Modern Sport

Volume 24 | Issue 1 Article 2

3-30-2025

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Recommended Citation
Fhaim, Magdy Mahmood and Abdulraheem, Ameera Mahmood Taha (2025) "Adaptive Learning Stations and Their Impact on Cognitive Achievement in the Course of Methods and Techniques of Teaching Physical Education," *Modern Sport*: Vol. 24: Iss. 1, Article 2.
DOI: 10.54702/2708-3454.1001
Available at: https://jcopew.researchcommons.org/journal/vol24/iss1/2

MODERN SPORT 2025;24:9–18

RESEARCH ARTICLE

Adaptive Learning Stations and Their Impact on Cognitive Achievement in the Course of Methods and Techniques of Teaching Physical Education

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Abstract

The study aims to identify the effect of adaptive learning stations on cognitive achievement in the course of "Methods and Techniques of Teaching Physical Education." The researchers employed the experimental approach due to its suitability for the nature of the study and the sample. A quasi-experimental design was used with two groups: one control and one experimental, using post-measurements for the research variables. The study sample was randomly selected from second-year female students in the Faculty of Physical Education at Sadat City University during the 2023/2024 academic year. The sample included 180 students, representing 32.37% of the total population. The students were divided into two equal groups: 90 in the control group and 90 in the experimental group. Additionally, 60 students (10.79% of the population) were selected from outside the primary sample for a pilot study, bringing the total sample size to 240 students, representing 43.16% of the total population. The following tools were used to collect data: Data analysis, Intelligence test, Cognitive achievement test Opinion and impression form regarding the use of adaptive learning stations. The study revealed statistically significant differences between the post-measurements of the control and experimental groups in the level of cognitive achievement in the course of "Methods and Techniques of Teaching Physical Education." The experimental group, which used adaptive learning stations, showed higher improvement rates in the oral test (51.74%) and cognitive achievement level (57.81%). Additionally, the relative importance of the emotional impressions and opinions of the experimental group regarding the use of adaptive learning stations ranged from 91.11% to 100%. This indicates that adaptive learning stations effectively enhance the affective domain and positively influence students' opinions and impressions about the course. and this achieves one of the sustainable development goals of the United Nations in Iraq which is (Quality Education)

Keywords: Learning stations, Adaptive learning, Methods and techniques of teaching physical education

1. Introduction

The immense progress in science and the accompanying knowledge explosion make it difficult to overload learners' minds with information. Filling their minds with ready-made information templates is extremely risky, as it prevents them from utilizing their cognitive abilities effectively and deprives them of participating in the educational process [7]. This has led to a growing emphasis on employing modern teaching strategies that meet students' needs, stimulate their ideas, and activate their participation in the educational process, enabling them to discover knowledge independently. Among these strategies is the Learning Stations Strategy, which is considered one of the most engaging and enjoyable methods in teaching. It creates an atmosphere of fun, variety, and movement within the classroom, helping to energize students, enhance their thinking abilities, and foster self-learning attitudes. This strategy allows students to move in small groups through a series of stations where information is presented in diverse ways tailored to their different learning styles. At each station, students complete the required tasks [12]. The importance of learning station strategies lies in their focus on the positive role of students through small group

Received 26 November 2024; revised 3 December 2024; accepted 18 December 2024.
Available online 30 March 2025

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https://doi.org/10.54702/2708-3454.1001

learning, integrating diverse technological activities. These stations offer various forms of applications, resources, and activities that encompass many aspects, including reading, exploration, research, visual, auditory, and digital activities. They enable all students to engage in hands-on activities, positioning the learner at the center of the educational process. Students build their knowledge independently, relying on their prior experiences and collaboration with peers through various educational activities as they rotate from one station to another within a time frame set by the teacher. Each station is equipped with tools, devices, educational materials, and worksheets to carry out the tasks, serving as a distinctive type of educational activity [8]. Jones (2007) [21] defined learning stations as "a teaching method where a small group of students moves through a series of stations, allowing teachers to utilize limited resources to enable each student to perform all activities by rotating through the different stations" [16, pp. 166–194]. On the other hand, Saidi and Al-Balushi (2011) did not provide a specific definition for learning stations. However, they described them as a series of spaced-out tables within a classroom or laboratory, with each table serving as a learning station presenting scientific material through various activities. Groups of learners move sequentially through these stations, interact with the activities, and acquire knowledge and information independently under the teacher's supervision. While typically used for teaching practical lessons, learning stations can also be adapted for theoretical lessons [12]. Essam Said (2020) described learning stations as "an instructional strategy based on an unlimited number of stations offering a variety of practical experiences and theories under suggested names that reflect their characteristics. This strategy relies on the nature of the learning content and the available resources in the educational environment. It contributes to developing students' higher-order thinking skills and creates an engaging atmosphere in the educational process, facilitating the acquisition of experiences and achieving learning outcomes" [13].

