synthesis, and evaluation) [12]. PBL is a learner-centered learning model that provides various real-life problems for learners [13]. PBL provides the right learning environment to improve students' metacognitive and scientific reasoning [14] [15]. Based on the need for the presence of learning that is far more creative, and innovative and of course produces learning that has high-quality value, as well as being a reference material in solving physical education and sports learning problems, we propose this literature review. The focus of the data that will be displayed in this literature review will at least describe the role, function, and benefits of AR and PBL in physical education and sports learning, as well as their respective advantages and disadvantages.

## 2.  Methods

Some concepts and procedures for literature review include; Secondary data collection can use the systematic literature review (SLR) method. The procedure for retrieving data by accessing journal indexes facilitates searching using keywords according to the theme to be reviewed [16]. A literature study is a research design by collecting data sources related to a topic. Data collection with database search tools from Google Scholar, ERIC, and or Scopus using tools; search terms in each database. The way this method works is by analyzing journals and then making summaries related to research questions and objectives [17]. This literature review uses the Preferred Reporting Items for Systematic Reviews and the Meta-Analysis method commonly referred to as PRISMA, This method requires certain stages so that it makes it different from just a literature study / traditional review. The following are the stages using the PRISMA method in this literature review: Stages of determining objectives and background, namely "student center learning process and learning media that can be run anytime and anywhere for students". The problem identification stage is "describing the role, function, and benefits of AR and PBL as in physical education and sports learning, as well as their respective advantages and disadvantages". Data search and

screening stages, namely; 1) Search techniques using application assistance (Mendeley, VOSviewer, Publish, or Perish). 2) The search time range is 2019-2023. 3) Initial findings using search keywords amounted to 821 articles. The data extraction stage (determining important findings related to the objectives and background of the research, and taking into account the limitations of the author) amounted to 65 articles. The data synthesis stage is the grouping of data, facts, and information which are then concluded in order to answer the objectives and background of the research.

## 3.   Results and Discussion

The following is the distribution and description of research results that "describe the role, function, and benefits of AR and PBL as in physical education and sports learning, as well as their respective advantages and disadvantages" that are disseminated in scientific journals.

**Table 1.** The results of data synthesis of the role, function, and benefits of augmented reality and problem-based learning as in physical education and sports learning.

| No | Theme | Article Identity | Findings |
|---|---|---|---|
| 1 | AR in Physical Education and Sports Learning | [18] | AR allows users to place digital information in the physical world through mobile devices. As well as physical education learning (practical) can be digitally poured |
| | | [19] | VR and AR can provide benefits in supporting the modern physical education process, and help promote effective learning for students. |
| | | [20] | AR can be a medium in observing various scenes in sports, but still requires various other additional features |
| | | [21] | AR is a distance learning solution to improve the understanding of physical activity and sports in the community. |
| 2 | PBL in Physical Education and Sport Learning | [22] | It is possible to improve the competence of physical education students in athletics on increasing conceptual, procedural and attitudinal knowledge through PBL and project-based learning (PJBL). |
| | | [23] | PJBL can be an effective method of introductory anatomy learning, through self-directed learning of anatomy before embarking on a more rigorous and difficult program. |
| | | [24] | The Faculty of Sports Science, which has a physical education physical study program, specifically teaches anatomy which includes understanding theory, which can easily be learned through practical activities with a PBL approach. |
| | | [25] | Project-based learning, problem-based learning, and discovery learning are effective in improving the teaching skills of physical education and sport teachers. |
| | | [26] | Problem-based learning and flipped classroom models combined with Android applications based on biomechanical analysis are effective for improving student learning outcomes in pencaksilat. |
| | | [27] | Recommend incorporating PBL into physical education teaching considering that after PBL the average badminton performance score and students' learning motivation increased. |
| | | [28] | PBL is essential in the reform of the teaching process of money physical education organized by colleges and universities. PBL significantly increases student engagement in class and improves knowledge acquisition compared to traditional classes. |
| | | [29] | PBL facilitates skill development and increases learning motivation by providing opportunities for students to interact and help each other in physical education learning. |
| | | [30] | Various learning methods are highly recommended to respond to certain situations (Covid 19), one of which is PBL. |

**Table 2.**The results of the data synthesis of the advantages and disadvantages of augmented reality and problem-based learning as physical education and sports learning.

| No | Theme | Article Identity | Advantages | Kelebihan |
|---|---|---|---|---|
| | | [18] | - | Compared to virtual reality (VR), AR in education provides more specific information, timely teaching and scaffolding, increased self-efficacy and tenacity, and better ease of collaboration and authoring. Rather than conducting problem-solving activities in a decontextualized setting, through AR learners can engage in inquiry-based problem-solving through interactive, dynamic, and contextualized learning experiences that encourage transfer to subsequent activities in the real world. |
| 1 | AR Physical Education and Sports Learning | [31] | The use of AR must always be balanced with accompanying learning methods, for that AR cannot stand alone as a learning medium, because otherwise AR is only limited to visual media. | - |
| | | [32] | - | AR as one of the learning media that can be done anywhere and anytime, is one of the solutions to the needs of physical education learning, namely distance learning. |
| | | [33] | - | AR technology can be a potential and effective tool to activate students' positive emotions in the PBL process. |
| | | [34] | AR is a learning media that is only one-way without a reciprocal response, so it needs development in the future. | Despite the shortcomings of one-way AR, it is much cheaper, easier, and more practical to use more widely. |
| 2 | PBL in Physical Education and Sport Learning | - | - | - |

