A comparative study between technology acceptors and non-acceptors in cognitive achievement of the ball apparatus in rhythmic gymnastics for female students

Estudio comparativo entre estudiantes que aceptan y no aceptan la tecnología en el logro cognitivo del aparato de pelota en gimnasia rítmica femenina

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Abstract

Objective: This research aims to compare the cognitive achievement of female students who are receptive to technology with those who are not, and to explore the relationship between technology acceptance and cognitive achievement.
Research methodology: The research methodology employed a descriptive approach using comparative and correlational methods. The sample consisted of second-year female students at the College of Physical Education and Sports Sciences, University of Baghdad. The research instruments included a technology acceptance scale and a cognitive achievement test.
Results: The results showed a difference in cognitive achievement between those who are receptive to technology and those who are not, indicating that technology acceptance plays a significant role in cognitive achievement.
Conclusion: Some female students are receptive to technology, while others are not, the number of female students who are receptive to technology exceeds the number of those who are not, and the cognitive achievement of female students who are receptive to technology surpasses that of female students who are not.

Keywords

Technology acceptance; cognitive achievement; students.

Resumen

Objetivo: Esta investigación tiene como objetivo comparar el rendimiento cognitivo de estudiantes mujeres receptivas a la tecnología con el de aquellas que no lo son, y explorar la relación entre la aceptación de la tecnología y el rendimiento cognitivo.
Metodología de investigación: La metodología empleada fue descriptiva, utilizando métodos comparativos y correlacionales. La muestra estuvo compuesta por estudiantes mujeres de segundo año de la Facultad de Educación Física y Ciencias del Deporte de la Universidad de Bagdad. Los instrumentos de investigación incluyeron una escala de aceptación de la tecnología y una prueba de rendimiento cognitivo.
Resultados: Los resultados mostraron una diferencia en el rendimiento cognitivo entre las estudiantes receptivas a la tecnología y las que no lo son, lo que indica que la aceptación de la tecnología desempeña un papel significativo en el rendimiento cognitivo.
Conclusión: Algunas estudiantes son receptivas a la tecnología, mientras que otras no lo son; el número de estudiantes receptivas a la tecnología supera al de las que no lo son, y el rendimiento cognitivo de las estudiantes receptivas a la tecnología supera al de las que no lo son.

Palabras clave

Aceptación de la tecnología; logros cognitivos; estudiantes.

Introduction

The use of technology has become an essential part of university education, especially in disciplines requiring continuous development such as physical education and sports science. With the rapid advancement of technology and its integration into sports education and training, technology acceptance studies are a vital field that aims to understand how individuals and institutions interact with and adopt new technologies. Students' levels of acceptance of these technologies vary.

The origins of technology acceptance studies can be traced back to the fields of psychology, information systems, and sociology. (Davis, 1989: Qazi & Hasan, 2022: Radhi, & Obaid, 2020) first developed it in as a reliable model for predicting and explaining the acceptance of new services based on emerging technologies and how the public uses them.

The Technology Acceptance Model (TAM) is a model that describes the determinants of a user's acceptance of a particular technology and determines whether they will use it based on their perception of its usefulness (perceived usefulness) and ease of use (Davis, 1989: Shaalan, et al., 2022). Technology Acceptance (TAM) is defined by (Liu & Ping, 2020: Lundberg, 2020) as the behavioral intention of potential users to use a new technology. The researcher defined it as the degree of responsiveness of the sample group to using technology in learning and their willingness to use technology (Pinho, 2020: Shaker, et al., 2022). A study shows the significant influence of gender on how individuals interact with technology (Hashemi, 2022: Ndebele, 2022). Males appear more confident in using information and communication technology tools compared to females, leading to differences in the level of participation and acceptance. Males consider technology tools more useful for achieving learning outcomes, while females prefer social interaction and collaborative learning opportunities. There are also gender differences in the obstacles they face. Females face greater social and cultural challenges, while males face more problems. Technology. The motivations for using technology differ; males tend to respond to competitive factors and games, while females prefer cooperative and supportive environments.

