The impact of a Metaverse-based educational program and the development of educational and technological methodology for the gymnastics lesson

Research Article

Ameen Atta Hassan *
Wasit University,
IRAQ

Abstract.

Background The importance of the study is due to the real-time interaction during the lesson and sharing with the members of the classroom together, and the presence of diverse spaces that are similar to or superior to real spaces in which virtual life is practiced. Time series coding of data for the educational process.

Objectives The purpose of this paper is to how the metaverse affects the development of the technological methodology for the physical education lesson.

Methods The researcher used the descriptive method within the framework of studies and theoretical literature related to the study and similar, and the experimental method by applying and analyzing the study variables, the study community was second-stage students in the College of Physical Education and Sports Sciences, and the research sample was selected from Section D and their number was (10) students, the scientific methodology of the study was to apply technological variables and augmented reality and virtual reality to the course of the physical education lesson by choosing to explain the gymnastics skill.

Results The results were the sum of the average arithmetic mean for the physical education lesson with metaverse applications (2.96), the highest percentage of technological influence on the physical education lesson and data science standards at a rate of (5.6), the percentage of improvement in the use of metaverse applications at a rate of (40%) and the application of metaverse technologies in various games for physical education.

Conclusion In conclusion, there is a statistically significant difference in the initial measurements of the experimental group regarding the percentage contribution of the metaverse application to the development of physical education courses.

Keywords: metaverse-based education, educational methodologies, sports technology, gymnastics lessons.

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*Correspondence: ameenhasan@uowasit.edu.iq
Ameen Atta Hassan
Faculty of Physical Education and Sports Sciences, Wasit University, Kut, Wasit Governorate, 52001, Iraq

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INTRODUCTION

Since Mark Zuckerberg announced the rebranding of Facebook Inc. to Meta, the conversation around the metaverse has been sparked. Many practitioners are opening discussions about the metaverse, and ordinary people are also wondering what the metaverse means and what its potential is in the future. The world of education and technology circles are no exception, and many studies are discussing the metaverse. According to Mark Zuckerberg, the metaverse is a place where people not only see who they are online, but also feel that they are there (Ning, 2021). Salloum (2022) asserts that the metaverse makes the online world look like the real world through digital experiences. Therefore, the creation of the metaverse has facilitated daily human communication and interaction via the internet through educational aspects (Salloum, 2022).

Ning & Wang, (2022) agree: The educational community lies in enjoying a virtual world that is different from the real world. So basically, with the help of devices such as virtual reality (VR), magic gloves, and controllers, we will be transported to a three-dimensional virtual world. This makes us appear as if we are leaving the real world and entering the imagination of the metaverse world to a three-dimensional virtual world inhabited by avatars of real people that benefit us in the educational

process (Ning, 2021, p. 47) (Wang, 2022, p. 71). Muhammad Asim (2022) states: The metaverse is a post-reality world, in which physical reality is merged with virtual environments with a connected network that includes continuous and multi-person interactions, and contains worlds for open play based on virtual reality VR and augmented reality AR, and users are represented in it by symbolic images that interact with each other in real time and with an immersive feeling that users experience, and these symbols are called avatars (Ghazi, 2022).

Jeon & Jung (2021) suggest that the potential of the metaverse as a new educational environment through a space for new social communication; a higher degree of freedom in educational design creation and engagement; and the provision of new experiences and high immersion through virtual representation, teachers should design classes for students to solve problems or implement projects collaboratively and creatively; educational metaverse platforms should be developed that prevent the misuse of student data.

The study of the metaverse within the framework of technological presence and changes occurring in our society from developing the educational system and technological development and pursuing the post-reality (metaverse) and using data science through research and study of time series to develop and implement digital globalization and digital transformations for educational environments, which leads to the fourth industrial revolution, which seeks to build educational policies within the framework of digital transformation, which directly affects the course of the lesson in the subject of physical education, which prompts those in charge of scientific research and those in charge of the educational and training process to look scientifically at research and study of this variable that the world seeks to reach scientific axioms, results and recommendations through scientific conclusions of those variables within the framework of building a sustainable society and special educational activity for the physical education lesson, which leads to the development of a good teaching system for the physical education lesson (Athaya et al., 2023; Ebrahim & Hussein, 2025; Yusroni, 2024).

