The Effectiveness of Instructional Media for Physical Fitness Activities through Interactive Multimedia-Based Games

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Abstract. This study aims to determine the effectiveness of instructional media for physical fitness activities through interactive multimedia-based games. This research employed a quantitative approach with a pre-experimental design. The sample consisted of 30 students who received treatment in the form of instruction using game-based interactive multimedia. The instrument used was a learning outcomes test administered before (pretest) and after (posttest) the intervention. Data were analyzed using a paired sample t-test to examine significant differences between pretest and posttest results. The analysis revealed that the average pretest score of 62.16 increased to 88.09 in the posttest, with a difference of 25.93 points. The t-test results showed that the calculated t-value of 18.27 was greater than the critical t-value of 2.045, with a significance value of 0.000 ($p < 0.05$). Therefore, it can be concluded that instructional media for physical fitness activities delivered through interactive multimedia-based games is effective in improving students' learning outcomes.

Keywords: Effectiveness; Interactive Multimedia; Physical Fitness; Games.

1 Introduction

Physical education is an essential component of the national education system, playing a strategic role in developing students' physical fitness, motor abilities, as well as character and social values. It can be understood as a learning process conducted through physical activities aimed at promoting the holistic development of physical, mental, and social aspects [1]. Physical education contributes significantly to overall individual development, encompassing not only physical aspects but also cognitive, emotional, social, and moral domains [2]. This goal aligns with the mandate of Law No. 20 of 2003 concerning the National Education System, which emphasizes that education must optimize the potential of learners, including their physical well-being [3].

ICIESC 2025, September 16, Medan, Indonesia
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DOI 10.4108/eai.16-9-2025.2361043

In practice, one of the core topics in physical education is physical fitness activities. This term refers to an individual's ability to perform daily physical tasks efficiently without undue fatigue, while still having sufficient energy for additional activities [4]. Physical fitness is defined as the capacity to carry out daily tasks with vigor and alertness, without excessive fatigue, and with ample energy to enjoy leisure-time pursuits and respond to emergencies [5]. Developing this capacity in schools is essential, as it directly contributes to students' health and readiness to engage in academic and social activities. However, teaching physical fitness activities in schools still faces several challenges. Observations at SMP Negeri 35 Medan revealed that physical education is often delivered using conventional methods, with teachers relying heavily on lectures and lacking the support of adequate media or instructional aids. While some visual media such as images and videos are utilized, they have yet to foster an engaging and interactive learning environment. Consequently, students remain passive recipients of information, with limited participation, leading to a monotonous and less stimulating learning process.

A needs analysis involving 20 students from the school found that most of them had never used interactive multimedia-based instructional media in learning physical fitness. Many reported not fully understanding the benefits of physical fitness activities, feeling unmotivated during lessons, and frequently choosing not to participate in outdoor physical activities. This indicates a gap between the intended learning outcomes outlined in the curriculum and actual classroom implementation. One contributing factor to the low effectiveness of physical education instruction is the suboptimal use of learning media. Instructional media are defined as any tools used to convey educational messages and stimulate students' attention and interest to facilitate more effective [6]. Media serve as crucial components in the teaching and learning process, commonly used by teachers to enhance understanding of subject matter. The use of media can increase interest, foster motivation, and produce positive psychological effects on student engagement [7]. In today's era of technological advancement, interactive multimedia presents a strategic alternative. Interactive multimedia combines various elements text, audio, images, animations, and video allowing users to actively engage in the learning process through direct interaction [8]. It is a technology-based instructional medium that can enhance students' learning motivation and enthusiasm through its interactive visual, audio, and animated components [9].

Moreover, active student participation is a key factor in the success of physical education. When teaching approaches are monotonous and lack contextual relevance, students struggle to engage fully in physical fitness activities, hindering the achievement of learning objectives. Therefore, innovative and enjoyable instructional strategies that cater to the characteristics of today's learners are necessary. One potential solution proposed in this study is the development of instructional media for physical fitness activities through interactive multimedia-based games. In this context, games serve as an instructional approach designed to create dynamic, challenging, and engaging learning environments. Game-based learning refers to the integration of game elements into instructional processes to increase meaningful student engagement [10]. This approach is commonly used in physical education to develop fundamental motor skills, combining outdoor game activities with a focus not only on physical exertion but also on building student motivation and psychological readiness [11].