Therefore, the importance of this research lies in studying and understanding the differences between those who accept technology and those who do not in their cognitive achievement regarding the ball in rhythmic gymnastics, as well as the role of technology acceptance in cognitive achievement. The research problem lies in conducting a study that attempts to answer the following question: ?Is there a difference between those who accept technology and those who do not in their cognitive achievement regarding the ball in rhythmic gymnastics, and does technology acceptance relate to the cognitive achievement of female students? To answer these questions, the research aims to determine the extent of the difference between those who accept technology and those who do not in their cognitive achievement regarding the ball in rhythmic gymnastics, and the relationship between technology acceptance and cognitive achievement. The researchers hypothesize the existence of statistically significant differences between those who accept technology and those who do not in their cognitive achievement regarding the ball in rhythmic gymnastics, as well as a statistically significant correlation between technology acceptance and cognitive achievement regarding the ball in rhythmic gymnastics for female students.

Numerous studies have confirmed a positive relationship between technology acceptance and academic achievement. Some studies indicate that students with positive attitudes toward using educational technology achieve higher levels of academic success compared to those who are not receptive to technology. Other studies have shown that ease of use and awareness of the benefits of technology contribute to improved learning and enhanced academic achievement. This underscores the importance of studying the differences between students who are receptive to technology and those who are not, and the relationship between this and their academic achievement.

Therefore, the importance of research in studying the acceptance of technology among female students and revealing the differences between those who accept it and those who do not, in addition to clarifying its role in cognitive achievement, becomes apparent.

Research problem

Lies in conducting a scientific study to answer the following question: Are there differences between female students who are receptive to technology and those who are not? In addition, does technological acceptance have a relationship with students' academic achievement? To answer these questions.

Research objective

This research aims to compare the cognitive achievement of female students who are receptive to technology with those who are not, and to explore the relationship between technology acceptance and cognitive achievement.

Method

Research Methodology

The researchers used a descriptive approach with comparative and correlational methods on second- and third-year students at the College of Physical Education and Sports Sciences, University of Baghdad, for the academic year (2025-2026). The total number of second-year students was (149), while the research sample consisted of (77) female students (36 from section (B) and (41) from section (D). These students were randomly selected using a lottery system, representing (51.67%) of the second-year students. The research instruments included the following:

Technology Acceptance Scale

The Technology Acceptance Scale was developed based on the Technology Acceptance Model (TAM) introduced by (Davis, 1989), which explains individuals' acceptance of technology through perceived utility, perceived ease of use, and behavioral intention to use the technology. The Technology Acceptance Scale consists of 15 statements distributed across three domains: perceived utility, perceived ease of use, and behavioral intention. Each statement contains five alternatives: strongly disagree, disagree, neutral, agree, and strongly agree. Scores of 1, 2, 3, 4, and 5 are awarded respectively. Thus, the highest score on the scale is 75, the lowest is 15, and the hypothetical mean is 45. Appendix 1 illustrates this (45) as show in the Appendix (1).

Cognitive Achievement Test

The test contains (40) statements and (6) areas with four alternatives (multiple choice) and a scoring key (0-1), with the highest score being (40) and the lowest score being (0) and presented it to a group of experts and specialists, as shown in Appendix (2) , (6) Areas were identified, namely: (General concepts and objectives of rhythmic gymnastics, characteristics of rhythmic movements and physical abilities, music and rhythmic movement, history and instruments in rhythmic gymnastics, including the ball, preparatory and educational exercises, basic motor skills and common ball errors). The researcher used the percentage to show their agreement on the test areas. The researcher adopted a 75% or higher agreement rate, as (Bloom, 1983) indicate, "The researcher must obtain a 75% or higher agreement rate from the reviewers." Thus, all six (6) areas of the scale, comprising 40 items, were retained, as shown in Appendix (2).

