Enhancing refereeing skills: exploring the influence of an Android table tennis app on student referees

Explorando el impacto de una aplicación de tenis de mesa para Android en los árbitros estudiantiles

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Abstract

Objective: The role of referees in table tennis is crucial for ensuring fair play and proper game management. Traditional training methods for referees face challenges in keeping up with the increasing pace and complexity of modern table tennis matches.
Objective to evaluate the impact of the Android Table Tennis Application (ATTA) on enhancing referee competence.
Methodology: The study employed a quasi-experimental design with 30 student participants divided into experimental and control groups. The experimental group used ATTA for training while the control group received traditional instruction. Both groups were assessed through pre-tests and post-tests to measure their understanding of officiating principles and practical refereeing skills.
Results: The experimental group showed significant improvement, with mean learning outcomes increasing from 73.9 to 90.0 (16-point increase). The control group's scores improved from 74.0 to 83.0 (9-point increase). Statistical analysis using paired sample t-tests showed a p-value <0.001, indicating significant differences between pre- and post-test results.
Discussion: The ATTA facilitates a deeper understanding of table tennis principles and standards while enhancing adjudicative skills in a simulated environment.
Conclusions: The Android Table Tennis Application proved to be an effective tool for enhancing referee training outcomes. The interactive and comprehensive nature of ATTA, combined with its accessibility and convenience, resulted in better learning outcomes compared to traditional teaching methods. The findings suggest that educational institutions should consider implementing ATTA to improve table tennis officiating education.

Keywords

Table tennis refereeing; android table tennis app; mobile educational applications; referee competency development; table tennis rules.

Resumen

Introducción: Los árbitros son cruciales para la equidad en el tenis de mesa, pero los métodos de entrenamiento tradicionales enfrentan desafíos debido a la naturaleza evolutiva del deporte.
Objetivo: Esta investigación investiga la eficacia de la aplicación Android Table Tennis (ATTA) para mejorar las competencias de los árbitros.
Metodología: Se empleó un diseño cuasiexperimental con 30 estudiantes divididos en grupos experimentales y de control; los primeros utilizaron la ATTA y los segundos recibieron una formación estándar, y las evaluaciones se realizaron antes y después de la intervención.
Resultados: El grupo experimental mostró un aumento significativo del aprendizaje, pasando de 73,9 a 90,0, mientras que el grupo control mejoró de 74,0 a 83,0; el análisis estadístico indicó un valor p inferior a 0,001, lo que confirma la existencia de diferencias significativas antes y después de la prueba.
Discusión: La ATTA fomenta la comprensión de los principios del tenis de mesa y mejora las habilidades de arbitraje dentro de un contexto estructurado.
Conclusiones: La aplicación para Android elevó notablemente la eficacia del entrenamiento de árbitros, ya que su formato interactivo arroja mejores resultados educativos que los métodos tradicionales, lo que sugiere su adopción por parte de las organizaciones educativas para la enseñanza de árbitros.

Palabras clave

Arbitraje de tenis de mesa; aplicación android de tenis de mesa; aplicaciones educativas móviles; desarrollo de competencias de árbitros; reglas de tenis de mesa.

