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EFFECTIVENESS OF USING THE FLIPPED CLASSROOM STRATEGY IN LEARNING BASIC MOVEMENTS OF FREESTYLE SWIMMING AMONG PHYSICAL EDUCATION FEMALE STUDENTS AT BIRZEIT UNIVERSITY

REEM HAMMAD[1*], TALEL MADDEH[1], SABER ABDELLAOUI[1], ABDERRAOUF BEN ABDERRAHMAN[1*].

[1]HIGHER INSTITUTE OF SPORT AND PHYSICAL EDUCATION OF KSAR-SAID, UNIVERSITY OF MANOUBA, TUNISIA.

REEM HAMMAD: rmhamad@birzeit.edu
TALEL MADDEH: talelmaddeh@hotmail.fr
SABER ABDELLAOUI : mailto:illusionnist@hotmail.com
ABDERRAOUF BEN ABDERRAHMAN **:** abderraouf.benabderrahman@issep.uma.tn

ABSTRACT

This study examined the effectiveness of the flipped classroom strategy in teaching the basic movements of freestyle swimming among female students of physical education at Birzeit University. A purposive sample of (40) students enrolled in the "Swimming (2)" course during the summer semester (2023–2024) was selected. Participants were divided into two equal groups: an experimental group that received instruction through the flipped classroom approach and a control group that followed a traditional program. The experimental method was applied with pre-tests and post-tests conducted for physical and skill-related variables. Data were analyzed using SPSS. The results indicated statistically significant improvements at the level of ($\alpha \leq 0.05$) in all physical and skill performance variables of freestyle swimming among the experimental group, favoring the post-test. In the control group, significant differences were also found in some physical variables such as standing vertical jump, trunk rotation, and sit-up performance, as well as in basic swimming skills, also in favor of the post-test. However, no significant differences were observed in the medicine ball throw test for the control group. When comparing post-test results between the two groups, the experimental group demonstrated significantly higher improvements across all physical and swimming skill variables than the control group. The findings highlight the positive impact of the flipped classroom strategy on enhancing physical abilities and skill acquisition in swimming. It is recommended to expand its application to other sports and scientific courses in physical education programs.

Keywords: Flipped Classroom, Blended Learning, Freestyle Swimming.

INTRODUCTION

The rapid transformations in the method, style, and strategies used in teaching physical education classes, as well as in the objectives sought to be achieved in modern societies, have gained wide and remarkable spread (Pereira et al., 2019). This has been achieved through teachers' possession of 21st-century skills and the integration of technology into physical education classes, Mace et al. (2025). Integrating technology into the educational process is considered a fundamental axis to keep pace with the developments of the digital age and to meet the needs of students in this century. In recent years, a decline in students' motivation to learn and in their level of academic achievement at the university level has been observed (Procopio et al., 2024). Therefore, the use of information and communication technology has become an integral part of individuals' lives in general and in the education sector in particular

(Maldonado et al., 2019). This was evident in the style adopted by teachers and the way students learn. This use was present in theoretical physical education classes, as it sought to create new, effective, and innovative concepts and means that make the educational process an active one (Manuel et al., 2016; Osterlie, 2022).

This radical change is based on teachers' possession of 21st-century skills in addition to the applications of the digital world (Pereira et al., 2019; Garrote et al., 2018). This led to a major change in the activities offered in traditional physical education classes, which were characterized by limited interaction and communication between teacher and student, low desire and interest in learning, and decreased quality of education and student satisfaction with learning (Yan & Huang, 2023; Sun et al., 2024).

Acquiring new skills in the field of education requires the presence of various techniques and multimedia. Area (2015) stresses the necessity of including new skills in the educational system, such as computer skills, navigating the internet, developing social communication competencies, and the necessary skills to know how to search for information instead of the teacher always being the main source of information, as well as the ability to transform information into acquired knowledge so that students possess the ability to solve problems and know how to interact with others. Therefore, teachers must possess digital competence in how to deal with a generation capable of consciously handling digital applications through the competence of academics in using programs and applications to create innovative materials and content that influence the teaching process of students (Pan et al., 2014).

When designing learning, teachers must take into account the tools and educational platforms used, teaching methods, and assessment approaches to be more interactive, making the educational process more active, thus reflecting on the quality of learning, the outcomes of the educational process, and the results of students' achievement (Arsalan, 2020). Hence comes the importance of using effective teaching strategies and activities, including the flipped classroom strategy, which is considered a gateway for student participation, where each student engages in the learning process according to their abilities, emotions, inclinations, and ways of thinking. This enriches the educational process due to the presence of many answers and inquiries. Linking technology to learning is a methodological framework created by Jonathan Bergmann and Aaron (2012) through the creation of audiovisual content published on the internet that summarizes what students are expected to learn, thus giving all students equal opportunities to access the innovative content so that they can determine the time and pace of learning as they see fit.

The integration of information and technologies in the field of education has generated innovative scenarios that made the elements of the educational process influential and interrelated, where this approach in education is reinforced by integrating ICT so that it is a blend between online learning and face-to-face learning in order to fully achieve this approach (Pereze et al., 2019). Therefore, it was necessary for teachers to develop their competencies in using digital educational platforms related to creating interactive videos and active resources related to what is to be taught to students. In this way, teachers bear a great responsibility in educating future generations and enhancing the digital competence of their students (Rodriguez et al., 2018). Consequently, blended learning has become a prevalent practice in higher education institutions, where the flipped classroom is one form of blended learning, as it is considered a mixture of individual online lectures and face-to-face collaborative learning activities (Kim et al., 2017). Thus, it helps students develop hard skills that appear in their abilities to deal with situations such as critical thinking, creativity, innovation, and problem-solving (Nurhayati et al., 2019).

