Virtual Reality-Based Basic Movement Learning to Improve the Effectiveness of Physical Education Learning

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Abstract. Fundamental movement skills are essential for students' motor development; however, conventional physical education instruction often lacks effective demonstrations, individualized feedback, and engaging learning environments. This study aimed to examine the effectiveness of Virtual Reality (VR)–based fundamental movement learning in improving students' learning outcomes. An experimental research design was employed to compare VR-based instruction with conventional teaching methods among elementary school students. Data were collected through performance assessments and questionnaires measuring learning effectiveness and student engagement. The results indicate that VR-based learning significantly improves students' fundamental movement skills, conceptual understanding, and motivation, with an effectiveness score reaching 85%, categorized as "very suitable." The immersive and interactive features of VR enable clearer visualization of movement and support meaningful motor learning experiences. Furthermore, students demonstrated increased enthusiasm and participation during the learning process. These findings suggest that the integration of VR in physical education enhances both instructional effectiveness and learner engagement. Despite requiring adequate technological infrastructure and teacher readiness, VR-based learning has strong potential as an innovative approach to improve the quality of physical education in schools.

Keywords: *Basic Movement, Virtual Reality, Physical Education*

1 Introduction

Physical Education (PE) is an essential component of school education that contributes to the development of students' motor skills, physical fitness, and overall growth across cognitive, affective, and psychomotor domains. Central to effective PE instruction is the acquisition of Fundamental Movement Skills (FMS), which include locomotor, non-locomotor, and manipulative movements. These skills serve as the basis for more advanced motor performance and support sustained participation in physical activity throughout life. Despite their importance, the teaching of fundamental movements in school-based PE continues to encounter various instructional challenges. [1-3]

In many schools, PE learning is constrained by inadequate facilities, large class enrollments, diverse levels of motor ability among students, and instructional approaches that remain

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predominantly teacher-centered [4-7]. These conditions often limit opportunities for accurate movement demonstrations, individualized feedback, and sufficient practice time. Consequently, students may struggle to understand movement principles, repeatedly perform incorrect techniques, and show low levels of motivation and engagement during lessons, which ultimately reduces the effectiveness of fundamental movement learning. [8-10].

The rapid development of digital technologies, particularly Virtual Reality (VR), presents new possibilities for addressing these instructional limitations. VR technology allows learners to engage in immersive environments that combine three-dimensional visualization, interactive simulations, and multisensory feedback. Within PE contexts, VR can facilitate precise movement modeling, offer safe and repeatable practice opportunities, and promote higher levels of learner engagement through immersive experiences. [11-13].

Although VR has been extensively utilized in fields such as medical training, engineering education, and high-performance sports, its application in school-based physical education especially for teaching fundamental movement skills remains relatively limited [14-15]. Existing research has largely focused on technical feasibility or motivational outcomes, with fewer studies examining VR as a pedagogically structured approach to fundamental movement instruction or empirically evaluating its impact on learning effectiveness. [16-17].

Furthermore, prior studies on VR in physical education reveal several important gaps. First, much of the existing research concentrates on sport-specific skills, rehabilitation, or elite athlete training, leaving the systematic development of fundamental movement skills at the school level underexplored. Second, many studies emphasize technological innovation or user acceptance without integrating VR into coherent instructional models aligned with PE pedagogy [18-19]. As a result, evidence regarding how VR supports key instructional processes such as demonstration, practice, feedback, and reflection remains limited. Third, evaluations of VR-based instruction often rely on single outcome measures, primarily motivation or enjoyment, rather than comprehensive assessments of motor learning outcomes and instructional effectiveness.

Therefore, there is a clear need for research that develops and empirically evaluates a pedagogically grounded VR-based fundamental movement learning model capable of enhancing both motor skill acquisition and overall instructional effectiveness in school physical education settings.

2 Methods

This research method uses the method *Research and Development* model Borg and Gall, [20-21] which consists of 10 steps, namely; a) research and data collection b) planning c) development draft product, d) field trials, e) product refinement initial, f) field trials, g) perfecting the product resulting from field trials, h) implementation trials field, i) final product refinement, and j) dissemination and implementation. The population in this study were elementary school students with basic movement material. The research subjects in the small group study consisted of 20 students of Al Ulum Elementary School and the large group trial consisted of 40 students of Gajah Mada Elementary School, Medan.

2.1 Research Instruments and Data Collection Techniques

The instrument used In this study, a research questionnaire was distributed to learning media experts. The questionnaire aimed to obtain data on the feasibility of the media in numerical form as a basis for product revisions. The instruments used were as follows.