Adaptive learning is considered a prominent concept in modern education and its various fields. It utilizes specific tools to meet individual educational needs and aims to provide a safe learning environment that accommodates the diversity of learners. People differ in their abilities, readiness, and learning styles. Therefore, adaptive learning techniques strive to create a comfortable and secure environment for every learner, allowing them to learn in ways suited to their abilities without causing embarrassment among peers or with their teacher. This approach breaks the mold of comparing students to one another, instead enhancing the learner's confidence in their own skills and experiences by encouraging self-comparison and progress, fostering a positive educational identity. The goal of adaptation is to align content with learners' diverse needs, ensuring each learner receives content in a way that suits them. In adaptive education, the educational content is tailored and presented in different formats that match the varied learning styles of students. For example, the same content can be presented auditorily for auditory learners and visually for visual learners (27).

Adaptive learning is defined as a learning method in which instruction is delivered according to the learning styles, methods, and characteristics of individual learners. It caters to each learner's way of learning, whether through traditional or electronic methods, while considering individual differences. This adaptation applies quantitatively and qualitatively to the educational environment, content, its presentation, the student, and the teacher [2, p. 10].

The course Methods and Techniques of Teaching Physical Education is one of the specialized courses in physical education. It provides students with all the necessary information and experiences related to teaching methods, techniques, and strategies, equipping them to become competent teachers. The course is characterized by its interconnected concepts, interrelated terminology, and a wealth of information and knowledge. Teaching this course requires a modern instructional strategy that increases students' motivation, simplifies the scientific content, considers individual differences among students, develops their cognitive abilities, and bridges theoretical knowledge with practical application. The researchers observed, through their experience teaching the Methods and Teaching Strategies course, that some students felt bored due to the course's difficulty and the overlapping and interwoven nature of its concepts. Moreover, the traditional teaching methods neither accounted for individual differences among students nor considered their unique learning styles, making it challenging for them to learn quickly, master the material, and fully comprehend the information. Additionally, students remained passive learners with no active role in the teaching process, further contributing to their feelings of difficulty, lack of understanding, and boredom. Hence, the researchers believe that employing learning stations during the teaching of this course would encourage students and stimulate their motivation to learn. This approach allows students to construct their own knowledge, build on their prior experiences, and collaborate with their peers through various educational activities and worksheets at each station. Students rotate from one station to another, engaging in diverse tasks. These stations are adaptive, accommodating the unique learning styles

of each student—visual, auditory, and kinesthetic—when presenting content at each station. As a result, this approach is expected to positively influence the students' cognitive achievement levels in the Methods and Strategies of Teaching Physical Education course.

1.1. Research objective

This research aims to explore the impact of adaptive learning stations on cognitive achievement in the Methods and Strategies of Teaching Physical Education course.

1.2. Research hypotheses

1. Statistically significant differences exist between the post-measurement results of the control and experimental groups, favoring the experimental group in terms of cognitive achievement in the Methods and Strategies of Teaching Physical Education course.
2. Variations exist in the opinions and emotional impressions of students in the experimental group regarding the use of adaptive learning stations.

1.3. Research terms

1.3.1. Adaptive learning stations

A strategy that consists of a series of educational activities and worksheets through which students learn sequentially while rotating among three adaptive stations designed to match their learning styles, including digital library, audiovisual, and technological stations. Each station is repeated twice, making a total of six stations, with the aim of improving academic achievement in the Methods and Strategies of Teaching Physical Education course.

2. Methods and procedures

2.1. First: research methodology

The researchers utilized the experimental method, which aligns with the study's nature and sample. The research design included two groups, one serving as the control group and the other as the experimental group, with post-measurements applied to the research variables.