The media developed in this study integrates physical fitness content with interactive features through an Android-based platform, equipped with animated movement demonstrations, quizzes, visual instructions, and activity-based assessments. It is expected that the use of interactive multimedia will enhance the effectiveness of physical education by improving material comprehension, student participation, and learning outcomes. Furthermore, this media can assist teachers in delivering fitness material more efficiently and attractively, aligning with current technological trends. Thus, this study aims to examine the effectiveness of interactive multimedia-based game media for physical fitness activities as an adaptive, contextual, and relevant instructional alternative for junior high school students.

2 Method

This study employed a quantitative approach with a pre-experimental design, specifically the One-Group Pretest–Posttest Design. The experimental method is defined as testing a treatment to determine its effect or outcome [12]. In this context, the study aimed to examine the effectiveness of instructional media for physical fitness activities through interactive multimedia-based games on students' engagement in learning. The subjects of the study were 30 eighth-grade students from SMP Negeri 35 Medan, selected using purposive sampling based on their availability and willingness to participate in the intervention. The treatment involved physical fitness instruction delivered through physical games conducted on the school field, guided by interactive multimedia-based instructional media, namely the Active 4C application.

The instrument used was a student engagement observation sheet, which consisted of several aspects such as active participation, seriousness in performing activities, communication, and collaboration during gameplay. Each aspect was rated on a 4-point scale, and the scores were summed to obtain a total engagement score. Observations were conducted both before (pretest) and after (posttest) the treatment, allowing for comparative analysis. The collected data were analyzed using a paired sample t-test to determine the significance of the difference between the pretest and posttest scores. Prior to this, normality tests were conducted using both the Kolmogorov–Smirnov and Shapiro Wilk tests. Although the data did not follow a normal distribution ($p < 0.05$), parametric analysis was still applied based on the Central Limit Theorem, considering the adequate sample size ($n = 30$). The analysis process was carried out using SPSS version 26.

3 Results and Discussion

Table 1. Normality Test Results for Pretest and Posttest Data

Test of Normality						
	kolmogorov-Smirnow			Shapiro-Wilk		
	statistic	df	Sig.	Statistic	df	Sig
PRETEST	.267	30	.000	.851	30	.001
POSTTEST	.290	30	.000	.844	30	.000

Based on Table 1, the significance values of the Kolmogorov–Smirnov and Shapiro–Wilk tests for both pretest and posttest data are below 0.05, namely 0.000 and 0.001. This indicates that the data are not normally distributed from a statistical standpoint. Nevertheless, given that the sample size in

this study consists of 30 participants, statistical analysis may still proceed using a parametric approach based on the principle of the Central Limit Theorem.

Table 2. Descriptive Statistics of Pretest and Posttest Scores in Physical Fitness Activity Learning

		Paired Samples Statistics			
		Mean	N	Std Deviation	Std. Error Mean
Pair 1	PRETEST	9,93	30	,785	,143
	POSTTEST	14,13	30	1,074	,196

Based on Table 2, the average student observation score before the treatment (pretest) was 9.93, with a standard deviation of 0.785. After the treatment (posttest), the average score increased to 14.13, with a standard deviation of 1.074. This indicates an increase in the mean score by 4.20 points. These results demonstrate a significant improvement in student engagement during learning after the implementation of game-based interactive media.

Table 3. Correlation Between Pretest and Posttest Scores

Paired Samples Correlations				
		N	Correlation	Sig.
Pair 1	PRETEST & POSTTEST	30	,011	,954

Table 3 shows the correlation results between pretest and posttest scores, with a correlation value of 0.011 and a significance level (Sig.) of 0.954. Since the significance value is far above the 0.05 threshold, it can be concluded that there is no significant relationship between students' initial (pretest) and final (posttest) scores. This indicates that the changes observed in the posttest scores were not dependent on the students' initial conditions, but rather resulted from the implementation of the instructional media.