The significance of this study lies in real-time interaction and collaboration with classmates during lessons; the availability of diverse virtual spaces that are similar to or larger than real-world environments where virtual life is practiced; and the encoding of time-series data related to the educational process. This study aims to design an educational program using the metaverse, assess its impact on gymnastics skill performance levels, and develop educational methodologies and technologies for physical education classes.

First: Study (Ahmed Azab (2023 AD): Entitled "The impact of metaverse technologies on the practice of some sports skills within the framework of simulation, the language of learning" The importance of the study is due to the direct interaction with the practiced sports skills, reducing the costs of training halls. Preparing and maintaining educational environments, and building all educational units with higher standards than building them in the real world. The study aims to use metaverse technologies to practice some sports skills within the framework of simulation, the language of learning, and the study method: The researcher used the descriptive method within the framework of studies and theoretical literature related to the study and the like, and the experimental method by applying and analyzing the study variables. From the metaverse technologies, the scientific methodology of the study was to apply technological variables (metaverse technologies) by choosing some sports skills such as running, cycling, swimming, and the study variables came The independent variable: metaverse technologies, the dependent variable: practicing some sports skills, and the conclusions were the sum of the average arithmetic mean with metaverse applications (8.00), the highest percentage of technological impact on games Data science standards at a rate of (5.9), the percentage of improvement in The use of metaverse applications was (35.2%). The recommendations were to apply metaverse technologies in various sports education games.

Second: Adhiyaman Manickam's study (2022): titled "Augmented Reality Technology Based on School Physical Education Training Physical Education" It aims to analyze the teaching effect by applying the increasing reality of physical education to create and acquire spatial orientation unlike traditional exhibition education. To educate school students in physical education developments, the AR method of training is effective and the recommendations came to propose an augmented reality (AR) solution for school physical education training based on AR technologies: cloud network, Internet of Things (IoT), and remote users. The results of the AR simulation explored that the athletes' performance data and the input of sports coaches, and the positive effect of the AR environment, proved to enhance the training and learning ability of school physical education systems.

Third: Study: Tarık Talank & Yusuf Kalınkara (2022) titled "Students' Opinions on the Educational Use of Metaverse" This study aims to determine students' opinions on the educational use of Metaverse. , A mixed method was used in which quantitative and qualitative research methods were studied together. As a result of the study, it was found that the majority of students had not used Metaverse before, but wanted to use the Metaverse environment in the classroom..

Fourth: Study: Chao Yi & Dan Li (2021): Titled "College Physical Education and Sports Training Based on Metaverse Virtual Reality Technology" The study aims to apply virtual reality technology in physical education and sports training. In this research, improving students' learning efficiency. Students' sports proficiency increased by 30%. At the same time, two-thirds of people believe that their interest in sports training has increased by 80% and another 90% of college coaches believe that the use of virtual reality technology in physical education is very necessary, which can improve the technical level and quality of training college athletes and contribute to China's competitive sports talent reserve.

Several studies agree on the role of metaverse technology in the educational process. Most studies conclude that metaverse applications are used in physical education classes. One study focused on the use of augmented reality and virtual reality (metaverse) technologies. Previous studies have helped determine the general direction of the current study's methodology, specifically from a scientific methodological perspective.

METHOD

Participant.

The research community was determined as third-year students in the College of Physical Education and Sports Sciences, University of Wasit, numbering (85) students distributed over five sections. The research sample was selected by random lottery and represented (10) students from Section D, while the survey sample was from outside the research sample and numbered 4 students. Thus, the research sample represented (11.7%).

Research Design.