Table 1. Represents the classification of the research sample into study groups.

Sample	Groups	No.	Percentage
Primary	Experimental Group	90	75.00
	Control group	90	
Pilot Sample		60	25.00
Total		240	100 %

2.2. Second: research population and sample

2.2.1. Research population

The research population was deliberately chosen from second-year female students enrolled in the Faculty of Physical Education at the University of Sadat City for the academic year 2023/2024, with a total of 556 students.

2.2.2. Research sample

The research sample was randomly selected from second-year female students enrolled in the Faculty of Physical Education at the University of Sadat City for the academic year 2023/2024. The sample included 180 students, representing 32.37% of the total population, and was divided equally into two groups: a control group of 90 students and an experimental group of 90 students. Additionally, 60 students, representing 10.79% of the total population and not part of the main research sample, were selected as a pilot sample. Thus, the total research sample consisted of 240 students, accounting for 43.16% of the total population, as shown in Table 1.

2.2.3. Normality of the research sample

To ensure that the research sample follows a normal distribution, skewness coefficients were used to determine the homogeneity factor for the main variables in the study for both the control and experimental groups. The results are presented in the following table:

Table 2. Presents the mean, standard deviation, median, and skewness coefficient for the variables of age, height, weight, and intelligence for the research population: (n = 240).

			Statistical Treatments				
No.	Variables	Unit of measurement	Arithmetic Mean	Standard Deviation	Median	Kurtosis	Skewness coefficient
1.	Age	Year	19.33	0.52	19.00	3.83	1.614
2.	Length	CM	163.38	5.17	162.00	−0.826	0.705
3.	Weight	KG	61.78	7.66	60.00	−0.285	−0.057
4.	Intelligence	Degree	87.74	6.59	88.00	−0.745	−0.301

Table 3. Shows the Significance of Differences Between the Averages of the Two Research Groups (N1 = N2 = 90).

No.	Variables	Experimental Group		Control group		Mean Difference	Calculated (T) value
		Arithmetic Mean −	SD +	Arithmetic Mean −	SD +		
1	Age	19.31	0.47	19.38	0.61	0.07	0.79
2	Length	163.78	5.21	162.71	4.97	1.7	1.19
3	Weight	62.33	7.17	61.09	8.25	1.24	1.02
4	Intelligence	87.83	6.91	87.66	6.21	1.78	0.19

Table 2 shows that the skewness coefficients for the selected variables under study—**age, height, and weight**—fall within the range of (±3), with values ranging from (−0.301 to 1.614). This indicates the homogeneity of the selected sample groups in terms of the variables **age, height, weight, and intelligence** under study. Consequently, the data aligns with the normal curve and exhibits a normal distribution.

2.2.4. Equivalence of research groups

To ensure the similarity of levels between the experimental and control groups in the selected variables under study, and to control the relationship between the two groups, the researchers calculated the equivalence between them. This is demonstrated in the following table:

The calculated "t" value at degrees of freedom (df: $n_1 + n_2 - 1 = 89$) and the significance level of $(0.05) = 2.000$.

The Table 3 shows that the calculated "t" values are less than the tabulated "t" value for all the aforementioned variables. This indicates no statistically significant differences in the means of **age, height, weight, and intelligence** under study, confirming the equivalence between the two research groups.

2.3. Third: data collection tools

The researchers used the following tools to collect data related to the research:

1. Data Analysis.
2. Intelligence Test.
3. Cognitive Achievement Test.
4. Questionnaire on Opinions and Impressions Regarding the Use of Adaptive Learning Stations.

Below is an explanation of each step:

1. **Data Analysis:**
   The researchers reviewed previous studies, related research, scientific production, and scientific references (both Arabic and foreign) related to the topic of the research, along with references on the methods and strategies of teaching physical education.
2. **Intelligence Test**:
   The researchers applied the verbal intelligence test for secondary school and university students, which was developed by "Jaber Abdel Hamid and Mahmoud Ahmed Omar" (2007). It has been used in various studies with the same student samples and has proven its validity and reliability for measuring the intended characteristic.
3. **Cognitive Achievement Test**:
   The researchers relied on the results of the final semester cognitive achievement exam, as well as the final oral exam scores for the course.
4. **Questionnaire on Opinions and Impressions Regarding the Use of Adaptive Learning Stations:**
   This questionnaire, in its final form, consisted of 12 statements aimed at understanding the attitudes and opinions of the "experimental group" students toward using adaptive learning stations for the course "Methods and Strategies of Teaching Physical Education."

