Modern Sport

Volume 24 | Issue 2 Article 4

6-30-2025

The Flipped Classroom and Its Effect on Enhancing the Learning of the Serve and Drop Shot Skills in Badminton

Moeen Mohammed Taha Al-Khalaf
University of Jordan – Faculty of Sports Sciences, Department of Kinesiology and Sports Training,
Moen_taha@yahoo.com

Recommended Citation
Al-Khalaf, Moeen Mohammed Taha (2025) "The Flipped Classroom and Its Effect on Enhancing the Learning of the Serve and Drop Shot Skills in Badminton," *Modern Sport*: Vol. 24: Iss. 2, Article 4.
DOI: https://doi.org/10.54702/2708-3454.2060

MODERN SPORT 2025;24:150–160

ORIGINAL STUDY

The Flipped Classroom and Its Effect on Enhancing the Learning of the Serve and Drop Shot Skills in Badminton

Moeen Mohammed Taha Al-Khalaf

University of Jordan – Faculty of Sports Sciences, Department of Kinesiology and Sports Training

Abstract

The aim of this study was to investigate the effect of the flipped classroom approach on enhancing the learning of the serve (both high and low) and drop shot skills in badminton among female students at the School of Sport Sciences at the University of Jordan, in comparison to the traditional teaching method. The sample consisted of 30 female students enrolled in the "Racquet Sports (1) – Badminton" course. The participants were divided into an experimental group, which was taught using the flipped classroom strategy, and a control group, which received instruction through conventional methods. The researcher employed the experimental method to conduct the study and utilized educational programs and skill-based tests, after ensuring their scientific validity. This approach aimed to create a more interactive and learner-centered environment that integrates digital content with in-class application. The findings indicated that both the traditional and flipped classroom strategies had a positive effect on learning the targeted badminton skills. However, the flipped classroom strategy proved to be more effective, showing a clear advantage in enhancing the learning of the high serve, low serve, and drop shot skills. Based on these results, the researcher recommended the use of modern technological tools in the teaching and learning of sports skills in general, and badminton in particular. The study further emphasized the importance of integrating contemporary teaching strategies—especially the flipped classroom approach supported by technology—into the instruction of motor and athletic skills, with a particular focus on badminton. and this achieves one of the sustainable development goals of the United Nations in Iraq which is (Quality Education)

Keywords: Badminton, Flipped classroom, Technology, Skills

1. Introduction

Education in many countries, particularly developing nations, is undergoing transformations driven by the demands of the digital age. As Mostafa (2012) asserts, today's education relies on converting scientific facts into practical behaviors through modern, technology-based instructional strategies. Salem (2004) highlights that this technological evolution has produced diverse learning modes, such as multimedia learning, distance education, and e-learning. These rely on presenting content in multiple formats (written, audio, static/moving visuals) via electronic devices—especially smartphones—which enhance engagement and educational quality.

According to Ismail (2009) and Muhafazah (2009), a teacher's effectiveness lies in choosing strategies that meet instructional goals and student needs. Annet (2008) emphasized the importance of using modern educational technologies to enhance motor skill acquisition and athletic performance. Traditional teaching methods, as described by Metwally (2015), often position the teacher as the center, whereas modern pedagogical philosophies (Zeidan, 2013) emphasize student-centered learning, focusing on individual learning styles, critical thinking, and collaboration.

As noted by El-Sayed (2022), the flipped classroom represents a contemporary model of blended learning, serving as an educational framework that reflects a comprehensive and integrated instructional

Received 30 May 2025; revised 15 June 2025; accepted 22 June 2025.
Available online 30 June 2025

E-mail address: moen_taha@yahoo.com (M. M. T. Al-Khalaf).

https://doi.org/10.54702/2708-3454.2060

process. It is viewed as a modern pedagogical approach designed to overcome the limitations of traditional teaching, address students' individual learning needs, and accommodate diverse learning styles. More broadly, it embodies the principles of constructivist theory, which posits that learners construct knowledge independently, rather than relying on external sources, with the instructor acting as a facilitator and guide throughout the learning process.

Flipped learning—also referred to as inverted or reversed classrooms—constitutes pedagogical models that employ modern technological media, particularly digital tools, to prepare instructional content in the form of video segments and audio-visual recordings for students to review prior to attending the formal lecture via their electronic devices. Students take notes and formulate questions to discuss interactively with the instructor during the in-person session. This strategy effectively shifts learning from a collective environment to an individualized one, where, after self-directed review of the materials at home, the classroom becomes an active learning space in which the teacher guides and facilitates students' application of the newly acquired knowledge (Al-Talhi, 2019).

Moreover, flipped learning represents one of the blended learning strategies that harness all available technological media to deliver an innovative educational experience aligned with learners' characteristics, needs, and the instructional objectives under pursuit (Awad & Abu Bakr, 2010).

