

Research article

Development of Augmented Reality-Based Gymnastics Learning Media

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Abstract: This study aims to develop augmented reality-based gymnastics learning media. Using the Research and Development (R&D) method, the study involved 3 competent experts in gymnastics, media, and language. These experts were engaged during the validation test stage to determine the good parts of the products and find out what could be improved. After this stage, the product was tried out directly on the potential users. A total of 25 students aged 20 to 25 were then selected as samples, using the random sampling technique to participate in this study. The data obtained were statistically examined using the r-correlation method. The results reported that AR-based gymnastics learning media were effective for gymnastics skills. This media was valid, practical, effective, and moderate reliable for improving gymnastics skills. With this potential, this research recommends that teachers, lecturers, and sports practitioners incorporate this media into their classes to facilitate the gymnastics learning process.

Keywords: Gymnastics; Learning Media; Augmented Reality

1. Introduction

Technological advances have had a major influence on the world of education [1]. One of the latest technology innovation is Augmented Reality (AR) [2]. With AR, virtual information or objects are presented in the actual scene using a particular computation [3]. Over the past few years, AR applications have become portable and widely available across a variety of devices [4]. It starts to take its place in audiovisual media and is being used in various areas of life. In education, this innovation has been presented in a real and interesting way to attract interest and increase student motivation in learning [5]. However, in reality, there are still many lecturers who have not fully mastered and are not ready to use technology in learning [6]. They fail to cultivate the benefits of this current technology. Their teaching and learning activities are carried out using conventional media [7]. In fact, such learning media places students as passive learning objects who do not actively seek information [8].

Ideally, the learning process prioritizes the active role of students as learning subjects, while lecturers act as companions or facilitators in the process [9]. One of the strategies to encourage students to be more active is incorporating technology in the classroom. Besides attracting students' engagement, the technology enables them to understand the material independently outside the class [9]. Scholars claim that conventional media does not adequately stimulate children in learning [9]. In addition, the conventional media requires lecturers to apply it in online learning through various applications such as zoom, Whatsapp Group, Google Meet, and Google Classroom [10].

Similarly, in a number of universities around the world, gymnastics learning is still done through multiple types of conventional e-learning, for example, WhatsApp groups [11]. However, this approach is not fully effective in encouraging students to achieve their learning objectives. These media are considered insufficient to provide appropriate learning media to improve student understanding. The lecturers have limited knowledge in designing interesting online learning, and the students have limited internet access, which prevents them from accessing online materials [12]. In addition, low motivation to exercise, limited access to professional gymnastics instructors, and minimal interactivity in independent exercise are also current problems.

For these reasons, a breakthrough is needed to create a more effective learning process. One example is the development of innovative learning media, such as AR-based gymnastics media. This new study reports that the use of AR technology in the sport of boxing can improve the learning process of basic protection techniques [13]. This newly developed media is a potential solution because it allows students to access materials offline, anytime, and anywhere. In this way, the teaching and learning process can take place more effectively without time and place limitations. This research is conducted to fill the gaps. It aims to develop augmented reality-based gymnastics learning media that students can use to help them achieve their learning objectives.

2. Materials and methods

2.1.1. Study Design

This study was conducted using the Research and Development (R&D) method. It involved 3 competent experts in gymnastics, media, and language. These experts were engaged during the validation test stage to determine the products' good points and to examine what could be improved. After this stage, the product was tried out on the potential users.

2.1.2. Subjects

A total of 25 students aged 20 to 25 were selected using the random sampling technique to participate in this study. The subjects came from students with bachelor's degrees, Faculty of Sports Science, Universitas Negeri Padang.

2.1.3. Statistical analysis

The data were tested using an advanced statistical analysis, the r-correlation method.

2.1.4. Product design

The product of this research and development model is called SenAR learning media. It contains several main features.

- 1) Media Instructions

This menu contains information about how to use the SenAR learning media. It also explains how to use other features in the learning media, such as lecture attendance, lecture materials, semester learning plans, practice videos, and assignments.

- 2) Semester Learning Plan

The semester learning plan menu explains the learning design in one semester. It contains the course identity, course description, and learning outcomes. The learning outcomes include aspects of attitude, knowledge, general skills, and specific skills.