Our findings show that: (1) AR and PBL clearly help the learning process of physical education and sports to be more creative and innovative and in accordance with the times. (2) AR is highly recommended to be used in the learning process of physical education and sports to be more creative and innovative but with the addition of various additional features. (3) AI, VR, and Educational Robotics are far more developed than AR, but the advantages of AR are efficiency, easy, and cheap for all groups. (4) Simultaneously, there are no journals that describe the advantages and disadvantages of PBL compared to other learning methods, but the fact that PBL is more effective when compared to traditional learning (teacher-centered learning). It was also found that PBL is very relevant to be implemented in universities because it is in accordance with the age level of students to learn with a critical situation of a problem.

## 4. Conclusions

AR and PBL clearly help the learning process of physical education and sports to be more creative and innovative and in accordance with the times. AR is highly recommended to be used in the learning process of physical education and sports to be more creative and innovative but with the addition of various additional features. However, it must be understood that AI, VR, and Educational Robotics are far more developed than AR, as for the advantages of AR in efficiency, easy, and cheap for all groups. We did not find articles that simultaneously describe the advantages and disadvantages of PBL compared to other learning methods, but it is a fact that PBL is more effective when compared to traditional learning (teacher-centered learning). It was also found that PBL is very relevant to be implemented in higher education because it is in accordance with the age level of students to learn with a critical situation of a problem.

## 5. References

[1]     S. L. Michael *et al.*, "Rationale for the Essential Components of Physical Education," *Res. Q. Exerc. Sport*, vol. 92, no. 2, pp. 202–208, 2021.

[2]     A. Andrade, W. Mayron da Cruz, C. K. Correia, A. L. Goya Santos, and G. G. Bevilacqua, "Effect of practice exergames on the mood states and self-esteem of elementary school boys and girls during physical education classes: A cluster-randomized controlled natural experiment," *PLoS One*, vol. 15, no. 6, 2020.

[3]     Q. Deng, B. Zheng, and J. Chen, "The Relationship Between Personality Traits, Resilience, School Support, and Creative Teaching in Higher School Physical Education Teachers," *Front. Psychol.*, vol. 11, 2020.

[4]     S. Harvey, S. Pill, P. Hastie, and T. Wallhead, "Physical education teachers' perceptions of the successes, constraints, and possibilities associated with implementing the sport education model," *Phys. Educ. Sport Pedagog.*, vol. 25, no. 5, pp. 555–566, 2020.

[5]     Y. Xiong, X. Y. Sun, X. Q. Liu, P. Wang, and B. Zheng, "The Influence of Self-Efficacy and Work Input on Physical Education Teachers' Creative

Teaching," *Front. Psychol.*, vol. 10, 2020.

[6]     H. S. Ferdous *et al.*, "'What's happening at that hip?': Evaluating an On-body Projection based Augmented Reality System for Physiotherapy Classroom," *Conference on Human Factors in Computing Systems - Proceedings*. 2019.

[7]     S. Widodo, N. Azizah, and T. Ikhwanudin, "Teaching mild mentally retarded children using augmented reality," *Int. J. Learn. Teach. Educ. Res.*, vol. 18, no. 7, pp. 184–199, 2019.

[8]     H. Li, H. Deng, and Y. Zhang, "Application of the PBL Model Based on Deep Learning in Physical Education Classroom Integrating Production and Education," *Comput. Intell. Neurosci.*, vol. 2022, 2022.

[9]     K. M. Edens, "Preparing Problem Solvers for the 21st Century through Problem-Based Learning," *Coll. Teach.*, vol. 48, no. 2, pp. 55–60, 2000.

[10]    T. Mayasari, A. Kadarohman, D. Rusdiana, and I. Kaniawati, "Apakah Model Pembelajaran Problem Based Learning Dan Project Based Learning Mampu Melatihkan Keterampilan Abad 21?," *J. Pendidik. Fis. dan Keilmuan*, vol. 2, no. 1, p. 48, 2016.

[11]    T. G. Ryan, "Problem-based learning opportunities within Ontario (Canada) elementary health and physical education," *J. Pedagog. Sociol. Psychol.*, vol. 3, no. 2, pp. 66–74, 2021.

[12]    W. Haigt, R. Kelly, and B. Bogda, *Project-based learning: a natural fit with discance education*. 2005.

[13]    M. Maulidiya and E. Nurlaelah, "The effect of problem based learning on critical thinking ability in mathematics education," *J. Phys. Conf. Ser.*, vol. 1157, no. 4, pp. 1–4, 2019.