Table 4. Paired Sample t-Test Results Between Pretest and Posttest Scores

Paired Samples Test									
Paired Differences									
		Mean	Std. Deviation	Std. Error Mean	95% Confidence interval of the Difference		t	f	Sig. (2-tailed)
					Lower	Upper			
Pair 1	PRETEST & POSTTEST	30	1,324	,242	-4,694	-3,706	-17,381	29	,000

Based on Table 4, the mean difference between the pretest and posttest scores is -4.200, with a calculated t-value of -17.381 and a significance level (Sig. 2-tailed) of 0.000. Since the significance value is less than 0.05, it can be concluded that there is a statistically significant difference between the pretest and posttest results. Therefore, the use of interactive multimedia-

based game media for physical fitness learning has been proven effective in increasing students' engagement and participation in the learning process.

Instructional media play a vital role in supporting the success of the educational process, as they serve not only as tools for delivering information but also as means to foster interaction between educators and learners. In the context of physical education, the media used must be designed to directly support physical activity while facilitating an engaging and enjoyable understanding of concepts [13]. However, teaching practices that are still dominated by conventional, lecture-based approaches often fail to encourage active student participation, especially in physical fitness lessons that require direct physical engagement. The use of interactive multimedia-based instructional media presents a relevant alternative, particularly aligned with the characteristics of today's learners. Well-designed media can also enhance student focus and participation in learning [14]. Interactive multimedia fosters a more communicative and stimulating learning atmosphere by combining visual, audio, and animated elements that help students fully grasp the subject matter [15].

This study utilized the Active4C application as an interactive medium for teaching physical fitness. The application includes instructional videos, animated movements, and features three physical games: Dodgeball Games, Tic Tac Toe Game, and Obstacle Course Relay Games. These games not only target components of physical fitness such as strength, agility, and endurance but also create a dynamic, competitive, and enjoyable learning environment [16]. The game-based learning model implemented in this study has proven effective in enhancing student engagement. Game-based approaches have been shown to improve students' motivation and learning outcomes in physical education [17]. Moreover, this model offers students the opportunity to learn through direct experience rather than merely memorizing concepts [18].

During the learning process, students exhibited positive behavioral changes. They became more active, enthusiastic, and demonstrated initiative in following instructions and understanding the benefits of physical fitness activities. This aligns with [19] assertion that student engagement can be improved through instructional media tailored to their needs and characteristics. Interactive multimedia such as Active4C also offers accessibility and flexibility in the learning process. Content can be displayed via projectors or mobile devices, enabling students to view movement demonstrations and instructions prior to practicing them physically. This strengthens students' understanding of the concepts taught and helps bridge the gap between theory and practice [20]. Furthermore, this media encourages teachers to move beyond the role of content deliverers and become facilitators capable of creating active and innovative learning environments. The integration of technology in education promotes teacher adaptability and creativity in developing teaching strategies relevant to current advancements [21]. Game-based digital media in physical education not only strengthens cognitive development but also supports character-building through teamwork, discipline, and competitive spirit. Therefore, this approach represents a learning model suited to the demands of 21st-century education, even though this study does not explicitly focus on the 4C skills dimension.

4 Conclusion

Based on the results of the study, the use of instructional media for physical fitness activities through interactive multimedia-based games has been proven to have a positive impact on student engagement and understanding during the learning process. The Active4C application—featuring Dodgeball, Tic Tac Toe, and Obstacle Course Relay games—successfully created a more enjoyable and active learning environment. Students were more motivated, enthusiastic, and able to follow instructions and comprehend the material more effectively. This approach also supported teachers in delivering physical fitness content in a more engaging and contextualized manner, making the learning process less monotonous and more interactive. Therefore, the use of interactive multimedia-based game media for teaching physical fitness activities has been proven effective and can be widely applied as a teaching strategy to enhance the quality of physical fitness education in schools.