Pilot Study

The researchers conducted a pilot study on (10) female students from section (A), randomly selected from the research population and outside the main experimental sample, on February 18, 2026. This was done to ensure the suitability of the scale and test for the sample level and their understanding of them, as well as to identify any difficulties or obstacles that might arise. After confirming all of this, the researchers conducted the main experiment by distributing the scale to the main experimental sample of 77 female students from sections (B and D) on February 23-24, 2026, in the classrooms of the College of Physical Education and Sports Sciences, University of Baghdad. Sufficient time was given to complete the scale after carefully reading the instructions and ensuring the sample understood the answering method. After completion, the forms were collected for statistical data analysis to determine which students were receptive to technology and which were not, the number of students receptive to technology was (49), while the number of those not receptive was (28). After identifying the students who were receptive to technology and those who were not, the researchers administered a cognitive achievement test the following day, following the same procedures used in the technology acceptance scale.

Statistical methods

The search data was processed through the Statistical Package for the Social Sciences (SPSS).

Findings

Presenting the results of the differences in cognitive achievement between female students who are receptive to technology and those who are not:

Table 1. Shows the differences in cognitive achievement between female students who are receptive to technology and those who are not

Group	N	Mean	Std. Deviation	Calculated t	Sig.	Significance
Accepting	49	37.131	12.080	6.011	.000	Significant
Non-accepting	28	23.339	9.152			

Presenting the results of the correlation between receptiveness to technology and cognitive achievement:

Table 2. Shows the correlation between acceptance of technology and cognitive achievement.

Variables	Correlation Coefficient (r)
Acceptance of Technology Cognitive Achievement	0.89

Discussion

The higher academic achievement of female students who are receptive to technology may be linked to technology's ability to provide multiple learning resources, increase opportunities for self-directed learning, and facilitate access to information, all of which contribute to improved knowledge acquisition. This finding aligns with the study by (Hanham, 2021), which indicated a positive relationship between technology acceptance and academic achievement, and with the study by (Teo, 2015), which demonstrated that students' attitudes toward technology influence its use and learning outcomes.

The two tables reveal differences in cognitive achievement between those who embrace technology and those who do not. A correlation is also found between technology acceptance and cognitive achievement. The researcher attributes this to the fact that students who embrace technology are exposed to numerous topics in physical education and sports science, specifically in rhythmic gymnastics. Their acquisition of information and knowledge available on technological devices, such as mobile phones, iPads, and computers, enhances their cognitive achievement and improves their understanding.

Furthermore, the speed and diversity of information acquisition facilitate and accelerate the learning process, making the theoretical material on the ball in rhythmic gymnastics more effective. This contrasts with those who do not embrace technology, as the lack of information outside the curriculum or textbook limits their knowledge to the textbook, resulting in weaker achievement. We also find a significant correlation between technology acceptance and academic achievement.

The researchers attribute this to the fact that technology provides learners with information that contributes to increased academic achievement. Consequently, those who are more receptive to technology tend to have more knowledge than those who are not. These results are consistent with several studies that have indicated a positive relationship between technology acceptance and academic achievement. These studies showed that students with positive attitudes toward technology achieve higher levels of understanding and achievement compared to those who are not receptive. These findings are also consistent with the study by (Hanham, 2021), which confirmed a positive relationship between technology acceptance and academic achievement, showing that students with higher levels of technology acceptance perform better academically than those who are not receptive.

This trend was further supported by demonstrating that ICT skills are positively correlated with academic achievement, with the relationship being more pronounced among female students. This reinforces the findings of the current study on female students. The results also align with the study by (Teo, 2015: Teo, 2020), which indicated that attitudes toward technology influence its actual use and educational outcomes, and that differences in acceptance directly affect academic performance.

Furthermore, a study by (Lei & Xie, 2021) confirmed a positive relationship between ICT skills and students' academic achievement. Higher levels of technology acceptance contribute to improved academic performance and cognitive understanding, and positive attitudes toward using educational technology directly affect learning outcomes. The researchers noted that many female students do not use paper textbooks at all, and instead use phones, tablets, and iPads to download and read these books electronically. Some of them resort to artificial intelligence programs to summarize these books and lectures, and sometimes convert them into audio lectures, which takes into account individual differences and learning styles

Conclusions

- Some female students are receptive to technology, while others are not.
- The number of female students who are receptive to technology exceeds the number of those who are not.
- The cognitive achievement of female students who are receptive to technology surpasses that of female students who are not.
- Acceptance of technology contributes to students' acquisition of a wealth of information, which in turn enhances their academic achievement.
- Acceptance of technology plays a significant role in the academic achievement of students using the ball in rhythmic gymnastics at the College of Physical Education and Sports Sciences.