- 3) **Augmented Reality (AR) Based Lecture Material**
The learning material menu contains theoretical explanations of the material accompanied by images. This lecture material is made according to the gymnastics learning syllabus. The material created in the application starts from meeting 2 to meeting 15. The material menu at each meeting contains an introduction, a presentation, and an understanding evaluation of the material.
- 4) **Practice Videos**
The learning material menu contains theoretical explanations of the material accompanied by images. The introduction contains a brief description of the learning, the relevance of the course, and the expected learning outcomes. The presentation of the material contains an explanation of the material in theory accompanied by images and a summary of the material.
- 5) **Assignment**
This assignment menu is made in the form of a Google form containing instructions of assignments for the students. Their assignment results must be uploaded to the Google form, with a specific format containing their ID number and YouTube link.
- 6) **Lecture Attendance**
Lecture attendance can be used while the lecture is taking place.

3. Results

This section presents key results of the learning media developed in this research. The learning media is called SenAR learning media. Its user interface is illustrated in Figure 1.

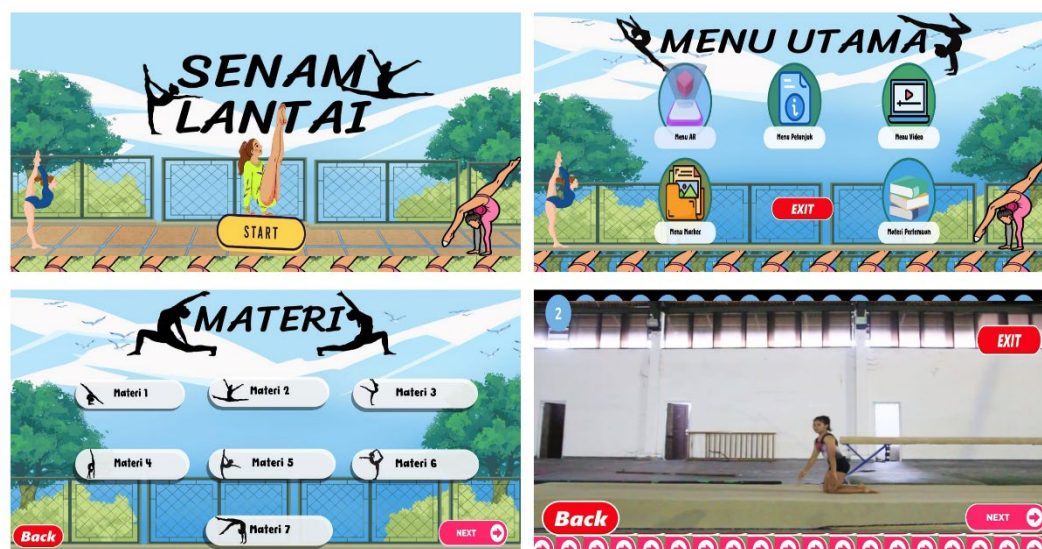


Figure 1. Augmented reality-based gymnastics learning media

Expert validity test

After developing the learning media, 3 experts were requested to give feedback in terms of the product's gymnastic content, media, and language. Their feedback examines the products' feasibility, reliability, practicality, and effectiveness. As shown in Table 1, the results indicate that all product's elements were classified as good or very good, meaning that it is eligible to be used by students in the classroom.

Table 1. Percentage and feasibility level of experts.

No	Expert	Percentage	Eligibility level
1	Gymnastic	90.58%	Very good
2	Media	80.21%	Good
3	Language	91.82%	Very good

The expert assessment results for the gymnastics content were assessed in the very good category. In addition, media experts assessed the feasibility in the good category. Meanwhile, the feasibility of the language was included in the very good category. Expert assessment criteria with percentages ranging from 0-100%.

Reliability

Table 2. Analysis of the Alpha Coefficient of Reliability Test

No	Variable	Alpha Number	Reliability
1	Gymnastics skills	0.630	Moderate reliable

Additionally, the gymnastic skills provided in the product were also moderate reliable. Based on the results of the alpha coefficient reliability test, the augmented reality-based gymnastics learning media is considered moderate reliable and consistent in data collection (Table 2).