Issani (2014) emphasized that the integration of technological devices—including mobile phones and tablet laptops—into individuals' daily lives constitutes a genuine revolution, altering the fabric of public life by influencing human relations and interactions both directly and indirectly. These devices have become the primary means of accessing scientific information and connecting with educational networks, enabling free interaction, bridging distances, and optimizing time and effort. Likewise, Al-Umayri (2017) and Al-Dahshan (2019) considered the use of mobile phones in education as a form of autonomous and distance learning.

Al-Mahdi (2008) asserted that employing tablets and smartphones in the educational process represents an e-learning modality that complements conventional instruction and serves as a fundamental channel for obtaining instructional content. Such devices adapt to the variables and innovations engendered by globalization while concurrently meeting learners' characteristics and needs, thereby extending education beyond classroom boundaries into a dimension of temporal and spatial freedom.

Badr (2012) noted that the advent of multiple educational media—most notably computers and smartphones—has democratized learning, as the majority of individuals worldwide, including university students, possess such devices. The integration of these tools into learning processes has generated a new educational revolution for both students and instructors. As primary communication media, they have become instructional resources inside and outside the classroom, solidifying the concept of self-directed learning and evolving into what is known as intelligent e-learning (Hosler, 2013).

Abdul-Adheem (2016) catalogued the services that smartphones, as advanced technological tools, can provide—web access via the Internet, SMS, Bluetooth, multimedia functionalities, direct and indirect audio-visual communication, and various software applications such as learning platforms and forums. The advantages and benefits conferred by smartphones in education include increased motivation toward learning, continuous teacher–student communication, and learners' autonomy in selecting the starting point of their learning based on their preferences and abilities, in both time and place of their choosing.

The researcher underscores the importance of selecting the most appropriate methods and media for teaching distinct skills in accordance with each skill's characteristics, thereby facilitating and reinforcing the learning process. Based on this premise, the researcher elected to employ the flipped classroom strategy to support the acquisition of certain badminton skills.

Numerous studies have investigated flipped learning and the use of modern technology in motor and sports skill education. Kamal El-Din and Youssef (2022) conducted a study to examine the effect of the flipped classroom strategy on learning offensive basketball skills among students, concluding its efficacy compared to traditional methods. In football, Matar and Hussein (2023) explored the impact of a flipped learning–based instructional program on acquiring fundamental soccer skills, finding significant improvements in learning and performance for the experimental cohort. Al-Harasis (2023) studied the use of smartphones as a flipped learning medium in comparison to a conventional program for teaching badminton skills to students at the University of Jordan's Faculty of Sports Sciences. The results indicated that students acquired badminton skills at varying levels depending on the instructional approach, with smartphone-mediated learning yielding more tangible benefits than traditional methods.

In basketball, Al-Adwani et al. (2024) investigated the effect of mobile learning on learning offensive

basketball skills among Kuwaiti intermediate school students. The findings demonstrated a positive effect of mobile learning on free-throw shooting performance in the experimental group relative to the control group, within the confines of the study's population and sample.

The significance of the study lies in drawing attention to the importance of utilizing and integrating modern learning strategies in conjunction with technological tools for teaching various sports skills. It emphasizes the need for creativity and innovation in diversifying educational inputs and moving away from the routine nature of traditional teaching methods by making the learner an active participant in the educational process. Additionally, it highlights the pressing need for educational institutions—particularly faculties of sport sciences—to create engaging learning environments that align with contemporary technological advancements.

The research problem emerged from the researcher's practical experience in academic teaching within the field of sports, as well as specialized coaching in badminton. Through this experience, the researcher observed a range of challenges and obstacles associated with teaching badminton skills, particularly among female students, regardless of the varying levels of difficulty involved. Over several years of field experience, the researcher identified numerous issues—some of which were related to the learners themselves, most notably a lack of motivation to learn, while others were linked to the instructor, including aspects of their role, teaching style, and the methods and tools employed to support and facilitate the learning of badminton skills. The core problem appears to lie in the continued reliance on traditional instructional methods that have long dominated the teaching of sports skills, including those specific to badminton.

In light of the technological revolution and the diversification of its media—now deeply embedded in university students' lives—it became imperative to explore eased teaching and learning methods. Given the variety of available instructional strategies that can be integrated with technology, it was necessary to evaluate their effectiveness in facilitating sports skill acquisition, particularly as some technological tools have become integral to students' daily experiences.

Collectively, these considerations shaped the researcher's decision to integrate a modern instructional strategy—namely, the flipped classroom—into the technological framework, by studying its impact on reinforcing the learning of high and low serves and drop shots in badminton among female students at the University of Jordan's Faculty of Sports Sciences.

2. Research objectives

1. To determine the effect of the flipped classroom on reinforcing the learning of high and low serves and drop shots in badminton among female students at the University of Jordan's Faculty of Sports Sciences.
2. To investigate the impact of the traditional method on reinforcing the same badminton skills among the same population.
3. To compare the effects of the flipped classroom and the traditional method on learning high and low serves and drop shots in badminton among female students at the University of Jordan's Faculty of Sports Sciences.