Accordingly, electronic applications become alternative means of communication, making it easier for students to access learning content anytime and anywhere, which facilitates teachers' ability to collect, evaluate, and provide feedback on the activities of the sent content (Ihsan et al., 2024). On the other hand, the characteristics of learners, teaching and learning methods, and the intended learning outcomes must be taken into account, as teacher quality has a direct relationship with the quality of the content sent to students, which in turn reflects on students' results (Shengru Li et al., 2019). This meets the students' psychological, physical, cognitive, and social needs (Brenna, A., 2024), contributing to making the educational process a positive one through interactive activities in which the student is the focus of the educational process. Providing educational materials to students and easy access to them motivated students to learn, especially since electronic applications are favored tools for them and they are sufficiently familiar with their use, which makes e-learning one of the positive elements in education (Matsumoto, T., 2016).

Problem Statement

Teaching strategies in the modern era have developed and taken a new form in aspects related to the student and how to improve performance (Wardani et al., 2018; Al-Sayyid, 2019). In view of the unique characteristics of Palestinian society, where students' learning methods are constantly evolving, there has been an urgent need for a deeper understanding of the opportunities and challenges facing university instructors in Palestine in general, and Birzeit University in particular, under the current circumstances experienced by the Palestinian people in innovating and continuing to implement new teaching methods and approaches to learning in various subjects, especially physical

education. Through the researcher's experience in teaching the swimming course at Birzeit University, it was noticed that the expected results in raising the technical and skill levels do not meet the desired goals, as the learning process is still following traditional methods through explanation and demonstration, which lack participation and interaction in the lesson.

In addition, learners' motivation is absent, and the traditional approach causes boredom, which in turn leads to negativity and a decline in performance, reflected in the emergence of additional movements that are difficult to eliminate, as well as the inability to link movements and the absence of fluency in performance, given the difficulty of swimming movements that require greater effort from both students and instructors. Therefore, there had to be a strategy that would make the educational process more engaging and stimulating, facilitating a deeper understanding of the content for students and attracting their attention through strategies that connect learners with technological tools, as an urgent human need to keep pace with rapid scientific developments that are favored by students. Accordingly, this study will attempt to answer the following main question:

What is the effectiveness of using the flipped classroom strategy in learning the basic movements of freestyle swimming among female students of physical education at Birzeit University?

Study Questions

This study seeks to answer the following questions:

1. Are there statistically significant differences at the level of significance ($\alpha \leq 0.05$) between the pre- and post-measurement means of some physical variables and basic freestyle swimming skills among the experimental group?
2. Are there statistically significant differences at the level of significance ($\alpha \leq 0.05$) between the pre- and post-measurement means of some physical variables and basic freestyle swimming skills among the control group?
3. Are there statistically significant differences at the level of significance ($\alpha \leq 0.05$) between the post-measurement means of some physical variables and basic freestyle swimming skills between the experimental and control groups?

Significance of the Study

To the best of the researcher's knowledge, this study is among the first to address the flipped classroom strategy in learning the basic movements of freestyle swimming among female students of physical education. It also explores one of the modern trends in blended learning, namely teaching through the flipped classroom strategy, and examines the effectiveness of this strategy in improving performance and enhancing students' skill levels. Furthermore, this study will open the door for researchers and those interested in employing this technique in other courses within physical education in general, and in the swimming course in particular, given its unique circumstances due to the unavailability of swimming pools on a regular basis compared to other practical courses. This study will also provide a detailed explanation of the method of using the flipped classroom strategy, which may benefit specialists in the Ministry of Education and Higher Education in generalizing this strategy according to the results reached by the study through its proposed recommendations. In addition, it contributes to the effective employment of technological tools and devices through the available educational platforms, which will open new horizons to improve the learning process under the current situation in Palestine.

Objectives of the Study

The study aims to identify the effectiveness of using the flipped classroom strategy in learning the basic movements of freestyle swimming among female students of physical education at Birzeit University. It also seeks to determine the differences between the pre- and post-measurements in the level of physical abilities and skill performance in freestyle swimming among female students of the experimental group. In addition, it aims to examine the differences between the post-measurements in the level of physical abilities and skill performance in freestyle swimming among the control group.

Theoretical Background

Blended learning in the 21st century is considered one of the essential competencies that both students and teachers must acquire (Zulhamdi et al., 2022). The need has emerged for effective instructional designs inside the classroom and for supporting students in learning both online and face-to-face, by integrating wireless technology and mobile communication features into the classroom to develop educational plans (Hwang et al., 2015). Learning patterns have shifted to become student-centered, with the teacher acting as a facilitator of the learning process (Zulhamdi et al., 2022). As a result of modern transformations in the educational process, represented in the emergence of new resources and methodologies in teaching, blended learning approaches have appeared. With the wide availability of technological tools, the younger generation shows significant interest in the digital world (Area et al., 2016). Digital and electronic media have become the new supporter of knowledge, and there is growing recognition that the classroom is not the only place for learning, as learning can occur anywhere. From this perspective, blended learning

meets the needs of education in today's world (Pereira et al., 2019), with the flipped classroom strategy forming a fundamental component of it (Belmont et al., 2019), allowing the creation of new scenarios in presenting educational content to students (Perez et al., 2019).