Introduction

The referee is an individual entrusted with the responsibility of supervising the match to detect infractions, tally scores, and ascertain the victor in adherence to the established regulations. Within sports like table tennis, a proficient referee plays a crucial role in guaranteeing equitable and pleasant gameplay for all involved participants (Guo, 2023). As posited by (Dodt et al., 2023) referees operating at the elite echelon encounter heightened demands in their decision-making processes attributable to the elevated pace and intricacies of the sporting event. The proficiency of referees plays a pivotal role in upholding the integrity of the sport and fostering equitable gameplay within table tennis tournaments (Moshayedi et al., 2019). In recent times, there have been technological advancements that offer novel prospects for improving the training of referees and their decision-making processes. With the escalation in both the pace and intricacy of table tennis, conventional training approaches may no longer suffice in adequately equipping referees for the challenges posed by the contemporary game (Solomon et al., 2011) A skilled referee should exhibit a deep comprehension of the rules and demonstrate the capacity to promptly and accurately deliver decisions in high-pressure scenarios. To meet this obligation, people must possess a wide array of abilities, like being able to effectively grasp various elements of ping pong, including its historical context, basic techniques, strategic gameplay, training methods, and rules for officiating (Schwager & Stylianou, 2012). Mastering the aforementioned materials proves to be a challenging endeavor. Numerous variables come into play, such as the structure and methodology of material delivery, multimedia resources, educational amenities and infrastructure, instructional frameworks, curriculum design, student engagement, and various other elements (Guo, 2023; Ibieta et al., 2017; Shoraevna et al., 2021). However, pupils may fall short of reaching a positive result if these components do not align with their necessities and the implementation tactic (Soliman, 2017; Kou, 2022; Surina & Surin, 2020). The factors mentioned above have been extensively crafted with great care, especially within the realm of acquiring basic skills through various mediums (Siregar & Hasibuan, 2023).

In the current technological period, teachers employ a variety of techniques to distribute educational material, including traditional printed materials, digital resources, multimedia presentations like videos and PPTs, educational apps, and other options (Saraswati et al., 2020; Lian & Xiu-zhen, 2011; Simatupang et al., 2020). With the rising ubiquity of mobile devices, educational applications have garnered heightened popularity as a means of disseminating content and fostering skill enhancement. Nevertheless, educators are required to adapt their instructional methodologies to cater to the distinct traits exhibited by their students (Gupta & Koo, 2010; Tlili et al., 2015). For instance, a professor might opt to utilize electronic texts and multimedia to accommodate the visual learning inclinations of their students, alongside integrating interactive tools to captivate kinesthetic learners (Amaniampong & Hartmann, 2023; Sepulveda et al., 2024). Through customizing their instructional resources to align with diverse learning styles, the professor can amplify the holistic educational encounter and guarantee that every student can proficiently comprehend the essential principles. Our research endeavors to investigate the viability of a mobile application tailored for table tennis referees in improving the education and competence development of student referees. A feasible approach to enriching referee training involves the utilization of mobile technology, like a table tennis application based on the Android platform. As reported, utilizing mobile technology for learning offers numerous advantages, such as convenient accessibility, alignment with academic material, and facilitation of eco-friendly learning practices (Guo & Shihan, 2011; Wang, 2021).

The Android Table Tennis App (ATTA) has been developed with the specific purpose of serving as a platform for showcasing a sophisticated model. This model facilitates students in effectively acquiring knowledge through the Android platform, providing flexibility in terms of time and location for learning. The creation of an ATTA is aimed at enhancing players' comprehension of the game's regulations and fostering the improvement of their abilities (Ashari et al., 2020; Irawan et al., 2020; Swadesi & Kanca, 2020). The application is intended to function as a medium for disseminating the created media content. The creation of said application will necessitate the involvement of information technology specialists whose expertise is pertinent. The application under investigation will be a Android Package Kit (APK) centered platform that is compatible for installation on Android mobile devices (Handayani, 2020). The advantages of this application encompass its comprehensive features, boundless resources, no cost, uninterrupted usability, and extensive customization capabilities, specifically tailored for student mobile devices with varying capacities. The study delineates five crucial characteristics of ATTA: its seamless

incorporation within the application, its lucid language and writing style, its availability, and its utilization of high-quality recording devices. Due to its minimal storage demands, this application is compatible with a broad array of Android gadgets. ATTA can be accessed at all times and from any place. The aspiration of students to acquire knowledge through this application can be satisfied at any given time and location in this scenario.