3. Research hypotheses

1. There are statistically significant differences between pre- and post-test measurements at a significance level of $\alpha \leq 0.05$ for the effect of the flipped classroom on reinforcing the learning of high and low serves and drop shots in badminton among female students at the University of Jordan's Faculty of Sports Sciences, favoring the post-test.
2. There are statistically significant differences between pre- and post-test measurements at a significance level of $\alpha \leq 0.05$ for the effect of the traditional method on reinforcing the learning of high and low serves and drop shots in badminton among female students at the University of Jordan's Faculty of Sports Sciences, favoring the post-test.
3. There are statistically significant post-test differences at a significance level of $\alpha \leq 0.05$ between the effects of the flipped classroom and the traditional method on reinforcing the learning of high and low serves and drop shots in badminton among female students at the University of Jordan's Faculty of Sports Sciences.

4. The study included the following terms: (operational definitions)

Flipped Learning: An instructional strategy that positions the learner at the center of the educational process, wherein the learner reviews pre-prepared content delivered by the instructor via WhatsApp prior to attending the in-person lecture.

Traditional Instruction: The dominant approach for teaching motor and sports skills, characterized by all instructional decisions being made by the teacher and learners merely listening and executing throughout the instructional unit.

Table 1. Means, standard deviations, and skewness coefficients for variables related to the study.

Variables	Unit of Measurement	Mean	Standard Deviation	Skewness Coefficient
Age	Years	19.40	0.52	0.13
Body Mass	kg	58.05	6.81	0.92
Height	cm	158.11	3.75	0.73
Low Short Serve	Score	36.79	11.11	0.98
High Long Serve	Score	19.25	6.79	0.77
Drop Shot	Score	21.78	5.30	0.43

Table 2. Means, standard deviations, and T-test results for the significance of differences in Pre-test measures between the experimental and control groups for variables related to the study.

		Experimental Group N = 16		Control Group N = 14			
Variables	Unit of Measurement	Mean	SD	Mean	SD	t-value	Significance Level
Age	Years	19.61	0.60	19.20	0.45	2.0917	0.0457
Body Mass	Kg	58.22	7.15	57.89	6.48	0.1317	0.8962
Height	Cm	158.23	3.45	157.99	4.06	0.1751	0.8623
Low Short Serve	Score	35.81	11.88	37.77	10.34	0.4786	0.6360
High Long Serve	Score	19.71	6.46	18.79	7.13	0.3708	0.7136
Drop Shot	Score	21.33	6.31	22.24	4.30	0.4546	0.6529

High Long Serve: A serve executed in accordance with legal conditions, sending the shuttle high and deep so that it lands in the rear third of the opponent's court.

Low Short Serve: A serve executed in accordance with legal conditions, sending the shuttle low over the net so that it lands in the front third of the opponent's court.

Drop Shot: A deceptive offensive shot in which the shuttle is struck over the head to fall immediately behind the net in the opponent's court.

5. Methodology and procedures

The researcher employed an experimental design with both a control group and an experimental group to achieve the study objectives. The study population comprised female students enrolled in the Racket Games (1) course—including badminton—at the University of Jordan's Faculty of Sports Sciences during the 2024/2025 academic year, totaling 68 students. A purposive sample of 30 students (45% of the total population) was selected and randomly assigned to two groups as follows:

1. **Experimental Group:** 16 students receiving instruction via the flipped classroom strategy to enhance the learning of high and low serves and drop shots in badminton.
2. **Control Group:** 14 students receiving instruction via the traditional method to enhance the learning of high and low serves and drop shots in badminton.

To ensure sample homogeneity, the researcher calculated the skewness coefficient for all relevant variables; Table 1 presents the means, standard deviations, and skewness coefficients for these variables.

Table 1 indicates that the skewness coefficients for all research variables among the study sample ranged between ± 3, which suggests that the sample was homogeneous.

Additionally, equivalence between the participants in the experimental and control groups was established prior to the implementation of the research procedures. This was verified through the results of the pre-tests and the variables of age, body mass, and height, assessed on November 17, 2024.

Table 2 demonstrates that the calculated t-values were below the critical t-value at the 0.05 significance level, indicating no statistically significant differences between the experimental and control groups across all research variables. This confirms the equivalence of the two groups in the pre-test measures.

The study comprised the following variables:

- Independent Variables: Flipped classroom strategy and traditional instruction method.
- Dependent Variables: Learning outcomes of the high and low serves and the drop shot in badminton.

To conduct the research experiment, the researcher developed a specialized instructional program for the experimental group using the flipped classroom strategy. The content of the instructional units, as designed within the program, was sent to students via WhatsApp one day prior to each scheduled class, allowing them to preview the assigned topics before attending the in-person session. The purpose of the class meeting was to respond to all inquiries related to the students' observations of the pre-class material and to maximize the use of class time for application, repetition, and actual practice of the required performance.