Recommendations

- Leveraging students' receptiveness to technology to integrate it into their learning.
- Conducting regular assessments of students' cognitive achievement.
- Conducting studies similar to those comparing gender differences in technology acceptance.

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Appendix

Appendix (1)

University of Baghdad

College of Physical Education and Sports Sciences

Graduate Studies | PhD

Technology Acceptance Scale (Final Version, Distributed to the Sample)

Dear Student,

Before you is a set of items designed to gather your opinions on the use of technology in learning. This is part of a scientific research study aimed at conducting a comparative study between technology-accepting and non-accepting students in terms of cognitive achievement using the ball in rhythmic gymnastics.

Please read each item carefully and then choose the answer that best reflects your true opinion from the following options: (Strongly Disagree – Disagree – Neutral – Agree – Strongly Agree).

There are no right or wrong answers; your honest opinion is what matters. Your answers will be used solely for scientific research purposes and will be treated with complete confidentiality. Please answer all items and do not leave any item unanswered.

Thank you for your cooperation and valuable contribution to the success of this research.

Domains	No.	Items	Alternatives				
			Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Perceived Usefulness	1	Using e-learning improves the quality of my performance.					
	2	Using e-learning increases my ability to learn.					
	3	Using a mobile device enhances my motivation.					
	4	I find e-learning useful.					
	5	Using a mobile device during learning helps me accomplish required tasks quickly.					
	6	I obtain more information when using a mobile phone in learning.					
Perceived Ease of Use	7	Using mobile phone applications is easy for me.					
	8	I benefit from mobile phone applications in carrying out what I want.					
	9	I interact greatly with e-learning.					
	10	I find e-learning easy to use.					
	11	I consider myself skilled in using mobile phone applications.					
	12	I interact quickly with my colleagues when using e-learning.					
Behavioral Intention	13	I intend to use mobile phones in learning in the future.					
	14	I will always be keen to use e-learning.					
	15	I plan to use mobile learning continuously.					

Appendix (2)

University of Baghdad

College of Physical Education and Sports Sciences

Postgraduate Studies | PhD

Cognitive Achievement Test in its final form distributed to students

Dear Student

Greetings

This questionnaire is part of a scientific study aimed at identifying the level of cognitive achievement among female students in rhythmic gymnastics, within the framework of scientific research requirements.

We ask you to read the questionnaire items carefully and answer them accurately and objectively by choosing only one answer for each item from among (4) alternatives that you believe is correct and reflects your true level of knowledge, without leaving any item unanswered.

Please note that your answers will be treated with the utmost confidentiality and will only be used for scientific research purposes. The results will be presented in aggregate form without any personal information.

Your sincere cooperation greatly contributes to the accuracy of the study's results, so we appreciate your active participation.

With sincere thanks and appreciation.

Name:

Grade Level:

Answer Instructions: - Circle (○) the correct answer.

Cognitive Achievement Test

1. What is the main objective of practicing rhythmic gymnastics?
a) Developing physical fitness and flexibility
b) Enhancing balance and motor coordination
c) Improving self-confidence and discipline
d) All of the above

2. One of the educational objectives of rhythmic gymnastics is:
a) Enhancing discipline and teamwork
b) Improving endurance ability only
c) Focusing only on competition and results
d) Reducing the importance of physical activity

3. How does rhythmic gymnastics contribute to building self-confidence among practitioners?
a) Through performing in front of an audience and gaining movement control skills
b) By focusing on individual performance without developing social skills
c) By practicing exercises without challenges or evaluation
d) Without the need for continuous training or commitment