– **Steps for Designing the Questionnaire on Opinions and Impressions Regarding the Use of Adaptive Learning Stations (Prepared by the researchers):**
   To design the questionnaire on opinions and impressions regarding the use of adaptive learning stations for the "Methods and Strategies of Teaching Physical Education" course, the researchers followed these steps: -

• **Formulation and Identification of Statements:**
   Based on the research title and objective, and drawing from scientific references and previous studies, several statements were formulated and identified to reflect students' opinions on the use of adaptive learning stations for the course on Methods and Strategies of Teaching Physical Education. The researchers employed the five-point Likert scale due to its suitability for the study. The scientific properties of the opinion and impression form were also utilized.

– **Validity by Experts:**
   The questionnaire was presented to a number of experts from the Faculties of Physical Education, totaling three individuals (see Appendix 1), to gather their opinions on the

Table 4. Shows the correlation coefficient between the first and second application of the questionnaire on opinions and impressions regarding the use of adaptive learning stations for the "methods and strategies of teaching physical education" course (N = 60).

Variables	Value of Coefficient of Correlation
Questionnaire of opinions and impressions towards the use of adaptive educational units for the course of methods and methods of teaching physical education	0.638*

The tabulated r-value at df: (N-2) = (58), and the significance level (0.05) = 0.273.

questionnaire's validity. Their feedback included clarity, coherence, and wording of each statement. Suggestions for modification, addition, or deletion of some statements were made. The proposed changes were limited to rephrasing some statements, and the experts approved the statements with 100% agreement.

– **Reliability of the Questionnaire**:

The researchers calculated the reliability coefficient using the **Retest Test** method, with a time gap of six days between the two applications. The questionnaire was administered to the experimental group students two weeks after using the adaptive learning stations. The first application was conducted on Tuesday, October 17, 2023, and the second application was carried out on Tuesday, October 24, 2023, on the same sample (experimental group) to measure the reliability of the questionnaire.

Table 4 shows that the calculated "r" value is less than the critical "r" value for the questionnaire on opinions and impressions regarding the use of adaptive learning stations for the "Methods and Strategies of Teaching Physical Education" course. This indicates that the "r" value is statistically significant, which suggests a correlation between the first and second applications. Thus, the questionnaire on opinions and impressions regarding the use of adaptive learning stations for the "Methods and Strategies of Teaching Physical Education" course is reliable.

2.4. Fourth: steps for preparing adaptive learning stations

- **Preparation and Planning Phase**

1. Identifying the Objectives of the Topics.
2. Selecting and Determining the Adaptive Learning Stations, ensuring the content displayed in each station is adapted to suit all learning styles ("auditory – visual – kinesthetic").
3. Determining the Content for the Adaptive Learning Stations.
4. Planning and Preparing Educational Activities and Worksheets for each station.
5. Determining the number of stations and the time allocated for each station.

The researchers selected three educational stations: "digital library – audiovisual – electronic" to align with the nature of the teaching methods course and the educational goals. These stations also accommodate different learning styles among students. The following was considered:

A. **Digital Library Station**: In this station, an electronic booklet is placed. Students review the topic assigned for study at the station, which contains text, images, and sound, accommodating various learning styles. This helps students become independent learners, allowing them to extract knowledge from its sources, increasing their motivation to learn and subsequently answering a number of accompanying questions.
B. **Audiovisual Station**: In this station, an educational video is displayed, and students watch it and respond to the accompanying questions in the worksheets.
C. **Electronic Station**: In this station, a computer is placed, and students view a PowerPoint presentation related to the lesson topic. They conduct online searches to answer the accompanying questions for the educational material.

These stations were designed to be similar in pairs, resulting in six total stations within the lesson. Each station allows students to stay for ten minutes.

6. Students are randomly divided into cooperative learning groups, ensuring they are heterogeneous based on a prior test.