Skill	Video Link
Low Short Serve	https://www.youtube.com/watch?v=kzWpvuWeih0
High Long Serve	https://www.youtube.com/watch?v=KRXCjhTI648
Drop Shot	https://www.youtube.com/watch?v=byoSDwCcBTQ
Shuttle Time Program	https://www.youtube.com/playlist?list=PLYqPBxMmvqpIWYh7U9fCYQ-e6Ft1R7CWw
International Federation Program (Level 1)	https://www.youtube.com/playlist?list=PLYqPBxMmvqpJL5NP37SD3r_OEPLSsaW7L

*The instructional program included video segments, which could not be appended as an annex to the study.

Table 3. Correlation coefficients between the first and second administrations of the skill-based tests for participants in the pilot study.

	First Administration		Second Administration			
Test	Mean	SD	Mean	SD	Correlation Coefficient	Significance Level
Low Short Serve	33.23	10.77	34.03	9.87	0.872	0.000
High Long Serve	18.78	7.02	17.91	6.66	0.923	0.000
Drop Shot	22.02	5.89	21.87	6.76	0.675	0.000

As for the control group, students received the same instructional program using the traditional method, which relied on direct explanation and model performance by the instructor, with students expected to replicate the demonstrated tasks. It is important to note that the exact same content—including the types and forms of exercises and the number of repetitions—was implemented for both groups.

In order to control all variables that might affect the course of the experiment, the instructional units were standardized across both groups in terms of duration, activity types, and exercise repetitions. The only distinction between the two groups lay in the method of content delivery.

Both groups followed a 12-unit badminton skills program, of which 6 units were dedicated to the high serve, low serve, and drop shot skills under investigation. The program spanned four weeks, with three 50-minute sessions per week for each learning unit. To implement the flipped classroom effectively, the instructional program included various skill-specific video segments sourced from YouTube, including official International Badminton Federation tutorials (Levels 1 and Shuttle Time), slow-motion clips, and sequenced illustrative images demonstrating each technique. Below are some of the video links utilized in the instructional content.

The researcher consulted various references, prior studies, and electronic resources to prepare the instructional content, which was then validated and evaluated by specialists—coaches and instructors in badminton. Subsequently, the researcher employed skill-related tests to assess performance levels in the high long serve, low short serve, and drop shot. These tests were developed based on relevant literature review, the researcher's international academic and practical expertise, and consultations with field experts (see Appendics 2), who confirmed the content's validity. As a final precautionary and scientific measure, reliability was assessed via test–retest correlation over a 7-day interval for the selected skills (high long serve, low short serve, drop shot) on a pilot sample of 4 students outside the main study sample. The first administration occurred on 21 November 2024, and the second on 27 November 2024. Table 3 presents the correlation coefficients between the two administrations for the skill tests, all of which met the required reliability criteria (see Appendics 1 for detailed results).

The researcher conducted a pilot implementation of two instructional units from the experimental group's program (flipped classroom via WhatsApp) on a pilot sample of four students drawn from the study population on 21 November 2024. The objectives were to verify procedural elements—especially for the experimental group—including safety considerations, potential challenges in unit delivery, the suitability of instructional materials, and the face validity of the flipped classroom strategy. Additionally, the researcher measured the total duration of video and electronic content sent to students via WhatsApp.

6. Research procedures

To ensure proper execution of the research procedures, the following instruments and materials were utilized:

- Skill performance tests for measuring the acquisition of high and low serves and the drop shot in badminton.

Table 4. Arithmetic means, standard deviations, and T-test values indicating the significance of differences between the Pre-test and Post-test measurements of the experimental group in the high long serve, low short serve, and drop shot skills in badminton (n = 16).

		Pre-Test		Post-Test				
Variables	Unit of Measurement	Mean	SD	Mean	SD	Mean Difference	t-value	Significance Level
Low Short Serve	Score	35.81	11.88	61.05	8.67	25.24	6.8646	0.0001
High Long Serve	Score	19.71	6.46	32.11	3.52	12.40	6.7421	0.0001
Drop Shot	Score	21.33	6.31	47.75	6.94	26.42	11.266	0.0001

Table 5. Arithmetic means, standard deviations, and T-test values indicating the significance of differences between the Pre-test and Post-test measurements of the control group in the high long serve, low short serve, and drop shot skills in badminton (n = 14).

		Pre-Test		Post-Test				
Variables	Unit of Measurement	Mean	SD	Mean	SD	Mean Difference	t-value	Significance Level
Low Short Serve	Score	37.77	10.34	58.52	6.67	20.75	6.3098	0.0001
High Long Serve	Score	18.79	7.13	26.36	4.36	7.57	3.3891	0.0022
Drop Shot	Score	22.24	4.30	35.47	7.31	13.23	5.8369	0.0001

- Custom-developed instructional programs for both the experimental and control groups, validated by subject-matter experts.
- Measurement devices: tape measure for height, scale for body mass, ropes, cones, and markers.
- Badminton racquets and Yonex medium-speed shuttlecocks.
- Badminton courts.