Referees' expertise and skills can be further developed via the implementation of Advanced Table Tennis Applications (ATTA) in various manners. Initially, this tool can deliver in-depth guidance on the protocols and standards of table tennis, encompassing the scoring mechanism, forbidden behaviors, and protocols for managing conflicts (Sismahendra et al., 2020). This information is crucial for referees in order to ensure uniform and equitable decision-making throughout matches. Moreover, the software can integrate interactive assessments and simulations to evaluate referees' comprehension of the regulations and their capacity to implement them in live situations (Suharta et al., 2021). Referees can enhance their decision-making abilities and bolster their confidence in overseeing matches through this method. Moreover, the software might contain video documentation of professional games, giving referees the opportunity to examine the decisions made by seasoned officials and extract valuable insights from their methods (Putri et al., 2023). Additionally, the ATTA offers referees the chance to improve their skills through engagement in simulated matches, empowering them to use their judgment and receive timely assessments of their competency (Guo & Shihan, 2011). This can help individuals in identifying areas that require improvement and sharpening their skills within a low-risk environment.

The research aims to evaluate the impact of the Android Table Tennis Application (ATTA) on enhancing referee competence among students in a physical education program. Recognizing the challenges in traditional referee training methods, the study seeks to investigate how a mobile educational application can improve students' understanding and practical skills in table tennis officiating (Mykhailyuk et al., 2024; Wu et al., 2023). The primary objective is to examine the effectiveness of an interactive, technology-driven approach in fostering comprehensive learning of table tennis rules and regulations. By comparing learning outcomes between students using the ATTA and those receiving traditional instruction, the research aims to explore the potential of mobile educational technology to enhance student engagement, motivation, and autonomous learning in sports officiating (Siagian, 2021). Fundamentally driven by the recognition that conventional training methods may not adequately prepare referees for the increasing complexity and pace of modern table tennis matches, the study proposes an innovative solution that provides more dynamic, accessible, and comprehensive learning resources for aspiring table tennis officials.

Method

This research endeavor will utilize a quasi-experimental framework, incorporating both a control group and an experimental group. The control cohort will be subjected to conventional referee training, whereas the experimental cohort will be granted utilization of the ATTA alongside the customary training. Extensive expert evaluation and field trials were conducted on the application. The schematic representation of the research methodology can be observed in the table presented below:

Table 1. Research Design The participants were divided into two groups: one group used the ATTA for training, while the other group received traditional training methods.

Group	Pre Test	Treatment	Post Test
Experiment	O1	X	O2
Control	O1	X	O2

The experimental group will initially conduct a pretest with the purpose of gathering data on students' comprehension levels and table tennis abilities prior to the intervention. Subsequent to the pretest, the intervention activities were implemented followed by a posttest.

Participants

This study involved 30 undergraduate students from Universitas Negeri Medan (Indonesia), enrolled in a physical education program. The participants were selected using a purposive sampling technique to

ensure they had a fundamental understanding of table tennis rules before the intervention. They were randomly assigned to two groups: 1) Experimental Group (n=15): Participants who used the Android Table Tennis Application (ATTA) for training, 2) Control Group (n=15): Participants who received traditional referee instruction.

Both groups underwent a pre-test to assess their initial refereeing knowledge and skills. The experimental group then engaged in ATTA-based training, while the control group continued with conventional training methods. A post-test was administered to evaluate improvements in refereeing competency. The study adhered to ethical research standards, ensuring participant consent, confidentiality, and voluntary participation.

Procedure

Analyzing the components in the Android Table Tennis App (ATTA)

To analyze the effectiveness of ATTA, the application components were evaluated based on the aspects outlined in the table 2 below.

Table 2. Analyzing the components in the Android Table Tennis App (ATTA).