This development led to the emergence of new methodologies such as the flipped classroom strategy, which primarily relies on the use of digital skills in creating digital content and materials while maintaining intended pedagogical objectives (Belmont, 2019). This strategy eliminates the traditional lecture and replaces it with interactive, participatory tasks and activities (Abeyesekera et al., 2015). It reverses the learning process, transferring the course material from the classroom to homework (Fautch, 2015), while class time is used for activities and problem-solving under the guidance of the teacher (Stone, 2012). It represents an innovative educational model in which students learn information independently before entering the classroom, thereby enhancing self-motivation toward learning. Technology is employed in the flipped classroom by providing access to innovative lectures and educational materials outside the classroom (Matsumoto, 2010). According to Bishop et al. (2013), students can watch video lessons outside the classroom through distance learning, after which they practice hands-on activities inside the classroom. This approach allows students to spend less time listening passively to teacher explanations during lectures and more time practicing individually or collaboratively (Zainuddin et al., 2016), thereby improving collaborative learning skills, higher-order thinking skills, and stimulating active learning (Long, 2017).

Since 2012, the flipped classroom strategy has increasingly gained popularity in higher education institutions. It emphasizes active and engaged student participation (Reyna et al., 2016), while the teacher's role becomes that of a facilitator, guide, and monitor who provides feedback on performance, rather than the sole controller of the educational process. The four pillars of the flipped classroom are summarized in the acronym FLIP: flexible environment, which enables students to choose the time and space that suit their learning process; learning culture, which positions the student as the center of the educational process through active participation in tasks and content; intentional content, where teachers assist students in comprehending the learning material; and professional educator, where the teacher acts as a facilitator and continuously monitors students' progress (Chen et al., 2017). Implementing the flipped classroom requires careful planning, beginning with identifying key learning outcomes, recording interactive and engaging videos directly tied to the intended objectives, then encouraging deep student understanding of the content, followed by group collaborative learning, discussions, and task assignments, and finally regrouping to share outcomes and dedicate class time to problem-solving (Dunn, 2014).

According to Bishop and Verleger (2012), the flipped classroom strategy consists of two parts: self-learning through computer-based activities and interactive group activities inside the classroom. This learning process is supported by a variety of applications, educational programs, and online learning platforms that are easily accessible to both students and teachers for submitting assignments online (Wardani et al., 2018). Among the platforms used in this context are Zoom, Padlet, Getmind, ITC, and Openbadges. Padlet, for instance, is a free collaborative web tool that allows teachers to create virtual walls with attractive backgrounds for uploading images, videos, texts, or drawings. It promotes collaborative work through interactive boards where students can post comments, respond to questions, exchange ideas, participate in discussions, and receive reminders about assignments. Teachers can also add multimedia links or resources for students to review, making it a versatile tool for interactive lessons and activities.

Freestyle swimming is characterized by a body position parallel to the ground, with the body facing downward on the water surface, and arms extended above the head at the same level. Alternating arm movements (pulling and pushing) continue until the thumbs touch the thighs before returning to the starting position (Rizkiynas & Mulyana, 2019). Swimming (2) is one of the compulsory practical courses taught in colleges and departments of physical education in Palestinian universities. Due to its significance, swimming has been included in the Olympic Games since their early beginnings and is officially recognized by the International Swimming Federation. Freestyle swimming, also called front crawl, ranks first among the four swimming styles, characterized by the horizontal, prone body position that minimizes frontal resistance. Its alternating arm and leg movements, with feet positioned underwater, make it highly effective. At the beginning of training, movements often lack fluency and are marked by frequent errors due to lack of control, which alters the quality of the skill. Therefore, auditory information must be paired with visual information in early learning stages. Using the flipped classroom strategy with its audiovisual resources can help students understand the technical steps of each skill component, facilitating accurate movement acquisition and effective mastery of basic swimming skills (Al-Hamdani, 2016).

Several studies have addressed the flipped classroom in physical education. Zamzami (2023) examined the effect of using a flipped classroom supported by mobile learning technology on gymnastic skills among 36 physical education students. Results showed significant post-test differences in favor of the experimental group, confirming the flipped classroom's effectiveness in improving gymnastic skill performance. Wibowo et al. (2024) explored the impact of the

flipped classroom approach on student engagement in basketball learning in a university program. Findings revealed significantly higher engagement in interactive, behavioral, and cognitive dimensions for the experimental group compared to the control. Feng (2023) investigated the integration of the flipped classroom in teaching volleyball skills to 83 students using multimedia perspectives. The experimental group achieved better results in volleyball skills compared to the control group. Østerlie et al. (2023) conducted a systematic review of 16 studies on flipped learning in physical education. Findings indicated that most studies highlighted positive impacts on student motivation, learning, motor skill development, and autonomy in classes. Setiawan (2024) assessed the flipped classroom's impact on motivation and academic achievement among 40 students at Surabaya University, reporting increased motivation and achievement in the experimental group.

Procopio et al. (2024) synthesized articles on flipped classrooms in university-level physical education, analyzing 10 studies published in the past five years across Science Direct, PubMed, and Web of Science. Results showed positive outcomes across cognitive, affective, and motor learning in multiple sports, including basketball, martial arts, gymnastics, and dance. Karaman and Arsalan (2023) studied the flipped classroom's effect on student motivation and skills among 62 students, finding increased knowledge, motivation, and improved performance levels in the experimental group. Eman et al. (2020) explored the flipped classroom's effect on ballet skills performance among 40 third-year female students at Mansoura University, showing significant skill improvements in the experimental group. Abdullah et al. (2021) examined blended learning approaches in athletics skills among 60 preparatory students, finding improved performance when combining collaborative learning and the fishbowl strategy.