Upon completion of the preparatory steps, the researcher administered the pre-test measures over two sessions on 17 November 2024 prior to the commencement of the instructional program. Following the pre-tests, the instructional units were delivered to both groups according to the predetermined schedule and pedagogical strategy, spanning from 1 December 2024 to 2 January 2025. Subsequent to the instructional phase, post-test measures were conducted over two sessions on 5 January 2025 for all participants.

The study encompassed the following domains:

- **Human Domain:** Female students of the Faculty of Sports Sciences, University of Jordan.
- **Spatial Domain:** Badminton courts at the Faculty of Sports Sciences, University of Jordan.
- **Temporal Domain:** First semester of the 2024/2025 academic year (17 November 2024 to 7 January 2025).

To obtain the research results and verify the study's hypotheses, the researcher employed the necessary statistical tests using the Statistical Package for the Social Sciences (SPSS). The following statistical tools were used:

- Arithmetic means
- Standard deviations
- Skewness coefficient
- Pearson correlation coefficient
- t-test for paired samples

7. Presentation and discussion of results

Table 4 displays the arithmetic means, standard deviations, and t-test results for the pre-test and post-test measures of the high long serve, low short serve, and drop shot skills among the experimental group participants. The findings indicate statistically significant differences between the pre-test and post-test scores at the 0.05 significance level in favor of the post-test measures across all variables. Based on these results, the research hypothesis is supported.

Table 5 presents the arithmetic means, standard deviations, and t-test results for the pre-test and post-test measurements of the control group in the variables of high long serve, low short serve, and drop shot skills in badminton. The results indicate statistically significant differences at the 0.05 level between the two measurements across all variables, in favor of the post-test. Based on these findings, the research hypothesis is accepted.

Table 6 presents the arithmetic means, standard deviations, mean differences, t-values, and significance levels for the post-test measures of the high long serve, low short serve, and drop shot skills between the control (n = 14) and experimental (n = 16) groups. The results indicate statistically significant differences at the 0.05 level in favor of the experimental group for all variables, as all p-values (0.0004 and 0.0001) are less than 0.05. Based on these findings, the research hypothesis is supported.

8. Discussion

The results shown in Tables 4 and 5 for the first, second, and third hypotheses reveal statistically significant improvements from pre-test to post-test in both the experimental and control groups for the

Table 6. Arithmetic means, standard deviations, and T-test results indicating the significance of differences in the Post-test measurements between the control and experimental groups in the high long serve, low short serve, and drop shot skills in badminton.

Variables	Unit of Measurement	Control Group N = 14		Experimental Group N = 16		Mean Difference	t-value	Significance Level
		Mean	SD	Mean	SD			
Low Short Serve	Score	58.52	6.67	61.05	8.67	2.53	0.8857	0.3833
High Long Serve	Score	26.36	4.36	32.11	3.52	5.75	3.9955	0.0004
Drop Shot	Score	35.47	7.31	47.75	6.94	12.28	4.7167	0.0001

high long serve, low short serve, and drop shot skills ($p < 0.05$). This indicates an overall enhancement in learning and performance across all measured variables.

The researcher attributes the observed improvements to the comprehensive instructional programs designed for both groups. These programs included varied skill exercises with sufficient repetitions, structured scientifically to accommodate individual differences and aligned with the learners' abilities and readiness. The exercises followed a progressive sequence—moving from simple to complex, part to whole—and utilized optimal time management, continuous reinforcement, and instructor guidance. The allocated time for skill practice was adequate to elevate novices to an acceptable performance level, and the learners' high motivation further contributed to the tangible gains observed.

The results related to the third hypothesis, as shown in Table 6, revealed statistically significant differences in the post-test measurements between the experimental and control groups, in favour of the experimental group, across the variables of high long serve, low short serve, and drop shot skills in badminton.

The researcher implemented an instructional strategy with the experimental group known as the flipped classroom approach. This strategy is based on having students view the instructional content prior to attending the actual lecture. The content was delivered via the WhatsApp application, giving students the opportunity to engage with the material at their own pace and revisit it multiple times. The content included high-quality video demonstrations of the technical performance of the targeted skills, a variety of illustrative images, and key instructional points essential for mastering the execution of those skills.

The researcher believes that the strategy and medium employed in the learning process enabled the learners to engage multiple senses—particularly hearing and sight—by presenting diverse stimuli such as sound, images, and motor skill demonstrations through advanced and engaging technological tools, including smartphones, laptops, or any other electronic device. This allowed the students to view the instructional content at a time and place of their choosing, which positively influenced their motivation to learn. The method used was both appealing and stimulating, providing a rich and engaging learning environment that enhanced their levels of attention and concentration. Moreover, this strategy helped move students away from the often-monotonous routine associated with traditional teaching methods, offering a refreshing and dynamic alternative in the educational process.