Practicality

Table 3. Practicality Percentage Results from Expert Assessment

Practicality	Percentage	Practicality level
Gymnastics skills	90%	Very practical

Based on the results of the practicality test, Table 3 shows that the augmented reality-based gymnastics learning media had a "Very Practical" level.

Effectiveness

Table 4. Effectiveness Percentage Results from Expert Assessment

Effectiveness	Percentage	Effectiveness level
Gymnastics skills	90%	Very effective

Finally, the experts examine the product's effectiveness. The research found that the augmented reality-based gymnastics learning media had a "Very Effective" level.

4. Discussion

This study aims to develop augmented reality-based gymnastics learning media by involving 3 competent experts in gymnastics, media, and language. Once the product has been developed, the study requested the experts to examine its validity by measuring its level of feasibility, reliability, practicality, and effectiveness. In terms of feasibility, in general, the product was classified as good or very good. In particular, the gymnastic content was rated in the very good category. Additionally, the media experts rated the feasibility in the good category. Meanwhile, the feasibility

of the language fell into the very good category. Validity in research is something that shows the truth or accuracy of a product [14]. Products with a good level of validity will help their acceptance in the wider community [15]. In terms of reliability, the results revealed that the alpha coefficient has a moderate reliable correlation. This finding indicates that the augmented reality-based gymnastics learning media is moderate reliable and consistent in data collection. Meanwhile, the results of the practicality test showed a very practical level, and the results of the effectiveness test showed a very effective level.

Research on augmented reality has received wide attention among educational scholars. It is an interactive technology that allows the placement of virtual elements into the real world with the help of certain devices so that both elements—virtual and real—can appear simultaneously at one time and place [16]. AR is widely used, solves many technical problems, and has many applications in teaching. For example, a study introduces a new structural analysis pedagogy that combines mobile AR and interactive 3D visualization techniques [17]. In addition, other scholars reported that AR aims to study reality projects to promote the design, production, and evaluation of augmented reality for university education (Cabero-Almenara, Vázquez-Cano, and López-Meneses, 2018). For students, AR can help integrate complex and abstract knowledge—which is difficult to understand due to its time and space scale—into the real environment through virtual displays [16]. In this way, a connection is created between virtual information and the real world. Additionally, AR allows students to experience and observe difficult concepts in various learning contexts, thus greatly supporting their learning process. Moreover, this technology has been used in several sports. For example, a study reported that 78% of students strongly support the application of AR for volleyball learning [19]. A more recent study also reported that AR-based basketball free-throw training improved free-throw shooting performance [20].

To our knowledge, there has been no research on the development of gymnastics learning media using AR. Our research findings report that AR-based gymnastics learning media is effective for gymnastics skills. However, it is necessary to admit that this research is still limited, especially in terms of the small number of research subjects. In addition, the results of the reliability test showed moderate reliable results. Future research should address this limitation by conducting higher-quality research by involving larger samples and better video forms.

5. Conclusions

This AR-based gymnastics learning media is valid, practical, effective, and moderate reliable as a medium for improving gymnastics skills. This AR-based gymnastics learning media is very useful for teachers, lecturers, and sports practitioners so that it can help in the gymnastics learning process.

Author Contributions: For research articles with several authors, a short paragraph specifying their individual contributions must be provided. The following statements should be used “Conceptualization, S.H.G. and A.K.; methodology, A.K.; software, N.A. and D.T.M.; validation, A.K. and S.G.H.; formal analysis, S.G.H.; investigation, S.G.H.; resources, S.G.H.; data curation, S.G.H.; writing—original draft preparation, A.K.; writing—review and editing, A.K. and N.A.; visualization, J.L.; supervision, S.G.H.; project administration, S.G.H.; funding acquisition, S.G.H.. All authors have read and agreed to the published version of the manuscript.” Please turn to the [CRediT taxonomy](#) for the term explanation. Authorship must be limited to those who have contributed substantially to the work reported.

Conflicts of Interest: The authors declare no conflict of interest.

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