4. How is coordination between skill performance and music achieved in rhythmic gymnastics?
a) By performing movements without attention to rhythm
b) Through training movements according to musical rhythm timing
c) By reducing movement during performances
d) By relying only on القوة in movement execution

5. What is the main characteristic of rhythmic movements in rhythmic gymnastics?
a) Relying only on strength
b) Coordination between movement and music
c) Performing movements quickly without accuracy
d) All of the above

6. How does rhythmic gymnastics help improve physical flexibility?
a) Through daily exercises that develop range of motion
b) By using apparatus such as ribbon and hoop during exercises
c) By relying only on strength without stretching muscles
d) By practicing gymnastics once a week

7. Which of the following factors helps improve movement performance quality in rhythmic gymnastics?
a) Balance, flexibility, and motor coordination
b) Relying only on muscular strength
c) Focusing on random movements
d) Neglecting regular training

8. Which of the following factors is considered the most important in rhythmic gymnastics?
a) Coordination between skills and music
b) Using muscular strength only
c) Performing movements quickly without accuracy
d) Relying on randomness in performance

9. What is the role of flexibility in performing motor skills in rhythmic gymnastics?
a) It helps execute movements smoothly and fluidly
b) It does not affect performance
c) It reduces body control ability
d) It makes movements more difficult

10. Which of the following elements should be focused on during individual exercises without apparatus?
a) Body control and balance during movements
b) Improving flexibility and muscular strength
c) Performing movements smoothly and harmoniously
d) All of the above

11. Which type of music is commonly used in rhythmic gymnastics?
a) Classical music and modern music
b) Random music without rhythm
c) Music without tonal variation
d) All of the above

12. How does music affect a student's performance in rhythmic gymnastics?
a) It helps improve coordination between movements
b) It increases the sense of rhythm and harmony
c) It enhances artistic expression and smoothness
d) All of the above

13. What factors should be considered when selecting music for rhythmic gymnastics?
a) Rhythm speed and its suitability for movements
b) Harmony between the music and the athlete's personality and style
c) Variety of tones to avoid monotony
d) All of the above

14. Why is classical music sometimes used in rhythmic gymnastics?
a) Because it provides rhythm variety and allows precise movement expression
b) Because it imposes a fixed rhythm on the athlete
c) Because it does not require advanced artistic skills
d) Because it reduces the importance of movement expression

15. What is meant by motor rhythm in rhythmic gymnastics?
a) Performing movements randomly without organization
b) The ability to perform movements according to a specific timing and harmony
c) Organizing and sequencing movements in harmony with time and musical rhythm
d) Focusing only on muscular strength during performance

16. Why is motor-musical coordination important in rhythmic gymnastics?
a) Because it ensures movements are performed according to the correct rhythm
b) It helps achieve harmony between performance and music
c) It enhances motor and artistic expression ability
d) All of the above

17. What is the importance of rhythmic preparation in rhythmic gymnastics?
a) Improving the ability to respond to musical rhythm
b) Increasing coordination between different movements
c) Developing rhythmic sense and fluency in performance
d) All of the above

18. What is the legal weight of the ball used in rhythmic gymnastics according to the International Gymnastics Federation?
a) 200 grams
b) 300 grams
c) 400 grams
d) 600 grams

19. What is the standard diameter of the ball used in rhythmic gymnastics?
a) 15–17 cm
b) 18–20 cm
c) 22–24 cm
d) 25–30 cm

20. What material is the rhythmic gymnastics ball made of?
a) Hard plastic
b) Metal
c) Rubber or similar flexible material
d) Foam

21. Why is the ball considered an important apparatus in rhythmic gymnastics?
a) It helps develop balance and motor coordination
b) It enhances smoothness and aesthetics in performance
c) It increases precision in apparatus control
d) All of the above

22. How did rhythmic gymnastics apparatus evolve throughout history?
a) Initially, only the rope was used
b) Apparatus were developed to be more flexible and lighter for artistic movements
c) Apparatus materials and designs were improved for better control
d) All of the above