Table 1. Research Instruments

Aspect	No	Indicator	Rating					Comment
			1	2	3	4	5	
Appearance	**1**	Basic movement learning application based on *Virtual Reality* to improve the effectiveness of physical education learning						
	2	Application *VR* which is easy to use.						
	3	Application *VR* which is safe and environmentally friendly when operated.						
	4	Application *VR* which is used does not confuse students and teachers when using the Application *VR*						
Effectiveness	**5**	Application Usage *VR* only requires one operator						
	6	Application *VR* The method used is in accordance with the definition of basic movement learning in elementary schools.						
	7	Application *VR* which can be used to measure teaching basic movement learning in elementary schools						
	8	Application *VR* portable and can be taken anywhere						
Efficiency	**9**	Application *VR* The development does not change the learning of basic movements in elementary schools.						
	10	The application of basic movement learning in elementary schools makes it easier for teachers to teach physical education.						

The data for this research was collected through data descriptive Qualitative and quantitative. Qualitative data consists of written interviews, input, suggestions, and responses from validators, experts, practitioners, observers, and subjects. Quantitative data is obtained from assessment scores given by validators, practitioners, observers, and subjects through validation activities and field trials. The data obtained is described in detail to determine the level of validity, practicality, and effectiveness. basic movement based learning *Virtual Reality* to improve the effectiveness of physical education learning.

2.2 Technique Analysis Data

Data analysis aims to organize data in a meaningful way so that it can be understood. In research on the development of basic movement-based learning *Virtual Reality* to increase the effectiveness of physical education learning, techniques analysis The data is used with quantitative analysis techniques with percentages. This technique is used to obtain quantitative data analysis obtained from distributing questionnaires to respondents. Sample trial. Data processing formula from questionnaire distribution with per subject the trial is as follows:

$$P = \frac{X}{X_1} X\ 100\%$$

Information:

P = Percentage of evaluation results/subject trials
X = Total score answers by subject trials
Xi = Maximum number of answers in the assessment aspect by subject test try
100% = Constant.

3 Results and Discussion

The Phase I trial was conducted on 20 elementary school students. The aim of the Phase I trial was to provide input and assessment of the trial results on the sample to see the benefits of basic movement-based learning. *Virtual Reality* to improve the effectiveness of the physical education learning that researchers developed. The results of the Phase I trial, conducted through the distribution of questionnaires, were used to determine the effectiveness of the developed product.

Table 2. Results of Small Group Trials

Respondent	Amount	P (%)
1	15	75.00
2	15	75.00
3	14	70.00
4	15	75.00
5	12	60.00
6	18	90.00
7	14	70.00
8	13	65.00
9	15	75.00
10	14	70.00

Respondent	Amount	P (%)
11	13	65.00
12	17	85.00
13	15	75.00
14	13	65.00
15	15	75.00
16	15	75.00
17	17	85.00
18	13	65.00
19	15	75.00
20	14	70.00
Amount	**292**	**75**

Based on the table above, to find out how effective the level of basic movement learning is based on. Virtual Reality *to* improve the effectiveness of physical education learning in a small group product trial measured by a questionnaire containing 20 questions about basic movement-based learning instruments *Virtual Reality* to improve the effectiveness of physical education learning. Calculation of the total score of the questionnaire items using the following formula:

From the values obtained, it is known that the empirical score obtained was 75% (Quite Valid or Effective), so it can be stated that the basic movement learning product is based on. Virtual Reality *to* improve the effectiveness of physical education learning effective in measuring basic motor skills.