Wang et al. (2024) assessed the effectiveness of blended learning on first-year basketball players (n=78), showing improved behavioral attitudes, targeted intentions, emotional experiences, and basketball skills in the experimental group. Cheng et al. (2023) conducted a systematic review of 22 articles on blended learning in physical education, identifying increasing adoption since 2018 and highlighting challenges such as instructional design, technological competence, self-regulation, isolation, and belief systems. Cheng Wang (2024) further studied the effects of blended learning on the physical fitness of 78 Chinese freshmen, finding significant improvements in lung capacity, flexibility, sit-ups, long jumps, and sprinting for the experimental group after 16 weeks, though no significant differences in BMI or long-distance running. Finally, Temirkhanov et al. (2024) examined the relationship between cooperative learning and practical skills acquisition among 310 students in Kazakhstan, reporting that cooperative learning positively correlated with self-efficacy and student participation in practical skills development.

MATERIALS AND METHODS

Participants

The study population consisted of all female students enrolled in the Swimming (2) course in the Department of Physical Education at Birzeit University and An-Najah National University, totaling (40) students according to the official admission and registration records at Birzeit University during the summer semester (2023–2024). The study sample comprised (80) male and female students enrolled in the Swimming (2) course, where the male sample included (40) students equally divided into an experimental group and a control group, while the female sample included (40) students also equally divided into an experimental group and a control group. They were selected intentionally from the study population. **Table (1)** shows the characteristics of the study sample in terms of body mass and height variables.

Table 1: Characteristics and homogeneity of the study sample of male and female students according to body mass and height variables (n=40).

Variables	Male students (n=20)		Female students (n=20)	
	Mean ± SD	Skewness	Mean ± SD	Skewness
Body mass (kg)	72.68 ± 8.48	0.28	59.70 ± 7.33	0.27
Height (cm)	1.74 ± 0.07	0.23	1.63 ± 0.06	-0.32

The results of **Table (1)** indicate that the mean and standard deviation of body mass and height for female students were (59.70 ± 7.33 kg, 1.63 ± 0.06 m), and the skewness values for these variables ranged between (±1), which means that the study sample was homogeneous and followed a moderate normal distribution. Accordingly, the female students were equally divided into two groups: the experimental group (20 students), who underwent the educational program using the flipped classroom strategy, and the control group (20 students), who followed the traditional educational program.

Subsequently, equivalence was confirmed in the variables of body mass, height, and pre-test means of physical variables and basic freestyle swimming skills between the experimental and control groups of female students by applying the Independent Samples T-Test, as shown in **Table (2).**

Table 2: Equivalence in body mass, height, and pre-test means of physical variables and basic freestyle swimming skills between the experimental and control groups of female students (n=40).

Physical and skill variables	Experimental group	Control group	T-value	Sig.
Body mass (kg)	60.31 ± 8.91	59.10 ± 5.76	0.36	0.72
Height (cm)	1.61 ± 5.76	1.65 ± 0.06	-1.54	0.14
Vertical jump (cm)	29.40 ± 2.37	29.80 ± 4.08	-0.29	0.79
Trunk rotation (cm)	6.30 ± 1.42	6.00 ± 2.31	0.35	0.73
Medicine ball throw (m)	3.58 ± 0.24	3.46 ± 0.28	1.02	0.32
Sit-ups in 60s (reps)	34.80 ± 3.55	34.70 ± 5.38	0.05	0.96
Arm movements max distance (m)	10.29 ± 2.25	10.62 ± 2.22	-0.33	0.75
Leg movements max distance (m)	10.60 ± 1.07	10.94 ± 1.03	-0.72	0.48
Performance technique (score)	6.35 ± 0.88	6.50 ± 0.71	-0.42	0.68
Freestyle swimming max distance (m)	31.60 ± 3.63	29.50 ± 2.37	1.53	0.14

***: Statistically significant differences at ($\alpha \leq 0.05$).**

The results of **Table (2)** show that there were no statistically significant differences at the level ($\alpha \leq 0.05$) between the experimental and control groups of female students in body mass, height, and the pre-test means of physical variables and basic freestyle swimming skills. These results confirm the equivalence between the experimental and control groups before implementing the educational programs.

Procedures

This study adopted the experimental method using the pre-test and post-test design for two groups (experimental and control) applied separately to male and female students. The sample was selected using the purposive sampling method from students enrolled in the Swimming (2) course at Birzeit University and An-Najah National University. Data collection involved observation, structured performance tests, and the use of standardized instruments for measuring both physical variables and skill performance in freestyle swimming.

The experimental group received a program designed according to the flipped classroom strategy, prepared by the researcher and validated by experts, and based on the framework of Diana Laurillard (2013) at University College London (UCL). The program aimed to improve the execution of basic freestyle swimming movements, focusing on arm strokes, leg kicks, breathing techniques, and body flow.

The program was implemented over 480 minutes of practical pool sessions (four units per week) and 135 minutes of theoretical online learning (interactive videos, tasks, and discussions). It incorporated blended learning by combining online and face-to-face instruction with activities such as peer teaching, collaborative learning, problem-solving, and guided discussions.