23. When was rhythmic gymnastics officially included in the Olympic Games?
a) 1952
b) 1968
c) 1984
d) 1996

24. What are the five apparatus used in rhythmic gymnastics?
a) Ball, ribbon, gloves, rope, hoop
b) Stick, ribbon, ball, rope, hammer
c) Ball, hoop, rope, ribbon, clubs
d) Ball, stick, hoop, gloves, hammer

25. Describe the correct way to hold the ball in rhythmic gymnastics.
a) The ball is held tightly throughout the performance to prevent dropping
b) The ball is only used in simple movements without complexity
c) The ball should not be held tightly, but should appear as a natural extension of the gymnast's body
d) The ball remains fixed in the hand without movement during performance

26. What is the main objective of preparatory exercises in rhythmic gymnastics?
a) Reducing training time and focusing only on performance
b) Improving flexibility, strength, and balance before the main performance
c) Preparing the body and muscles for rhythmic movements and reducing injury risk
d) Performing movements quickly without preparation

27. Which of the following elements should be emphasized during preparatory exercises in rhythmic gymnastics?
a) Activating muscles and increasing blood flow
b) Improving balance and readiness for rhythmic movements
c) Stimulating the nervous system for quick response
d) All of the above

28. How do educational exercises help develop rhythmic gymnastics skills?
a) By teaching basics such as balance, flexibility, and coordination
b) Through gradual exercise application according to the athlete's level
c) By developing technical understanding of rhythmic movements
d) All of the above

29. What is the main benefit of performing paired exercises without apparatus?
a) Improving interaction and coordination between athletes
b) Enhancing balance and motor coordination skills
c) Developing sense of rhythm and motor communication
d) All of the above

30. Which of the following exercises is considered a basic preparatory exercise in rhythmic gymnastics?
a) Warm-up and muscle stretching exercises
b) Balance and motor coordination exercises
c) Muscular endurance and breathing exercises
d) All of the above

31. What is the main objective of dance-like skills in rhythmic gymnastics?
a) Improving muscular strength only
b) Enhancing movement expression and coordination with music
c) Increasing performance speed
d) Reducing the athlete's effort during exercises

32. Which of the following factors should be considered while performing walking and running movements in rhythmic gymnastics?
a) Balance and movement control
b) Coordination with musical rhythm
c) Smooth transition between movements
d) All of the above

33. What is the main difference between rhythmic steps and running in rhythmic gymnastics?
a) Rhythmic steps depend on precise coordination with music, while running is used for movement transitions
b) Running is faster but unrelated to rhythm
c) Rhythmic steps are only used at the end of the performance
d) Running is not used in rhythmic gymnastics

34. What are the basic skills performed using the ball in rhythmic gymnastics?
a) Throwing and catching the ball
b) Rolling and rotating the ball, and passing it between hands and body
c) Controlling the ball on the floor or during jumps
d) All of the above

35. Which of the following mistakes is associated with poor control of the ball's speed on the arms?
a) Gradual speed consistent with hand movement
b) Inappropriate variable or accelerating/decelerating speed causing the ball to fall or loss of control
c) Precise timing in receiving the ball
d) The ball moving along the forearms without deviation

36. One of the common mistakes in using the ball in rhythmic gymnastics is:
a) Moving the ball continuously and harmoniously
b) Stopping the ball and lack of continuity during performance

c) Coordination with musical rhythm
d) Using varied throws

37. What causes loss of control when catching the ball?
a) Inaccurate timing
b) Good balance
c) Correct trajectory
d) Balanced weight distribution

38. What is the main objective of performing jumps in rhythmic gymnastics?
a) Improving strength and balance
b) Achieving movement variety and increasing aesthetic performance
c) Enhancing fluency between different movements
d) All of the above

39. Which of the following factors is necessary for performing rhythmic steps correctly?
a) Adherence to musical rhythm
b) Maintaining balance during movement
c) Coordination between hands and feet
d) All of the above

40. Loss of control over the ball during catching often occurs because of:
a) Inaccurate timing of the receiving movement
b) Stabilizing trunk muscles
c) Straight ball trajectory
d) Balanced weight distribution