[14]    S. Haryani, Masfufah, N. Wijayati, and C. Kurniawan, "Improvement of metacognitive skills and students' reasoning ability through problem-based learning," *J. Phys. Conf. Ser.*, vol. 983, no. 1, 2018.

[15]    J. R. Savery, *Comparative Pedagogical Models of Problem-Based Learning*. 2019.

[16]    M. Ridwan, "Small sided games meningkatkan kebugaran jasmani dan keterampilan bermain sepakbola," *J. Sport Educ.*, vol. 3, no. 1, p. 35, 2020.

[17]    M. Syofian and N. Gazali, "Journal of Sport Education ( JOPE )," *J. Sport Educ.*, vol. 3, no. 2, pp. 63–74, 2021.

[18]    J. M. Reilly and C. Dede, "Augmented Reality in Education," *Handbook of Mobile Teaching and Learning: Second Edition*. pp. 1337–1351, 2019.

[19]    Y. Shao and X. Min, "VR and AR Technology Used in Education in the Education of Packaging Design for Students," *ACM International Conference Proceeding Series*. pp. 1073–1076, 2021.

[20]    A. A. Rafique, A. Jalal, and A. Ahmed, "Scene Understanding and Recognition: Statistical Segmented Model using Geometrical Features and Gaussian Naïve Bayes," *2019 International Conference on Applied and Engineering Mathematics, ICAEM 2019 - Proceedings*. pp. 225–230, 2019.

[21]    F. D'Elia and G. Raiola, "Sport and Exercise Sciences Degrees in Italy: Comparison Between Online and Traditional Teaching Models," *Communications in Computer and Information Science*, vol. 1091. pp. 209–

216, 2019.

[22]  D. A. Aguilera, V. S. Rivera-Aguilera, and R. Cordovés-Peinado, *Strategy proposal for the redesign of the Subject Program Athletics I of the Physical Education career curriculum approach by competence according to the educational model of the university*, vol. 15, no. Proc4. rua.ua.es, 2020.

[23]  M. Bains and D. Z. Kaliski, "An anatomy workshop for improving anatomy self-efficacy and competency when transitioning into a problem-based learning, Doctor of Physical Therapy program," *Adv. Physiol. Educ.*, vol. 44, no. 1, pp. 39–49, 2020.

[24]  Y. Makhambetov, A. Baikenzheyeva, S. Kassymov, Z. Yessirkepov, and R. Kurmanbaev, "Opinions about the content of the anatomy course of future physical education teachers and their ability to apply what they have learned in professional activities," *Cypriot J. Educ. Sci.*, vol. 16, no. 6, pp. 3385–3393, 2021.

[25]  Muarifin, "The development of scientific methods for teaching elementary physical education," *J. Phys. Educ. Sport*, vol. 22, no. 12, pp. 3044–3050, 2022.

[26]  J. Lubis, A. Haqiyah, M. Kusumawati, A. A. Irawan, Y. N. Hanief, and D. N. Riyadi, "Do problem-based learning and flipped classroom models integrated with Android applications based on biomechanical analysis enhance the learning outcomes of Pencak Silat?," *J. Phys. Educ. Sport*, vol. 22, no. 12, pp. 3016–3022, 2022.

[27]  C.-C. Kao and Y.-J. Luo, "The influence of low-performing students' motivation on selecting courses from the perspective of the sport education model," *Phys. Educ. students*, vol. 23, no. 6, pp. 269–278, 2019.

[28]  Q. Li, Y. Liu, and Y. Wang, "Reform of public physical education teaching mode in colleges and universities based on PBL teaching concept," *ACM International Conference Proceeding Series*. pp. 551–554, 2021.

[29]  Y. J. Luo, "The influence of problem-based learning on learning effectiveness in students' of varying learning abilities within physical education," *Innov. Educ. Teach. Int.*, vol. 56, no. 1, pp. 3–13, 2019.

[30]  V. R. Arrabal, J. H. Robles, and S. J. Marfil, "Methodological organization of a physical education didactic unit during covid-19," *Retos*, vol. 42, pp. 757–766, 2021.

[31]  A. N. Sanderasagran, A. A. Aziz, and D. M. N. D. Idris, "Real-time computational fluid dynamics flow response visualisation and interaction application based on augmented reality," *J. Inf. Commun. Technol.*, vol. 19, no. 4, pp. 559–581, 2020.

[32]  S. Akkaya, "Technological pedagogical content knowledge as a predictor of physical education and sports teachers' evaluations of distance education," *Cypriot J. Educ. Sci.*, vol. 16, no. 4, pp. 1643–1659, 2021.

[33]  M. Fidan and M. Tuncel, "Integrating augmented reality into problem based learning: The effects on learning achievement and attitude in physics education," *Comput. Educ.*, vol. 142, 2019.

[34]  F. C. Ou Yang, H. M. Lai, and Y. W. Wang, "Effect of augmented reality-based virtual educational robotics on programming students' enjoyment of learning,

computational thinking skills, and academic achievement," *Comput. Educ.*, vol. 195, 2023.