Phases of the flipped classroom program:

1. **Pre-class phase:** Students received digital materials (videos, images, texts) and engaged in discussions via Padlet before the practical session.
2. **In-class phase:** Sessions included a 10-minute warm-up, 55 minutes of supervised practice (individual, pair, or group), and 5 minutes of feedback.
3. **Post-class phase:** Students consolidated learning through concept maps, reports using QR-linked materials, or video submissions demonstrating technical performance.

Table (3) presents the distribution of learning activities in the flipped classroom program, highlighting the balance between acquisition, practice, collaboration, and production tasks designed to enhance student engagement.

Table 3: Distribution of Learning Experience in the Flipped Classroom Program

Learning Mode	Minutes	%
Acquisition (Read, Watch, Listen)	30	6

Investigation	30	6
Discussion	35	7
Practice	320	63
Collaboration	60	12
Production	35	7

Table (4) shows the modes of participation and delivery in the flipped classroom program, indicating how students engaged in learning individually, in groups, and as a class, as well as the balance between online and face-to-face learning and teacher presence.

Table 4: Participation and Delivery Modes in the Flipped Classroom Program

Mode	Minutes	%
Whole class	125	35
Group work	140	39
Individual work	95	26
Face-to-face (not online)	330	65
Online learning	180	35
Teacher present	355	70
Teacher not present (asynchronous)	155	30

To evaluate the effectiveness of the instructional programs, both physical performance and swimming skills were measured using standardized tests supported by appropriate tools and materials. Physical performance was assessed through a set of established fitness tests, including the vertical jump from standing, trunk rotation, medicine ball throw using a 2 kg ball for females and a 3 kg ball for males, and the sit-up test performed over 60 seconds. In parallel, freestyle swimming skills were evaluated by measuring the maximum distance achieved in arm movements, the maximum distance achieved in leg movements, the scoring of technical performance, and the maximum distance swum using the freestyle technique. For the purpose of ensuring accuracy and reliability in data collection, the study employed a set of standardized instruments, namely a measuring tape for body height, an electronic scale for body mass, floating boards to support swimming tasks, medicine balls of different weights for the throwing test, a stopwatch to time both sit-ups and swimming performance, and structured recording sheets designed to capture demographic information and all physical and skill-related test results.

Study Variables

The current study included both independent and dependent variables. The independent variables were represented by the type of instructional program applied, namely the flipped classroom strategy and the traditional instructional program. The dependent variables consisted of the performance outcomes obtained by the study participants in two domains: physical fitness tests and freestyle swimming skill tests. The physical fitness tests included the vertical jump from standing, trunk rotation, medicine ball throw, and the sit-up test. The freestyle swimming skill tests measured the maximum distance of arm movements, the maximum distance of leg movements, the technical performance score, and the maximum distance swum using the freestyle technique.

Data Analysis

To reach the results of the study and verify the validity of its hypotheses, the statistical program (SPSS) was used through the application of the following treatments:

- Arithmetic means, standard deviations, and skewness coefficient.
- (Paired samples t-test) to determine the differences between the pre-test and post-test means of the studied variables for both the experimental and control groups, and to extract the effect size values according to (Cohen's d) standards which are: very small effect ($d \geq 0.01$), small effect ($d \geq 0.20$), medium effect ($d \geq 0.50$), large effect ($d \geq 0.80$), very large effect ($d \geq 1.20$) (Sawilowsky, 2009).
- (Independent samples t-test) to ensure the equivalence between the experimental and control groups in the variables of body mass and height and the pre-test means of the physical and skill variables under study, as well as to confirm the validity of the tests using the discriminant validity method.
- (Pearson correlation coefficient) to ensure the reliability of the physical and skill variables under study.
- (Analysis of Covariance, ANCOVA) to determine the differences in the post-test means between the experimental and control groups, and the extraction of effect size values using (Eta partial squared, ηp^2) according to the following standards: small effect (0.01), medium effect (0.06), large effect (0.14) (Richardson, 2011).

RESULTS

To ensure the quality of the study's measurement tools, both validity and reliability of the physical and skill tests were examined. Validity was verified using discriminant validity, by applying the physical and skill tests to a pilot sample of 12 female students (distinguished and non-distinguished in freestyle swimming) who were excluded from the main study sample. The differences between the two groups were analyzed using the Independent Samples t-test, and the results are presented in **Table (5).**

Table 5: Results of Independent Samples t-test for Differences Between Distinguished and Non-Distinguished Students in Physical and Skill Variables (n = 12)

Physical and skill variables	Distinguished group (Mean ± SD)	Non-distinguished group (Mean ± SD)	T-value	Sig.
Vertical jump (cm)	47.50 ± 3.39	40.83 ± 3.43	3.39	0.007*
Trunk rotation (cm)	7.00 ± 1.84	4.83 ± 1.47	2.29	0.045*
Medicine ball throw (m)	5.12 ± 0.24	4.25 ± 0.42	4.4	0.001*
Sit-up (60s)	46.67 ± 4.27	39.33 ± 3.55	3.23	0.009*
Arm movements max distance (m)	14.17 ± 1.32	11.41 ± 1.06	3.97	0.003*
Leg movements max distance (m)	14.50 ± 1.64	11.17 ± 0.98	4.26	0.002*
Technique score	8.67 ± 0.82	6.66 ± 0.52	5.07	0.000*
Freestyle max distance (m)	56.17 ± 8.37	38.00 ± 4.73	4.63	0.001*

***: Statistically significant at $\alpha \leq 0.05$**

The results of **Table (5)** indicate statistically significant differences ($\alpha \leq 0.05$) in favor of the distinguished group across all physical and skill variables, confirming that the tests possess discriminant validity and measure what they were designed to measure.