The researcher also believes that the students' prior exposure to the targeted skills provided them with essential pre-class feedback, allowing them to build a foundational base of both knowledge and skill. This prior knowledge enhanced their understanding of the detailed components of skill execution, as they had reviewed carefully selected instructional materials. As a result, they were better equipped to recognize key performance elements and avoid many of the common errors typically encountered during execution.

In contrast, the control group, which was taught using the traditional method—based on instructor-led demonstrations and explanations—lacked the advantages offered by the flipped classroom strategy. Consequently, the learners in this group were deprived of the enriched, multisensory engagement facilitated by modern instructional technologies. Moreover, the researcher could not determine which specific sensory modality the students in the control group primarily relied upon during the learning of the targeted skills.

In conclusion, based on his review of numerous previous studies related to flipped learning and its effectiveness as a modern instructional method, the researcher believes that this approach is particularly valuable for engaging multiple senses in the learning process—especially when teaching sports skills such as those required in badminton. Most of the reviewed studies emphasized the importance of using instructional tools that simultaneously stimulate more than one sense, noting that learning through direct sensory experiences is one of the most effective forms of learning, as it fosters accurate perception of the skill being acquired.

By implementing the flipped classroom strategy in the learning process and analyzing the results of the current study, the researcher was able to confirm and align with the findings of prior research: technology-enhanced instruction leads to higher-quality learning outcomes and greater effectiveness when compared to traditional teaching methods.

9. Conclusion

- Both the traditional instructional programs and the flipped classroom program developed by the researcher were effective in teaching the high long serve, low short serve, and drop shot skills in badminton.

- The use of the flipped classroom strategy had a positive and significant effect on reinforcing skill acquisition for the high long serve, low short serve, and drop shot in badminton, achieving a higher level of proficiency than the traditional method.

10. Recommendations

- Integrate modern technological media into the teaching and learning of sports skill domains in general, and badminton in particular.

- Implement the flipped classroom strategy combined with technology as a contemporary instructional method for motor and sports skill education.

- Leverage modern educational technologies to support and enhance traditional teaching methods

Conflicts of interest

The authors declare no conflict of interest.

Ethics statement

Not applicable.

Author's contributions

Author did all the work.

Funding

This research received no external funding.

Data availability

The data that support the findings of this study are available on request from the corresponding author.

References

Abdul-Adheem, S. (2016). *General and electronic teaching strategies and methods*. Arab Group for Training and Publishing.

Al-Adwani, F., Mowafi, M., Salama, Y., & Abdeen, M. (2024). The effect of using mobile learning on acquiring some offensive basketball skills for middle school students in Kuwait. *Journal of the Faculty of Physical Education, Mansoura University*, (51), p. 237. https://ejsk.journals.ekb.eg/article_327182.html.

Al-Dahshan, G. A. K. (2019). The use of mobile phones in education and training [conference presentation]. In Seminar on Applications of Information and Communication Technology in Education and Training, King Saud University. https://www.researchgate.net/publication/334174256_astkhdam_alhatf_almhmwl.

Al-Harasis, R. (2023). The effect of using smartphones as an educational and informational tool in badminton (Unpublished master's thesis). University of Jordan, Faculty of Sports Sciences. https://search.mandumah.com/Record/46271.

Al-Mahdi, S. (2008). *Virtual education*. New University House.

Al-Talhi, S. (2019). *Flipped learning*. Experimentation and Implementation. King Fahd National Library.

Al-Umayri, S. (2017). The effectiveness of using mobile phone applications in teaching social studies on achievement and the development of learning process skills among tenth grade students in the Sultanate of Oman (Unpublished master's thesis). Sultan Qaboos University. https://search.mandumah.com/Record/947513.

Annet, J. (2008). On knowing how to do things: A theory of motor imagery. *Brain Research. Cognitive Brain Research*, *3*, p. 67.

Awad, H., & Abu Bakr, E. (2010). The impact of using the blended learning pattern on students' achievement at Al-Quds Open University – Palestine. Al-Quds Open University.

Badr, A. F. (2012). The effectiveness of mobile learning using SMS in developing awareness of certain educational technology terms among educational technology specialists and their attitudes toward mobile learning. *Journal of the Faculty of Education*, *23*(90), p. 152. https://search.mandumah.com/Record/162350.

El-Sayed, F. (2022). The effectiveness of the flipped learning strategy using the educational platform (Edmodo) on developing the skill level of female students majoring in basketball. *The Scientific Journal of Physical Education and Sports Sciences*, (94) Part 1.

Hosler, K. A. (2013). Pedagogies, perspectives, and practices: Mobile learning through the experiences of faculty developers and instructional designers in centers for teaching and learning (Doctoral dissertation). University of Northern Colorado. https://digscholarship.unco.edu/cgi/viewcontent.cgi?article=1162&context=dissertations.