References

[1] Vania Aurellia Azzahra, Dinda Ayu Lestari, Syahwa Ananda Aulia, Maulida Aldora Fahira & Burhan Hambali. (2024). Jenis Jenis Aktivitas Dalam Pendidikan Jasmani. *Jurnal Ilmiah SPIRIT*, 24(2), 56-65. https://doi.org/10.36728/jis.v24i2.3581

[2] Muh. Aswar, Aura Farrel, Senja Ariya Putra, Carsiwan. (2024). Pendekatan Filosofis Dan Ilmiah Dalam Memahami Manusia Dan Pengetahuan: Implikasinya Terhadap Pendidikan Jasmani Holistik. *Gelanggang Olahraga: Jurnal Pendidikan Jasmani dan Olahraga*, 8(1), 132-144.https://doi.org/10.31539/jpjo.v8i1.10607

[3] Angel Ria Astuti Damanik & Ahmad Riady Hasibuan. (2024). Peran Pendidikan Jasmani Dan Kesehatan Dalam Pendidikan Nasional Di Sekolah Dasar. *Ameera Jurnal Pendidikan Sains dan Matematika*, 1(1), 25-30. https://journal.ptibm.co.id/index.php/ameera/article/view/24

[4] Lailatur Rohmah & Heryanto Nur Muhammad. (2021). Tingkat Kebugaran Jasmani Dan Aktivitas Fisik Siswa Sekolah. *Jurnal Pendidikan Olahraga dan Kesehatan*, 9(1), 511-519. https://ejournal.unesa.ac.id/index.php/jurnal-pendidikan-jasmani

[5] Cristian Ştefan LIUŞNEA. (2019). Fitness or Optimal Physical Condition ConceptualDelimitation. *Lumen Proceedings, 4th International Scientific Conference SEC-IASR 2019, 12,* 169-181.https://doi.org/10.18662/lumproc/sec-iasr2019/19

[6] Amelia Putri Wulandari, Annisa Anastasia Salsabila, Karina Cahyani, Tsani Shofiah Nurazizah & Zakiah Ulfiah. (2023). Pentingnya Media Pembelajaran dalam Proses Belajar Mengajar. *Journal on Education*, 5(2), 3928-3936. 10.31004/joe.v5i2.1074

[7] Isnaini Naffi'an, Arri Handayani & Dini Rakhmawati. (2024). Pentingnya Media Pembelajaran Untuk Meningkatkan Minat Belajar Siswa. *Jurnal Studi Multidisipliner*, 8(6), 987-992

[8] Arini Putri Fitriya, Noviana Dini Rahmawati, Kalimatus Saadah & Joko Siswanto. (2024). Pemanfaatan Multimedia Interaktif Sebagai Inovasi Media Pembelajaran Berbasis Teknologi Pada Pembelajaran Pendidikan Pancasila Kelas IV Sekolah Dasar. *Nusra: Jurnal Penelitian Dan Ilmu Pendidikan*, *5*(3), 1512-1522. https://doi.org/10.55681/nusra.v5i3.3232

[9] Eka Wulandari, Intan Annidya Putri & Yoni Napizah. (2022). Multimedia Interaktif Sebagai Alternatif Media Pembelajaran Berbasis Teknologi. *Jurnal Tonggak Pendidikan Dasar: Jurnal Kajian Teoridan Hasil Pendidikan Dasar*, 1(2), 109-115. https://doi.org/10.22437/jtpd.v1i2.22834

[10] Y. Maliani, I.N. Suastika & N. Dantes. (2025). Pengaruh Model Pembelajaran Berbasis Permainan Berbantuan Quizizz Terhadap Motivasi Belajar Dan Prestasi Belajar Pendidikan Pancasila Siswa Sekolah Dasar. *Jurnal Penelitian dan Evaluasi Pendidikan Indonesia*, 15(1), 50-61.