Reliability was established through the test–retest method with the same pilot sample, applied twice with a one-week interval. Pearson correlation coefficients were calculated between the two applications, and self-validity values were obtained using the square root of the reliability coefficient. The results are presented in **Table (6).**

Table 6: Reliability and Self-Validity Coefficients of Physical and Skill Variables (n = 12)

Physical and skill variables	R-value	Self-validity	Sig.
Vertical jump (cm)	0.91	0.953	0.000**
Trunk rotation (cm)	0.88	0.938	0.000**
Medicine ball throw (m)	0.87	0.932	0.001**
Sit-up (60s)	0.92	0.959	0.000**
Arm movements max distance (m)	0.91	0.953	0.000**
Leg movements max distance (m)	0.93	0.964	0.000**
Technique score	0.92	0.959	0.000**
Freestyle max distance (m)	0.93	0.964	0.000**

****: Statistically significant at $\alpha \leq 0.01$**

The results of **Table (6)** show that the reliability coefficients for physical variables ranged between (0.87) and (0.92), with self-validity values between (0.932) and (0.959). For the skill variables, reliability ranged between (0.91) and (0.93), with self-validity values between (0.953) and (0.964). All coefficients were statistically significant at $\alpha \leq 0.01$, confirming that the physical and skill tests used in the study are both reliable and valid for achieving the intended research objectives.

RESULTS RELATED TO THE FIRST HYPOTHESIS

The first hypothesis stated:

"There are no statistically significant differences at the level ($\alpha \leq 0.05$) between the pre-test and post-test means for some physical variables and basic freestyle swimming skills among the experimental group."

To test the validity of this hypothesis, the (Paired Samples t-test) and (Effect Size) (Cohen's d) were applied for the female students, and the results are shown in **Table (7).**

Table 7: Effect Size and Results of the Paired Samples t-test for Differences Between Pre-test and Post-test Means of Some Physical and Basic Freestyle Swimming Skill Variables for the Experimental Group (Female Students) (n = 20)

Physical and skill variables	Pre-test (Mean ± SD)	Post-test (Mean ± SD)	T-value	Sig.	Effect size (Cohen's d)	Interpretation
Vertical jump (cm)	29.40 ± 2.37	35.50 ± 1.27	7.54	0.000*	2.55	Very large
Trunk rotation (cm)	6.30 ± 1.42	9.80 ± 1.87	6.45	0.000*	1.71	Very large
Medicine ball throw (m)	3.58 ± 0.24	3.96 ± 0.37	4.33	0.002*	0.28	Small
Sit-up (60s)	34.80 ± 3.55	40.30 ± 2.58	5.49	0.000*	3.17	Very large
Arm movements max distance (m)	10.29 ± 2.25	14.95 ± 1.28	6.4	0.000*	2.3	Very large
Leg movements max distance (m)	10.60 ± 1.07	13.60 ± 0.97	7.12	0.000*	1.33	Very large
Technique score	6.35 ± 0.88	7.95 ± 0.96	7.24	0.000*	0.7	Medium
Freestyle max distance (m)	31.60 ± 3.63	37.70 ± 2.50	5.88	0.000*	3.28	Very large

*: Statistically significant at the level ($\alpha \leq 0.05$)

The results of **Table (7)** indicate statistically significant differences at the level ($\alpha \leq 0.05$) between the pre-test and post-test means across all physical and skill variables under study for the experimental group (female students), in favor of the post-test. Therefore, the first null hypothesis is rejected. Regarding the physical variables, the effect of the flipped classroom instructional program was very large for vertical jump, trunk rotation, and sit-up test, with effect size values of (2.55), (1.71), and (3.17) respectively, while the medicine ball throw showed a small effect size of (0.28). For the basic freestyle swimming skills, the effect was very large in arm movements for maximum distance, leg movements for maximum distance, and freestyle for maximum distance, with effect sizes of (2.30), (1.33), and (3.28) respectively. In contrast, the effect on technique performance was medium, with an effect size of (0.70).

Results Related to the Second Hypothesis

The second hypothesis stated:

"There are no statistically significant differences at the level ($\alpha \leq 0.05$) between the pre-test and post-test means for some physical variables and basic freestyle swimming skills among the control group."

To test the validity of this hypothesis, the (Paired Samples t-test) and (Effect Size) (Cohen's d) were applied separately for male and female students. Table (8) presents the results for the female students.

Table 8: Effect Size and Results of the Paired Samples t-test for Differences Between Pre-test and Post-test Means of Some Physical and Basic Freestyle Swimming Skill Variables for the Control Group (Female Students) (n = 20)

Physical and skill variables	Pre-test (Mean ± SD)	Post-test (Mean ± SD)	T-value	Sig.	Effect size (Cohen's d)	Interpretation
Vertical jump (cm)	29.80 ± 4.08	31.10 ± 3.14	3.07	0.013*	1.33	Very large
Trunk rotation (cm)	6.00 ± 2.31	6.70 ± 2.41	3.28	0.010*	0.67	Medium
Medicine ball throw (m)	3.46 ± 0.28	3.50 ± 0.25	0.42	0.686	0.26	Small
Sit-up (60s)	34.70 ± 5.38	35.40 ± 5.54	2.69	0.025*	0.82	Large
Arm movements max distance (m)	10.62 ± 2.22	11.34 ± 1.81	3.64	0.005*	0.63	Medium
Leg movements max distance (m)	10.94 ± 1.03	12.05 ± 0.83	4.97	0.000*	0.73	Medium
Technique score	6.50 ± 0.71	7.10 ± 0.74	3.66	0.005*	0.52	Medium
Freestyle max distance (m)	29.50 ± 2.37	31.60 ± 2.37	4.85	0.000*	1.37	Very large