Ismail, A.-G. (2009). E-learning courses: Their design, production, dissemination, implementation, and evaluation. Alam Al-Kutub.

Issani, R. A.-T. (2014). Internet and mobile phone usage among University of Sharjah students and its impact on their social communication. *Arab Journal of Media and Communication*, (11), p. 169–174. https://jkom.journals.ekb.eg/issue_16753_16754.html.

Kamal El-Din, M., & Youssef, S. (2022). The effect of using the flipped classroom strategy in learning some offensive basketball skills among students. *Journal of Physical Education*, *34*(2), p. 535. https://jcope.uobaghdad.edu.iq/index.php/jcope/article/view/1354.

Matar, D., & Hussein, M. (2023). The effect of flipped learning on learning some basic football skills among students. *Al-Qadisiyah Journal for Sports Sciences*, *23*(2), Part 1, p. 50. https://spojou.qu.edu.iq/index.php/qjpes/article/view/68.

Metwally, A. E.-D. (2015). Employing the flipped classroom strategy in the teaching and learning process. In *Proceedings of the 15th Annual Scientific Conference of the Egyptian Society*,Ain Shams University, p. 91–102.

Mostafa, R. (2012). Utilizing e-learning to achieve quality standards in the educational process. *The Arab Journal for Quality Assurance in Higher Education*, (9), 2. https://search.shamaa.org/PDF/Articles/YEAjqahe/9AjqaheVol5No9Y2012/1AjqaheVol5No9Y2012.pdf.

Muhafazah, S. (2009). The future teacher: Characteristics, skills, and competencies. In *Proceedings of the Educational and Psychological Scientific Conference*, University of Damascus, *1*, p. 25.

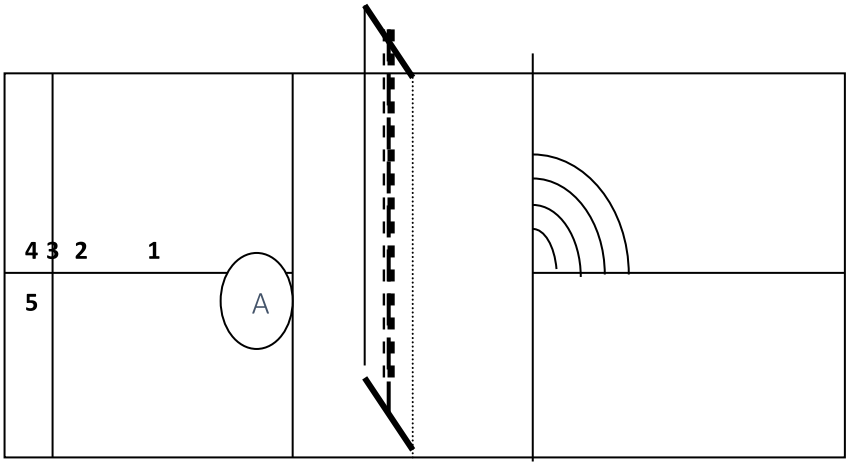
Salem, A. (2004). *Educational technology and e-learning*. Al-Rushd Library.

Zeidan, A. K. (2013). Attitudes of physical education college students towards teaching practical subjects using the computer as an instructional aid according to gender and academic level variables. *Al-Qadisiyah Journal for Physical Education Sciences*, *13*(1), 147–155.

Appendix 1

- *Short Serve Test*

Purpose of the test: To measure achievement in the short backhand serve skill.
Test application: Applied to a sample of male and female students from institutes and colleges.
Required equipment: Badminton rackets, shuttlecocks, elastic cord, and a court marked with test-specific zones as illustrated in the original diagram.