- **Implementation Phase**

1. The teacher sets up the books, activities, and worksheets at the stations.
2. The teacher assigns students to the stations.
3. The teacher announces the start of reviewing and executing the activities at the learning stations.
4. The teacher reminds students to complete the required tasks in the worksheets.
5. The teacher announces the end of the time for each station and instructs students to switch to the next station.

- **Evaluation Phase**

After preparing and producing the adaptive learning stations "digital library – audiovisual – electronic" with all the educational activities and worksheets for each station, the researchers conducted a pilot study on (60) students from the second-year students at the Faculty of Physical Education, outside the primary sample. This

took place from Tuesday, October 3, 2023, to Tuesday, October 10, 2023, to ensure the safety, content, usability, and effectiveness of the adaptive learning stations. The goal was to gather students' feedback and observations about these stations, identify potential errors, and make necessary adjustments to prepare them for the final experiment. The results of the pilot study showed that the students were impressed with the design and implementation of the adaptive learning stations, the clarity of the content, and there were no issues with the stations. Thus, they were finalized and ready for the main research experiment.

2.5. *Fifth: steps for conducting the research experiment*

– **Meeting with the Students:**
A meeting was held with the second-year students who constituted the research sample to discuss the importance and benefits of the study. It was explained to them that this research aims to enhance their cognitive achievement levels and contribute to improving their grades in the course "Methods and Strategies of Teaching Physical Education" by enabling them to acquire knowledge, information, and relevant terminology. The process of working with adaptive learning stations during the lecture was also clarified, including how to switch between stations and ensure that all students pass through them. Emphasis was placed on completing and implementing the educational activities and worksheets assigned to each station within the specified time. Moreover, the researchers assured the students that the study would account for individual differences and that they would benefit from the availability of multiple adaptive learning stations for the course. This approach ensures better learning outcomes and raises their cognitive achievement in the course material.

2.5.1. *Pre-measurements*

The researchers conducted the pre-measurements for variables under study (height, weight, age, and intelligence) for both the control and experimental groups on Tuesday, October 3, 2023.

- **Main Study**: The **instruction** took place inside the college, following the scheduled classes once a week on Mondays, from Tuesday, October 3, 2023, to Tuesday, December 19, 2023.

2.5.2. *Post-measurements*

The post-measurements were carried out to evaluate the oral exam scores by a panel of examiners from the Curriculum and Instruction, and Sports Movement Sciences departments. These were held on Wednesday and Thursday, December 27 and 28, 2023, by the examiners from the Curriculum and Instruction Department at the Faculty of Physical Education, Sadat City University. Additionally, the researchers used the final exam scores for cognitive achievement in the course as part of the post-measurement.

2.6. *Sixth: statistical treatments*

The researcher used appropriate statistical treatments according to the nature of the study, employing the **SPSS (Statistical Package for the Social Science)** program. The following statistical treatments were applied:

- **Arithmetic Mean Percentage of Improvement Rates**
- **Standard Deviation F-test Equation**
- **Median LSD (Least Significant Difference)**
- **Skewness Coefficient Spearman Correlation Coefficient**

2.6.1. *Presentation and discussion of results*

The results of the post-measurements for both the experimental and control groups in terms of cognitive achievement and oral testing for the "Methods and Strategies of Teaching Physical Education" course were presented and discussed.

The tabulated value of "t" at degrees of freedom (df: $n_1 + n_2 - 1 = 89$), with a significance level of (0.05) is 2.000. Table 5 shows that the calculated "t" value is less than the table value for cognitive achievement and oral testing in the "Methods and Strategies of Teaching Physical Education" course under study, indicating that the calculated "t" value is statistically significant. This suggests the presence of differences between the post-measurements in cognitive achievement and oral testing in the "Methods and Strategies of Teaching Physical Education" course in favor of the experimental group. The calculated "t" values ranged between (23.58 to 132.23), as shown in Fig. 1.

Table 5 and Fig. 1 demonstrate the existence of differences in the post-measurements of cognitive achievement and oral testing levels in favour of the experimental group. The researchers attribute this change to the use of adaptive learning stations for the course "Methods and Strategies of Teaching Physical Education." These stations created an integrated environment that included multiple adaptive learning stations, which facilitated and encouraged students to acquire knowledge and information effectively, while also promoting longer retention of learning outcomes. The more students engage with

Table 5. Shows the significance of differences between the average post-measurements in cognitive achievement and oral testing for the "Methods and Strategies of Teaching Physical Education" course for the experimental and control groups N1 = N2 = 90.