The researcher used the experimental method for its suitability to the nature of this research, by following the experimental design of one experimental group with pre- and post-tests. The first stage "preparation": Determining the general framework of the study, its fields, objectives, and the basic variables to be analyzed, as well as determining the study steps, appropriate tools, and means of data collection. Preparing the required tools and devices and ensuring their validity and accuracy. The presence of electronic laboratories. The second stage "exploratory studies": The first exploratory study: The researcher conducted it on a sample of (5) students on Wednesday 2/10/2024. Its goal was to: Ensure the validity of the study and approvals from the administrative authority to conduct the study. The third stage "Basic study": The researcher conducted measurements on the study sample of age, height and weight.

Table 1. The Arithmetic Mean, Standard Deviation, And Skewness Coefficient In The Variables Of Age, Height, And Mass.

No.	Variables	Measuring unit	Mean	Std. Deviations	Median	Skewness
1	Age	Year	175.1	180	4.94	-0.701
2	Length	Cm	70.75	76	9.86	0.205
3	Mass	Kg	21.98	22	1.01	-0.417

It is clear from Table (1) that the values of the skewness coefficient for the research sample were limited to (±3), which indicates the moderation of the sample individuals in these variables.

Table 2. Shows The Arithmetic Mean, Standard Deviation And Skewness Coefficient In The Physical And Skill Tests

No.	Tests	Arithmetic mean	Standard deviation	Minimum	Maximum	Skewness
1	Standing Broad Jump	19.500	3.739	190	210	0.042-
2	Sargent's Vertical Jump	33.600	2.722	30	38	0.157
3	Low prone	30.300	3.555	25	36	0.350
4	Pushing a medicine ball weighing 800 grams	10.242	1.208	8.40	13.50	0.403-
5	Vertical jump from standing with half bent knees	24.3300	3.362	29	40	0.131-

6	Handstand	12	2.575	10	17	0.308
7	Front somersault	24.707	3.249	19.90	30	0.158
8	Side somersault	2.050	0.825	1	3	0.098-
9	Open jump on pony	20	2.051	17	24	0.366
10	Front roll	3.950	0.825	3	5	0.98

It is clear from Table (2) that the values of the skewness coefficient for the research sample were limited to (±3), which indicates the averageness of the sample individuals in the physical tests and the skill level under study.

Data collection tools

Tools and devices used in the research: Restameter to measure length to the nearest 1/2 cm, Stopwatch, Electronic scale to measure weight to the nearest 1/2 km, Cones, Medicine balls weighing 800 grams, Mattresses and High jump device.

Physical tests under study

After referring to scientific references, research and related studies, the following tests were identified: Standing Broad Jump, Sargent's Vertical Jump, Low prone, Pushing a medicine ball weighing 800 grams and Vertical jump from standing with half bent knees.

Skill performance level tests

The tests and measures that measure the basic skills in gymnastics were identified and selected according to the reference survey of references and scientific studies and reference studies, which resulted in the following tests:

Table 3. Shows The Validity Coefficients Of The Skill Tests Under Study N1=N2=10

Variables	Non-Distinctive Group		Distinctive Group		difference between the two mean	T value calculated
	Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation		
Handstand	14.21	0.89	27.60	1.57	9.41	6.51
Front somersault	24.10	0.75	25.20	2.83	14.08	17.16
Side somersault	2.40	1.48	7.40	1.89	4.96	9.43
Opening jump on pony	15.14	1.87	27.51	2.65	9.28	6.48
Front roll	1.5	2.86	7.32	2.87	6.18	12.64

Table "t" value at a significance level of 0.05 and a degree of freedom of 22 = 2.074

It is clear from Table (3) that there are statistically significant differences in the scores of the skill tests between the two groups, the undistinguished and the distinguished, at a significance level of (0.05), as the calculated (t) value was limited to (6.48 - 17.16), which is greater than the critical values of the (t) test, which reached (1.72), indicating the validity of the tests used in the research.