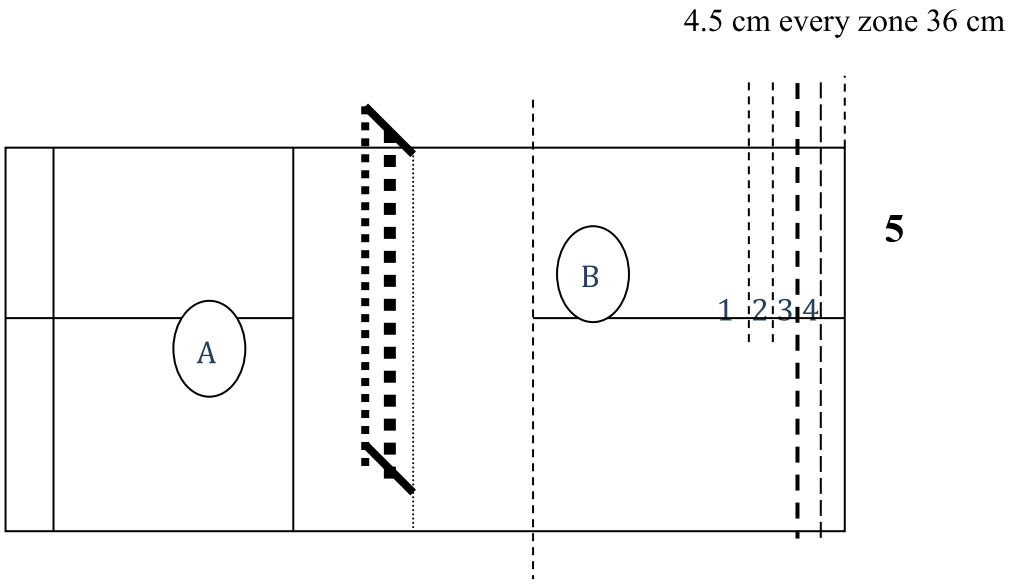
The dimensions of each scoring zone are as follows: the 5-point zone has a radius of 55.8 cm from the center; the 4-point zone, 76 cm; the 3-point zone, 96.5 cm; the 2-point zone, 117 cm; and the 1-point zone encompasses the remaining area beyond these measurements.
Test execution method:
The server stands at the designated service position (A) and performs 20 attempts, divided into two sets, aiming to send the shuttle through the space between the net and a rope positioned 51 cm above it, with the objective of landing the shuttle in the highest scoring zone.
Scoring method:
- Scores are based on the landing zone of the shuttlecock.
- Shuttlecocks landing on the boundary between zones receive the higher score.
- Serves not passing between the net and cord, or landing outside the zones, score zero.
- Serves hitting the cord are repeated.
- Final score is the total of the 20 attempts.

- *High Long Serve Test*

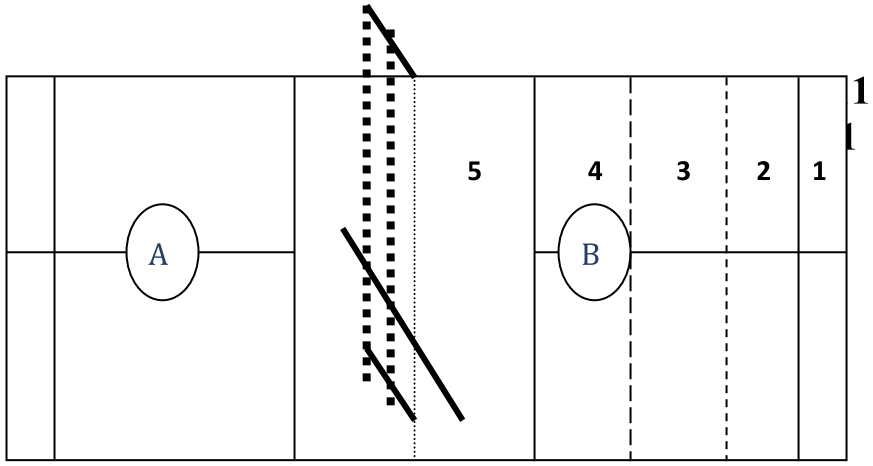
- Purpose of the test: To measure the achievement level in the high long serve skill.
- Test application: Administered to a sample of male and female students from institutes and colleges.
- Required equipment: Badminton rackets, shuttlecocks, an assistant, and a court marked according to the test design illustrated below.
Test execution method:
The server stands in zone (A) and performs a high and long serve such that the shuttlecock passes over the net and then over the player, who is holding a racket extended upward in zone (B), attempting to land the shuttlecock in the highest scoring zone. The player performs 12 serve attempts.
Scoring method:
- The score is based on the landing zone of the shuttlecock.
- If the shuttlecock lands on a line between two zones, the higher score is awarded.
- The final score is the sum of the best 10 serves out of the 12 attempts.
- Scoring zones are marked from 5 to 1.

- *Drop Shot Test:*

- Purpose of the test: To measure achievement in the drop shot skill.



- Test application: Administered to a sample of male and female students from institutes and colleges.
- Required equipment: Badminton rackets, shuttlecocks, elastic cord, additional posts with a height of 213 cm, an assistant, and a court marked according to the test design as illustrated in the original diagram.



Test Execution Method:

- The player stands in the designated position (A) and returns the shuttlecock sent from the opposite area (B) with a drop shot, aiming to land it in the highest scoring zone.
- The shuttlecock must pass over the net and below the cord fixed behind the net at a distance of 60 cm and a height of 213 cm. The player performs 20 attempts.

Scoring Method:

- Points are awarded based on the landing zone of the shuttlecock.
- If the shuttlecock does not pass over the net and under the cord or lands outside the designated zones, it scores zero.
- A shuttlecock landing on the line between two zones receives the higher score.
- Scoring zones are marked according to zones (1,2,3,4,5)
- The final score is the sum of the scores from all 20 attempts.

Appendix 2: Names of expert evaluators for the badminton skill tests

- Dr. Nidal Bani Saeed – Yarmouk University – Faculty of Physical Education and Sport Sciences