[11] Adi Prastyo Kurniawan & Sasminta Christina Yuli Hartati. (2016). Penerapan Model Pembelajaran Dengan Pendekatan Bermain Terhadap Peningkatan Keterampilan Gerak Dasar Dalam Pembelajaran Pendidikan Jasmani, Olahraga Dan Kesehatan (Studi Pada Siswa Putra Kelas Vii SMP Negeri 1 Balongpanggang Gresik). *Jurnal Pendidikan Olahraga dan Kesehatan*, 4(1), 148-156.

[12] Leni Apriani, Merlina Sari & Joni Alpen. (2021). Studi Eksperimen Pada Unit Kegiatan Mahasiswa Petanque Universitas Islam Riau: Meningkatkan Kesegaran Jasmani Melalui Permainan Hadang dan Bentengan. *Jurnal MensSana: Jurnal ilmiah Bidang Pendidikan Olahraga*, 6(1), 50-55. https://doi.org/10.24036/MensSana.06012021.19

[13] Ella H Tumaloto, Al Ilham, Oddie Bernanda Rizki & Suriyadi Datau. (2024). Edukasi Penggunaan Media Pembelajaran Pendidikan Jasmani Berbasis Augmented Reality. *Lamahu: Jurnal Pengabdian Masyarakat Terintegrasi*, 3(2), 128-134.

[14] Burhayani, Siti Nuridah, Andi Muh Akbar Saputra, Suyuti, Yenny Anggreini Sarumaha & Anyan. (2023). Penerapan Media Pembelajaran Berbasis Video Untuk Meningkatkan Konsentrasi Belajar Peserta Didik. *Jurnal Review Pendidikan dan Pengajaran*, 6(2), 166-172.https://journal.universitaspahlawan.ac.id/index.php/jrpp

[15] Munawir, Ainur Rofiqoh & Ismi Khairani. (2024). Peran Media Interaktif Dalam Meningkatkan Motivasi Belajar Siswa pada Mata Pelajaran SKI di Madrasah Ibtidaiyah. *Jurnal Al Azhar Indonesia Seri Humaniora*, 9(1), 63-71. http://dx.doi.org/10.36722/sh.v9i1.2828

[16] Okta Setiawan, Sapto Wibowo & Anang Thohari. (2024). Peningkatan Minat Belajar Melalui Motode Kompetitif Pada Materi Bola Basket Di SD Negeri Lidah Kulon 1 Kota Surabaya. *JIIC: Jurnal Intelek Insan Cendikia*, 1(7), 2471-2478.https://jicnusantara.com/index.php/jiic

[17] Muhamad Fikri Multazam Setiawan, Carsiwan, Muhammad Dzikry Abdullah Al Ghazaly & Resty Sriayu Rahmadayanti. (2025). Pendekatan Bermain dalam Pembelajaran Pendidikan Jasmani untuk Meningkatkan Motivasi dan Hasil Belajar Siswa. *Jurnal Pendidikan Olahraga*, 15(2), 81-91. 10.37630/jpo.v15i2.2616

[18] Gusti Idris. (2018). Penerapan Model Pembelajaran Experiential Learning Untuk Meningkatkan Prestasi Belajar Materi Ungkapan Pemaparan Jati Diri Di SMA. *Jurnal Pembelajaran Prospektif*, 3(2), 134-148. https://doi.org/10.26418/jpp.v3i2.37812

[19] Sapriyah. (2019). Media Pembelajaran Dalam Proses Belajar Mengajar. *Prosiding Seminar Nasional Pendidikan FKIP*, 2(1), 470-477.

[20] Salsabila As Sa'adah, Nur Wakhidah, Wahyuni Fajar Arum, Sri Hidayati & Tatik Indayati. (2025). Analisis Tingkat Pemahaman Konsep Siswa Pada Pembelajaran IPA. Edu-Sains, 14(1), 7 15. 10.22437/jmpmipa.v14i1.39419

[21] Rakha Aditya Putra, Wildan Satio Siregar & Gusmaneli Gusmaneli. (2024). Model Pembelajaran Adaptif: Untuk Meningkatkan Efektifitas Pembelajaran di Era Digital. Jurnal Inspirasi Pendidikan (ALFIHRIS), 2(3), 1-9. https://doi.org/10.59246/alfihris.v2i3.832