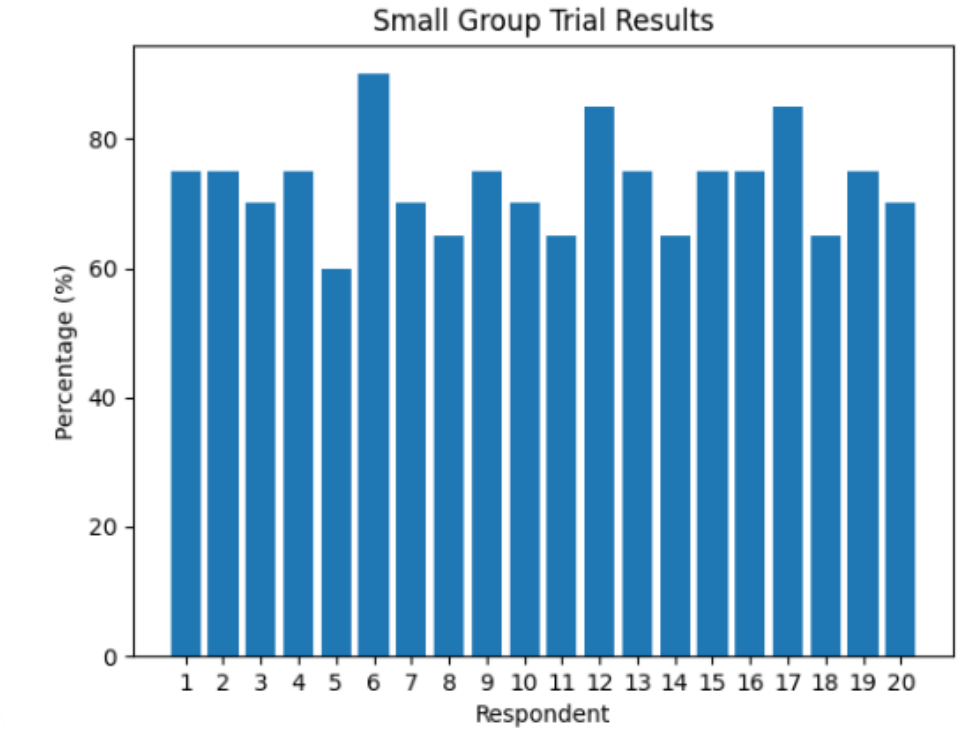

Figure 1. Small Group Trial Results

3.1. Large Group Product Trial

Phase II trials were conducted on 40studentsGajah Mada Elementary School Medan, An-Nizar Islamic Elementary School, the aim of conducting the Phase II trial is to provide input and assessment of the trial results on samples to see the benefits of basic movement-based learning .*Virtual Reality* to improve the effectiveness of physical education learning The results of the Phase II trial, conducted through questionnaire distribution to determine the effectiveness of the product developed, can be seen in Table 3 below.

Table 3. Percentage (%) of Large Group Trials

Respondent	Amount	P(%)
1	17	85.00
2	18	90.00
3	19	95.00
4	15	75.00
5	16	80.00
6	17	85.00
7	18	90.00
8	19	95.00
9	15	75.00
10	16	80.00
11	17	85.00
12	18	90.00

Respondent	Amount	P(%)
13	14	70.00
14	18	90.00
15	19	95.00
16	15	75.00
17	16	80.00
18	17	85.00
19	18	90.00
20	17	85.00
21	18	90.00
22	19	95.00
23	15	75.00
24	16	80.00
25	17	85.00
26	18	90.00
27	19	95.00
28	15	75.00
29	16	80.00
30	17	85.00
31	16	80.00
32	18	90.00
33	19	95.00
34	16	80.00
35	17	85.00
36	16	80.00
37	18	90.00
38	19	95.00
39	17	85.00
40	18	90.00
Amount	**684**	**85%**

Based on the table above, to find out how effective the level of basic movement learning is based on. Virtual Reality *to* improve the effectiveness of physical education learning in a large group product trial measured by a questionnaire containing 40 questions about basic movement-based learning *Virtual Reality* to improve the effectiveness of physical education learning. Calculation of the total score of the questionnaire items using the following formula:

From the values obtained, it is known that the empirical score obtained was 85% (Very Suitable for Use), so it can be stated that the basic movement learning product is based on *Virtual Reality* Effective for elementary school students' basic movements. Student responses to large group game trials have improved, with increased enthusiasm and passion. Students are also motivated, as evidenced by the questionnaire results for the basic movement learning instrument based on the game. The graph shows a comparison of students' learning outcomes before and after the implementation of the Virtual Reality (VR)-based learning product, indicating an increase in effectiveness to 85% (very suitable category) and improved student engagement and motivation.