Aspects	Indicators	No.	Sub Indicators
Visual Communication	Graphic Design Principles	1	Composition
		2	Balance
		3	Rhythm
		4	Proportion
		5	Unity
	Colour	6	Appropriate use of background and object colours
		7	The level of contrast between the background colour and the overall object(symbols, images, and text).
	Authoring	8	Appropriateness of the use of text style (*font style*)
		9	Font size
		10	Text spacing
		11	EYD and punctuation
		12	Use of emphasis in writing
		13	Use of table fonts, italics and underlining
		14	Density of text in one *frame*
	Navigation	15	Clarity of navigation button function
		16	Smooth functioning of navigation buttons
		17	Consistency of navigation buttons
	Illustrations and Supporting Media	18	Suitability of illustrations with the material
		19	Appropriate use of tables, charts and graphs
		20	Readability of tables, charts and graphs
		21	Video suitability to the material
		22	Video readability
		23	Audio clarity
		24	Suitability of audio to its function
Software Engineering	Attraction	25	The attractiveness of the material delivery strategy
		26	Reliability (smooth running of the application)
		27	Ease of use of the app
		28	Compatibility with android versions
		29	Clarity of application usage instructions
		30	Application for learning process
Style	Content Design	31	Appropriateness of application content with learning materials
		32	Completeness of information required
		33	Order of presentation of material
		34	Suitability of the example to the material
		35	Relatability of examples
		36	Use of language
		37	Appropriateness of learning evaluation with learning materials
		38	Providing feedback on evaluation

Activities during the Android Table Tennis App (ATTA) study

Methodology ensures consistency among participants. Activities were designed to improve learning outcomes and referee skills through theoretical and practical approaches. The ensuing table presents key activities from the ATTA implementation's three primary lessons, detailing the progression from orientation to evaluation. The intricate learning process and systematic application of the ATTA framework were executed through a structured series of three distinct learning phases, which are elaborately described in the subsequent table.

Table 3. Presents the activities carried out within the research study of the Android Table Tennis App (ATTA).

The Syntax and Step-By-Step Process of Referee Training.	
Lesson 1.	Students upload table tennis application media to their Androids for use; Explanation is provided for the use of this media. An initial test is conducted using a questionnaire to assess Student understanding of table tennis refereeing material Problem orientation is achieved through trigger questions The students are divided into 6 groups. They analyze material and videos of table tennis referee simulations on their Androids, discussing and improving within their groups.
Lesson 2.	Students conduct exploration and simulation activities in groups. Create a PowerPoint report on exploration findings. Conduct presentations, simulations, and discussions. Non-presenting groups ask unclear questions as audience observers. The lecturer supports groups that have presented.
Lesson 3.	Examination after learning Evaluation and contemplation Strategy for enhancing student progress.

Data analysis

Data for the research was obtained using observation sheets focused on table tennis refereeing skills alongside the playing methodology. The research will encompass 30 participants who are students in a physical education program and are mandated to undertake a table tennis refereeing module within their academic curriculum. The data processing technique uses JASP software Version 0.19.0.0.

Results

This study constitutes an experimental endeavor aimed at assessing the efficacy of educational interventions in enhancing students' comprehension and proficiency in officiating table tennis matches. Evaluation of the understanding of table tennis officiating principles was based on a written assessment, while the assessment of officiating skills was conducted through practical exercises utilizing a standardized assessment tool.

Descriptive Data for Experimental Group

The following table presents the descriptive statistics for the experimental group, highlighting the mean scores, standard deviation, standard error, and coefficient of variation for both pre-test and post-test assessments.

Table 4. Data Description for the Experimental Group

Descriptives					
	N	Mean	SD	SE	Coefficient of variation
Pree Test	30	44.333	2.564	0.468	0.058
Post test	30	54.233	1.695	0.310	0.031

Test the hypothesis with Paired Samples T-Test For Experimental Group

Reciprocal teaching methodology is employed during instruction to facilitate collaborative discussions among students for mutual understanding and correction during practice sessions. Notably, the instructional activities differ between the experimental and control groups. While the control group receives traditional instruction, the experimental group utilizes educational technology for table tennis officiating instruction. Throughout the course of instruction, students in the experimental group engage in group discussions comprising seven members each, focusing on various aspects of table tennis officiating, including match rules, equipment, infractions, and referee gestures. Following the acquisition of a conceptual understanding of table tennis officiating, students progress to practical simulation exercises where they assume specific roles such as chief executive, main referee, assistant referee, player, and scorekeeper within a simulated match scenario. The final phase involves the administration of a comprehensive examination to assess the learning outcomes of both groups, which are graphically represented for analysis.