***: Statistically significant at the level ($\alpha \leq 0.05$)**

The results of Table (8) indicate statistically significant differences at the level ($\alpha \leq 0.05$) between the pre-test and post-test means in the physical variables of vertical jump, trunk rotation, and sit-up test, as well as in all basic freestyle swimming skill variables under study for the female students in the control group, in favor of the post-test. Therefore, the second null hypothesis is rejected. No statistically significant differences were found in the medicine ball throw variable. With regard to the physical variables, the traditional instructional program produced a very large effect in the vertical jump (1.33), a large effect in the sit-up test (0.82), a medium effect in trunk rotation (0.67), and a small effect in the medicine ball throw (0.26). Concerning the basic freestyle swimming skills, the effect of the traditional instructional program was very large in freestyle maximum distance (1.37), while medium effects were observed in arm movements for maximum distance (0.63), leg movements for maximum distance (0.73), and technique performance (0.52).

Results Related to the Third Hypothesis

The third hypothesis stated:

"There are no statistically significant differences at the level ($\alpha \leq 0.05$) between the post-test means of some physical variables and basic freestyle swimming skills between the experimental and control groups."

To examine this hypothesis, (ANCOVA) was used to control and isolate the effect of the pre-test and to compare the post-test means between the experimental and control groups. In addition, the effect size was calculated using partial eta squared (ηp^2) to determine the proportion of variance explained by the flipped classroom strategy in improving some physical variables and learning basic freestyle swimming skills compared with the traditional method. The results are presented in Table (9).

Table 9: Summary of ANCOVA Results for Differences Between Post-test Means of Some Physical and Basic Freestyle Swimming Skill Variables Between the Experimental and Control Groups (Female Students) (n = 40)

Variables	Group	Adjusted Mean (SE)	F-value	Sig.	Effect size (ηp^2)	Interpretation
Vertical jump (cm)	Experimental	35.61 (0.47)	47.48	0.000*	0.736	Large
	Control	30.99 (0.47)				
Trunk rotation (cm)	Experimental	9.67 (0.42)	22.56	0.000*	0.57	Large
	Control	6.84 (0.42)				
Medicine ball throw (m)	Experimental	3.92 (0.09)	9.83	0.006*	0.366	Large
	Control	3.54 (0.09)				
Sit-up (60s)	Experimental	40.26 (0.71)	23.31	0.000*	0.578	Large
	Control	35.44 (0.71)				
Arm movements max distance (m)	Experimental	15.03 (0.39)	47.58	0.000*	0.737	Large
	Control	11.26 (0.39)				
Leg movements max distance (m)	Experimental	13.66 (0.27)	18.97	0.000*	0.527	Large
	Control	11.99 (0.27)				
Technique score	Experimental	8.01 (0.19)	12.65	0.000*	0.427	Large
	Control	7.04 (0.19)				
Freestyle max distance (m)	Experimental	37.20 (0.65)	28.77	0.000*	0.629	Large
	Control	32.10 (0.65)				

*: Statistically significant at the level ($\alpha \leq 0.05$)

The results of Table (9) show statistically significant differences at the level ($\alpha \leq 0.05$) between the post-test means of all physical and basic freestyle swimming skill variables under study between the experimental and control groups, in favor of the experimental group. Thus, the third null hypothesis is rejected. The effect size values (ηp^2) further indicate that the flipped classroom strategy had a large impact in improving the studied variables compared to the traditional program after controlling for the pre-test. Specifically, the flipped classroom strategy explained (73.60%) of the

improvement in vertical jump, (57%) in trunk rotation, (36.60%) in medicine ball throw, (57.80%) in sit-up performance, (73.70%) in arm movements for maximum distance, (52.70%) in leg movements for maximum distance, (42.70%) in technique performance, and (62.90%) in freestyle maximum distance.

DISCUSSIONS

The results of the first hypothesis showed clear improvements in all physical and skill variables for the experimental group, with post-test performance significantly higher than pre-test scores. This finding supports the idea that the flipped classroom allows students to build theoretical understanding before practice, which in turn strengthens performance in the water. By watching videos and reviewing material ahead of class, students entered practical sessions with greater confidence and focus, leaving more time for active application and problem-solving. Similar to the findings of Vaughn et al. (2019) and Long et al. (2024), this study confirms that flipping instruction creates an interactive learning environment where students become more engaged and capable of applying what they have learned. Large effect sizes in measures such as vertical jump, trunk rotation, and sit-ups suggest that extended practice time in the pool helped develop both lower and upper body strength, with water resistance amplifying gains in explosive power.