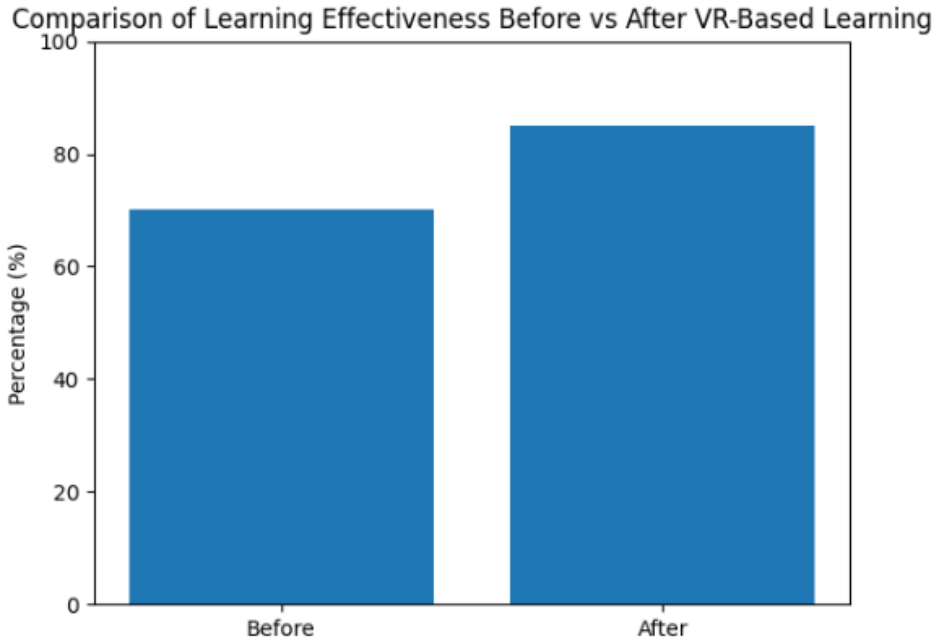

Figure 2. Comparison of Learning Effectiveness Before vs After VR-Based Learnin

Virtual Reality *to* increase the effectiveness of physical education learning that the average basic movement learning is based on Virtual Reality *to* improve the effectiveness of physical education learning provides a good impact on basic movement learning abilities.

Basic Motion VR Application Products

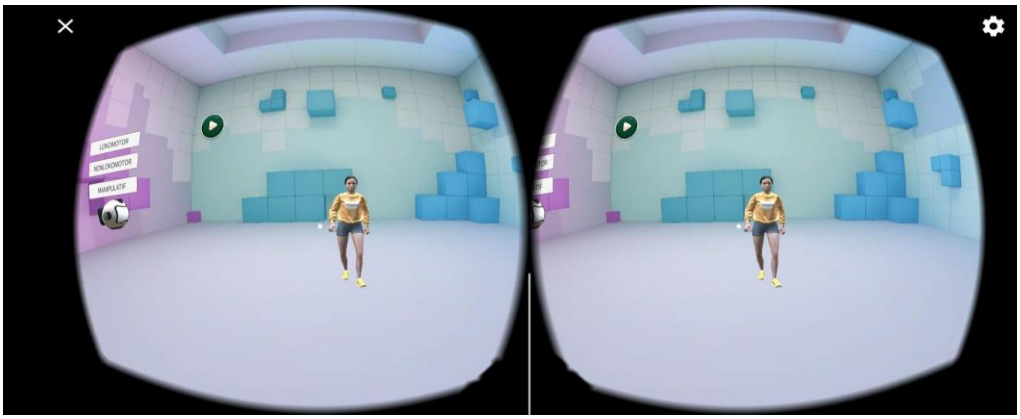

Figure 3. Basic Motion VR Research Products

Advances in digital technology have influenced the implementation of Physical Education, Sports, and Health (PJOK) learning, particularly through the introduction of Virtual Reality (VR). VR technology allows students to experience realistic three-dimensional simulations, offering new possibilities for teaching and learning in physical education.

The use of VR helps students better understand movement techniques by presenting clear and detailed visual demonstrations. Students can observe movements from various angles and practice repeatedly, which is especially useful for learning complex skills. VR also increases learning motivation, as interactive and immersive experiences make physical education lessons more engaging and enjoyable.

In addition, VR provides a safe learning environment where students can practice movements without the risk of injury. This encourages active participation and confidence in learning new skills. VR supports individualized learning, as students can adjust practice intensity according to their abilities, and it offers a practical solution for schools with limited sports facilities. The integration of VR also enhances students' familiarity with modern technology.

The results of this study show that VR-based fundamental movement learning is more effective than conventional teaching methods. VR improves students' motor skills, conceptual understanding, and engagement during lessons. These findings suggest that VR can be applied as an innovative and effective instructional approach to improve the quality of fundamental movement learning in school physical education.

4 Conclusion

This study concludes that Virtual Reality–based fundamental movement learning effectively enhances physical education instruction. VR supports students' movement skill acquisition, conceptual understanding, and engagement by providing accurate visualization and interactive learning experiences. When integrated with appropriate pedagogical design, VR offers a learner-centered alternative to conventional methods. Despite requiring adequate infrastructure and teacher readiness, VR demonstrates strong potential to improve instructional effectiveness in school-based physical education. Future studies should explore its long-term impact across diverse educational settings.

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