Table 5. Shows the Paired Samples T-Test conducted for the Experimental Group.

Paired Samples T-Test								
							95% CI for Mean Difference	
Measure 1	Measure 2	t	df	p	Mean Difference	SE Difference	Lower	Upper
Pree Test -	Post test	-18.085	29	< .001	-9.900	0.547	-11.020	-8.780

Note. Student's t-test.

Figure 1. The results of data analysis using JASP software with Raincloud Plots Pree-Post Test.

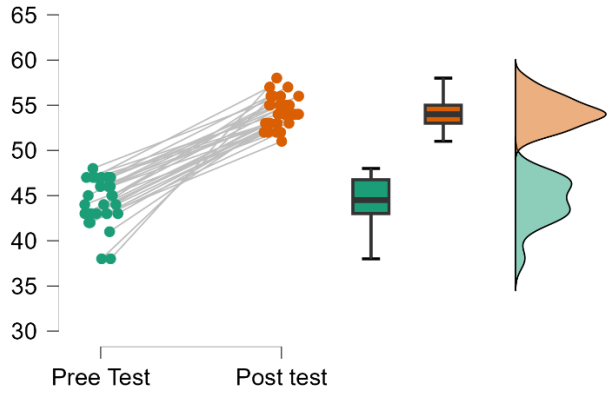

Figure 2. Comparison Chart of Student Learning Outcomes of Experimental Group with Control Group.

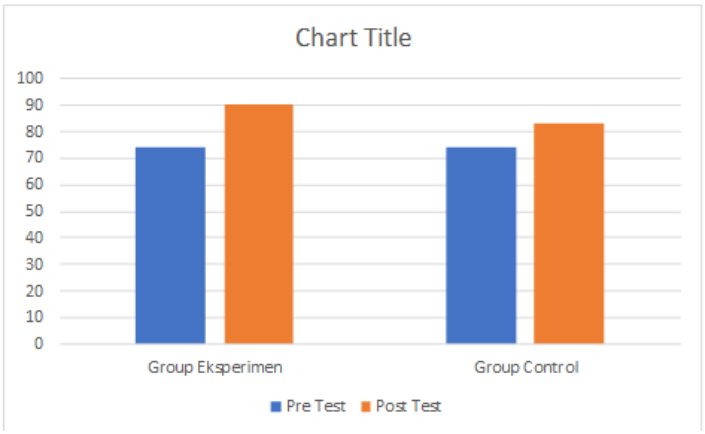

Figure 1 and 2. Depicted above serves the purpose of delineating the disparities in learning achievements in table tennis refereeing between the experimental and control groups. Analysis of this graphical representation reveals that the experimental group exhibited an average initial learning outcome of 73.9. Subsequently, following the utilization of the application for table tennis refereeing instruction, the average learning outcome surged to 90.0, indicating a disparity of 16. Conversely, the control group displayed an average initial learning outcome of 74.0. After undergoing traditional methods for learning table tennis refereeing, the average learning outcome escalated to 83.0, presenting a difference of 10. Evaluation of the average learning outcomes of the aforementioned groups elucidates that the experimental group surpasses the control group.

Discussion

The results of this research offer empirical support for the utilization of an Android-based Table Tennis Application in improving the officiating abilities of individuals enrolled in a physical education curriculum. Through its interactive and thorough features, the ATTA enables students to cultivate a more profound comprehension of the principles and standards of table tennis, along with honing their adjudicative skills in a simulated setting (Wu & Chang, 2016). The performance of the experimental group in

table tennis refereeing surpasses that of the control group in terms of learning outcomes. Discrepancies in the learning achievements between the two groups can be attributed to variations in the learning methodologies employed. In the context of table tennis refereeing, the experimental group engaged in a learning process that incorporated application-based refereeing learning resources, facilitating student discussions and mutual reinforcement during the learning phase. The utilization of application-based learning resources for table tennis refereeing instills a heightened level of motivation among students (Herliana et al., 2022; Putri et al., 2023; Zhang, 2021). Through this motivation, students' desire to learn becomes increasingly concentrated. In addition to this, the utilization of the application encourages students to develop autonomy in their learning. This means that upon completing their in-class studies, students are able to engage with the material independently once they return home, enabling them to learn at their preferred time and place by simply accessing the application through an android device. It has been elucidated that media plays a crucial role in shaping students' learning approaches, with the selection of suitable media having a notable influence on the educational outcomes of students (Guo & Shihan, 2011).