At the same time, the results showed that the flipped classroom was less effective in improving the medicine ball throw, where the effect size was small (0.28). This may be because not all students responded equally to the activities and arm strength requires more specialized resistance training than what the program offered. Variations in motivation and self-directed practice could also explain the uneven results, which aligns with the conclusions of Borzuolo et al. (2022) and Sun et al. (2024). For the swimming skills, the flipped approach proved especially powerful in improving arm and leg movements and freestyle distance, where effect sizes were very large. Students reported that pre-class preparation helped them focus on technique during practice, while peer feedback and collaborative drills deepened their understanding of movement mechanics. Still, the effect on technical performance remained moderate, likely because mastering fine details such as coordination and breathing requires longer and more intensive practice. This echoes the mixed evidence in the literature: while Bishop & Verleger (2013) and Gorbel (2024) found similar outcomes, studies such as Park & Park (2018) reported greater improvements when flipped designs were supported by more structured technical training.

The second hypothesis results also showed significant improvements in the control group, although these were less consistent. Students improved in vertical jump, trunk rotation, sit-ups, and all swimming skills except the medicine ball throw. The traditional program clearly supported endurance and general strength, as shown by the very large effect in freestyle maximum distance (1.37), a result consistent with Cormie et al. (2011) and Behm et al. (2017). The large effect in sit-ups (0.82) highlights how repeated and stable exercises can build core endurance, while the medium effect in trunk rotation (0.67) likely reflects the absence of targeted activities for lateral core muscles. This mirrors earlier findings by Hibbs et al. (2008) that emphasized the need for neuromuscular coordination to improve flexibility and balance. The medicine ball throw again showed only a small effect (0.26), which suggests that the traditional program's lack of variety and time limitations reduced its ability to develop upper body strength.

For swimming skills, traditional instruction helped students improve freestyle distance, but effects on arm movements, leg movements, and technique were only moderate. The absence of interactive feedback and motion analysis limited students' ability to refine technique, resulting in surface-level rather than deep improvements. These findings echo Seifert et al. (2014) and Bessa et al. (2021), who also argued that conventional methods focus heavily on physical repetition and less on creativity, problem-solving, or immediate feedback. This highlights a key limitation of traditional teaching: while it can improve endurance through repetition, it struggles to foster technical precision and adaptive learning.

The third hypothesis results provided the most compelling evidence in favor of the flipped classroom. After controlling for pre-test scores, the experimental group significantly outperformed the control group in every variable, with large effect sizes across the board. The flipped classroom explained between (36.60%) and (73.70%) of the variance in improvements, particularly in arm movements, leg movements, freestyle distance, and technique. These findings suggest that flipped instruction does more than just extend practice time—it changes the way students engage with learning. By preparing before class, students used in-class sessions for meaningful practice, collaboration, and immediate feedback, which amplified both physical and technical gains. This agrees with the conclusions of Bergman and Sam (2012) and Chen (2020), who highlighted the role of flipped learning in promoting autonomy, motivation, and deeper engagement.

Skill development was especially notable in this study. Students in the flipped classroom were able to review theoretical materials, videos, and demonstrations before class, then apply this knowledge during diverse individual and group drills. This reduced lecture time and increased practice opportunities, while also encouraging peer collaboration and teacher feedback. Such conditions fostered active learning, creativity, and problem-solving—outcomes also reported in studies by Gilboy et al. (2015), Safapour et al. (2019), and Ferriz-Valero et al. (2022). In contrast, the traditional program remained constrained by its focus on in-class theory, leaving less time for practice and fewer opportunities for interaction. Correcting mistakes and refining technique became more time-consuming, which limited its impact on complex motor skills. As Tune et al. (2013) and Akers (2021) noted, technical skills demand both time and feedback-rich environments, conditions that flipped learning is better positioned to provide.

Limitations

There are some obvious limitations to the study. Because it only involved a small sample of female students from two universities, the findings may not be generalizable. Additionally, the program was short-lived, so we are unsure of the long-term effects of the flipped classroom. Lastly, the outcomes were contingent on particular skill assessments and the facilities that were available, which may differ in other locations.

CONCLUSIONS

The study showed that using the flipped classroom approach made a clear difference in how female students in physical education learned the basic movements of freestyle swimming. Students who learned through this method outperformed those taught in the traditional way, as the combination of pre-class preparation with in-class practice improved both their physical fitness and technical skills. Traditional teaching, on the other hand, had only limited influence on performance. The strength of the results, ranging from moderate to very strong effects, highlights the value of the flipped classroom in building swimming skills more effectively than conventional instruction.

Based on these outcomes, the study suggests that physical education programs at Birzeit University and other Palestinian universities integrate the flipped classroom into their training courses. This requires providing students with access to online resources and preparing teachers to use digital platforms as part of their teaching. The approach could also be enriched with new technologies such as virtual reality and artificial intelligence to give students better feedback and more personalized learning experiences. Future studies are encouraged to test this strategy in other sports, with both male and female students, and over longer periods to confirm its long-term impact.

PRACTICAL IMPLICATIONS

The findings of this study have clear meaning for teaching and training in physical education. They show how important it is to connect theory with real practice, so students stay engaged and learn better. With the flipped classroom, teachers can give students more time in class for practice, teamwork, and quick feedback. This helps improve technique in swimming and makes the learning process more active. For teachers, this means preparing lesson materials in advance and letting students study them before class, so class time can focus on solving problems and improving skills.

In practice, physical education programs can use the flipped classroom by creating simple digital resources, asking students to go through them before class, and then using class time for individual coaching and correcting mistakes. Coaches can also apply this method in other sports, since it supports learning skills and improving performance. The study also points to the future use of tools like virtual reality for practice and artificial intelligence for tracking progress, which could make sports education more modern and give students better chances to learn and perform.

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