Variables	Experimental Group		Control group		F-test	Calculated (T) Value	Percentage of Improvement (%)
	Arithmetic Mean	Standard Deviation ±	Arithmetic Mean	Standard Deviation ±			
Oral Test	12.87	3.67	5.43	0.90	7.44	23.58	57.81
Cognitive Test (Theoretical)	48.53	3.58	23.42	2.35	25.11	132.23	51.74

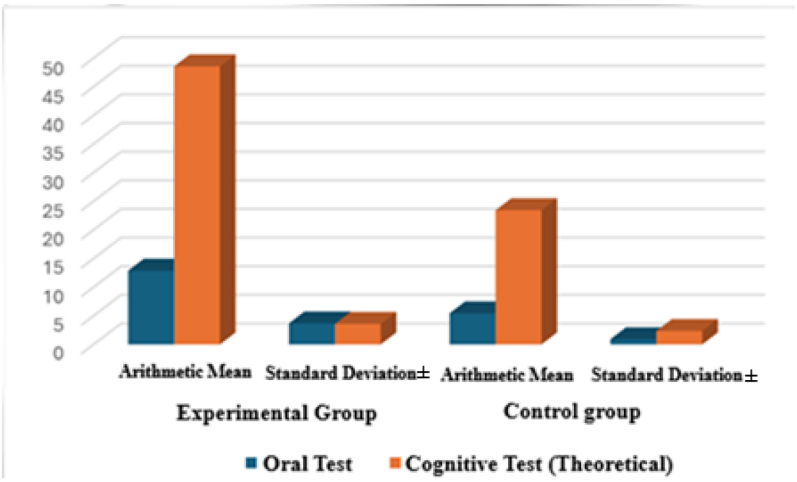

Fig. 1. Shows the differences in means between the post-measurements of the experimental and control groups in cognitive achievement and oral testing in the "Methods and Strategies of Teaching Physical Education" course under study.

the learning experiences they encounter, the greater their retention of those experiences, and the less impact distracting factors have on their learning.

The adaptive learning stations also accounted for individual differences among the students by tailoring the stations to address various learning styles—visual, auditory, and kinesthetic. This approach helped the students ensure their understanding and enhanced their cognitive achievement.

Additionally, the adaptive learning stations took into account individual differences among students by tailoring the stations to address various learning styles—visual, auditory, and kinesthetic. This approach helped students to ensure their understanding and improved their cognitive achievement. Furthermore, the adaptive learning stations supported the development of critical thinking skills among students and made the lessons non-traditional, unlike the methods they were previously accustomed to. It became a pleasurable learning experience that encourages students to actively think, engage with activities, and complete the work provided at each station. This approach builds students' self-confidence, ability to freely express their opinions, and fosters innovative thinking and solutions.

This result aligns with the findings of the studies conducted by Fahim and Fattouh (2021) [16, pp. 166–194], Shamri (2011) [3], Zaki (2013) [5], Qishta (2018) [8], Al-Muhammadi (2015) [17], and Shwia and Shati (2021) [6, pp. 23–36]. These studies confirmed the positive impact of scientific stations on students' knowledge acquisition levels. This is attributed to the adaptive educational stations, which include various educational activities and worksheets that present information to students in multiple ways. Such methods enhance their motivation and interest in studying the curriculum and its various topics, foster their skills in understanding and comprehending different concepts and terms, and ultimately improve their academic performance.

Therefore, the first hypothesis is validated: there are statistically significant differences between the post-measurement results of the control and experimental groups in cognitive achievement in the "Methods and Strategies of Teaching Physical Education" course, favoring the experimental group.

Presentation and Discussion of the Results of Students' Opinions and Impressions in the Experimental Group Regarding the Use of Adaptive Educational Stations Based on the Opinions and Impressions Questionnaire.

Table 6 shows the relative importance of the opinions and impressions of the experimental group towards the use of adaptive educational

Table 6. Shows the responses of students in the experimental group to the statements on the opinions and impressions questionnaire regarding the use of adaptive learning stations. N = 90.