When the educational resources are designed with the students' needs in mind, it is plausible to anticipate an elevation in students' levels of interest and focus throughout the learning process (Hughes et al., 2019; Indawati, 2021; Lubis et al., 2023). The media ought to be aligned with the advancements in information technology and the evolving student culture (Nabila & Usman, 2019; Suryani et al., 2022). At present, there is a prevalent phenomenon among students wherein they heavily rely on android mobile phones for information retrieval, social interaction, and entertainment purposes. It appears as though these devices have seamlessly integrated into the very essence of a student's being, to the extent that their absence can evoke feelings of ennui and disconnection. This dependency on android mobile phones is unmistakably conspicuous in the demeanor of individuals within educational settings (Hamzah, 2018; Morphitou, 2014; Suki, 2013; Sutisna et al., 2020). The existence of student android phones presents an opportunity to employ them as learning tools, particularly through the use of educational applications. The advantages of utilizing such applications within the experimental group include enhancing the engagement between teachers and students, both within school hours and beyond. (Indah et al., 2023; Irawan et al., 2020; Morphitou, 2014). During this educational procedure, the learning results for the experimental group surpass those of the control group.

The inclusion of the ATTA in the training program for table tennis referees offers students a distinctive chance to interact with the content in a creative and dynamic way. The findings of this research indicate that employing the ATTA leads to advancements in students' comprehension of table tennis rules and regulations, as well as in their practical officiating abilities during simulated match situations (Humairah et al., 2020). Moreover, the availability and ease of use of the ATTA, functioning as a mobile application, enable students to extend their learning and exercises beyond the traditional classroom setting. This in turn serves to strengthen the understanding and proficiency in the subjects and abilities acquired through formal educational sessions (Hardi & Servanda, 2021).

In comparison to the educational approach employed by the control cohort, exclusively incorporating books and powerpoints as instructional tools, the experiment was confined to the school premises and solely conducted during school hours. Following school hours, students engaged in self-directed study using available textbooks. This instructional technique induces rapid ennui among students, leading to a gradual waning of their academic drive (Hur & Oh, 2012; Indawati, 2021; Patton et al., 1983; Serna, 1989). Drawing upon the findings and discourse outlined previously, it is recommended that educators possess the capability to employ educational apps as a tool for enhancing students' self-directed learning.

The constraints of this study encompass the comparatively limited sample size and the particular setting of a table tennis officiating program at an individual university. Subsequent investigations ought to assess the effectiveness of the ATTA in a wider array of physical education environments and investigate its possible utilization in other sports-related officiating and refereeing programs.

Conclusions

The results of this study illustrate the efficacy of an Android Table Tennis App in enhancing the officiating capabilities of students enrolled in a physical education curriculum. The ATTA offers a comprehensive and interactive platform for students to enhance their comprehension of table tennis rules and

regulations, and to hone their decision-making skills as referees in simulated match scenarios. It can be inferred that utilizing application media for learning table tennis officiating has been shown to enhance educational interactions between teachers and students, boost students' learning drive, elevate the level of student engagement both within and beyond academic settings, and foster peer-to-peer interaction. By fostering a conducive learning environment, students are able to efficiently and effectively attain their learning objectives. Hence, based on the successful testing of this application, it is recommended for educators at both secondary and tertiary levels seeking to enhance their students' understanding and proficiency in table tennis officiating.

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It is an optional section, which is used to recognize all those who helped to obtain the results of the research, projects that finance the research, colleagues who review the scientific value of the articles, among other variables present.

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