No.	A very large extent	Large extent	Medium degree	Little degree	Very little degree	Estimated Sum	Percentage	Arrangement
1	75	15	5	-	-	410	91.11%	12
2	85	5	-	-	-	445	98.89%	7
3	90	-	-	-	-	450	100%	1
4	87	3	-	-	-	447	99.33%	3
5a	-	-	-	4	86	446	99.11%	4
6	86	3	1	-	-	445	98.89%	7R
7	90	-	-	-	-	450	100%	1R
8a	-	-	2	22	76	430	95.56%	11
9	88	-	2	-	-	446	99.11%	4R
10	85	5	-	-	-	445	98.89%	7R
11	87	2	1	-	-	446	99.11%	4R
12a	-	-	-	-	90	445	98.89%	7R

stations for the course "Methods and Techniques of Teaching Physical Education." The percentage of their responses ranged between 91.11% and 100.00%.

The researchers attribute the students' responses to the use of adaptive educational stations, which included various diverse educational activities. These helped the students remove feelings of boredom and negativity that typically accompany traditional methods, increasing their enthusiasm and motivation to learn. This allowed the students to acquire a great deal of knowledge that they needed during the learning process.

Therefore, the second hypothesis has been achieved, which states that "there is a difference in the opinions and emotional impressions among the students of the experimental group regarding the use of adaptive educational stations and their impact on the level of cognitive achievement in the course Methods and Techniques of Teaching Physical Education".

3. Conclusions and recommendations

3.1. First: conclusions

Based on the objective and hypotheses of the study, and the sample used, the study reached the following conclusions:

1. There are statistically significant differences between the post-measurement results of the control and experimental groups in the level of cognitive achievement in the course "Methods and Techniques of Teaching Physical Education," favoring the experimental group that used the adaptive educational stations. The improvement in the oral test was (51.74%) and in cognitive achievement was (57.81%).
2. The relative importance of the opinions and emotional impressions of the experimental group towards using the adaptive educational stations ranged between 91.11% and 100.00%. This is a good indicator that the use of adaptive educational stations is effective in achieving emotional aspects and improving students' opinions and impressions towards the course "Methods and Techniques of Teaching Physical Education."

3.2. Second: recommendations

Based on the results obtained by the researchers, and the sample used in the study, the following recommendations are proposed:

- Train faculty members and teaching assistants on using adaptive educational stations and encourage their use in blended learning environments in the teaching process.
- Conduct more studies to explore the effectiveness of using adaptive educational stations in teaching various subjects and educational stages, particularly in higher education.

Author's declaration

Conflicts of interest: None.

We confirm that all tables and figures in this article are ours and written by the researchers themselves.

Ethical-Clearance: this manuscript approved by local ethical committee of physical education and sport sciences college for women on (January/2024).

Author's contributions

All contributions of this study were done by the researchers (M.M. and A.M.) who get the main idea and work on writing and concluding also with number of experts, Magdy Mahmoud Fahim in Statistics, **Prof. Khitam Mousa** in revision, Nibal Ahmed in translating, Dr. Batoul Ahmed Salim in proofreading.

Facilitate the task: this study was supported by Second-year female students at the Faculty of Physical Education, Sadat City University.

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Appendix 1

Opinions and Impressions Survey on the Use of Adaptive Learning Stations
Student Name/ .....

Nr.	Statments	Rating Scale				
		Extreamly helpful	Very helpful	Somewhat helpful	Somewhat unhelpful	Very unhelpful
Useing of adaptive learning stations during my study of the Teaching Methods course						
1	It motivated me to put in greater effort during my learning journey to attain accurate information					
2	It enhanced my understanding of the concepts, terminology, and various components of the course.					
3	It boosted my self-confidence and encouraged me to seek information in several ways					
4	It helped me understand and retain the information better by presenting it in various ways “through text, videos, and presentations”					
5	It made the lecture feel even more tedious and monotonous					
6	Moving between different stations contributed to improving my cognitive and knowledge retention skills					
7	It encouraged me to work within groups without fear or hesitation					
8	It failed to assist me in grasping complex and ultimately seemed like a waste of time					
9	It helped me understand and clarify difficult points by presenting the information in multiple ways					
10	It increased the excitement and kept me engaged while learning the course topics					
11	The worksheets at each station helped me research and explore further					
12	It widened the gap in individual learning differences among the students because the information was delivered in a single, uniform manner					