Table 4. Shows The Stability Coefficients For The Skill Tests Under Study, N = 10

Variables	First application			Second application			Critical value (r)		Calculated value(r)
	Mean	Median	Std. Deviations	Mean	Median	Std. Deviations	0.01	0.05	
Handstand	20.19	20	1.89	29.60	30	1.57	0.558	0.485	0.713
Front somersault	25.12	25.26	1.75	39.20	40.11	2.83	0.615	0.444	0.705
Side somersault	3.44	3.45	2.48	8.40	8.6	1.89	0.620	0.432	0.610
Opening jump on pony	20.23	21	3.87	29.51	30	2.65	0.611	0.425	0.622
Front roll	1.14	1.03	3.86	7.32	7.56	3.87	0.658	0.417	0.826

The tabular "r" value at a significance level of 0.05 and a degree of freedom of 10 in one direction = 0.497

Table (4) shows a statistically significant correlation between the first and second applications of the skill tests, where the values of the correlation coefficient ranged between (0.610 - 0.826), which

are values greater than the critical value of the Pearson correlation coefficient, which reached (0.05 = 0.497, 0.01 = 0.658) at a degree of freedom (22), which shows the extent of the stability of the test used.

Study questions

What are the metaverse technologies used in the work environment (physical education lesson)?

Through metaverse reference studies on educational science and the ability of metaverse applications to simplify the teaching and learning processes, especially simplifying lesson presentation and special skills of passing and aiming in gymnastics, and to take advantage of the potential of the metaverse as a three-dimensional, global, interconnected, and immersive online space in real time, we need new ways to connect the physical world with augmented and virtual reality experiences. (Hirsh-Pasek, 2022, p. 22)), Kwang-Hyung Lee (2022) confirms that providing education in the metaverse world for students can help increase opportunities to make up for what they have missed in traditional education by using virtual reality tools. (Lee, 2022, p. 58)

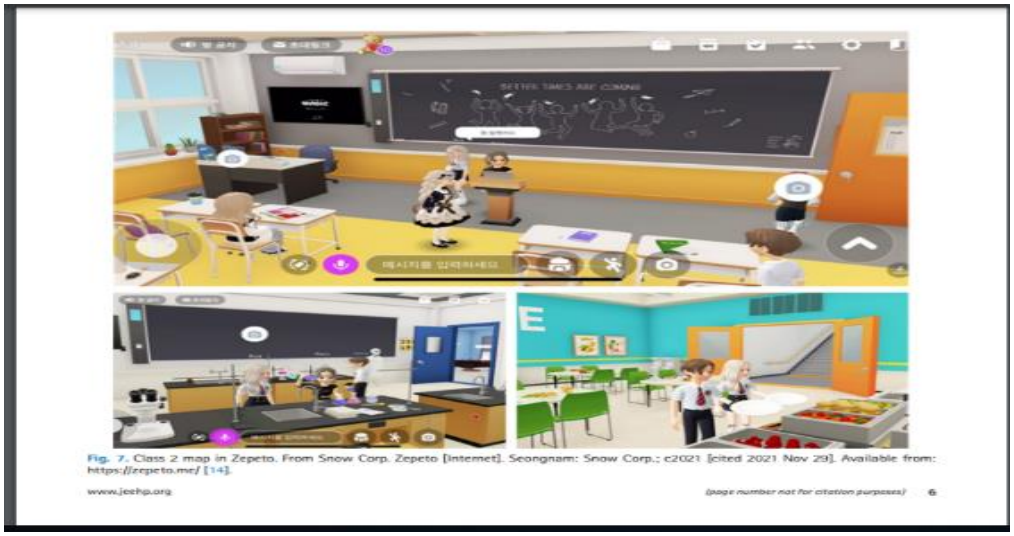

Figure 1. Show The Metaverse Technologies Used In The Workplace (Physics Lesson)

Figure 2. Shows The Impact Of The Metaverse On The Development Of The Technological Methodology For The Physical Education Lesson.

In Figure (2), it is the room that was designed by the program (https://framevr.io/Lesson physical education). By using the skills of passing and aiming in gymnastics under study through the technical steps and reviewing the educational steps and also reviewing the skill and planning steps, and thus, through augmented reality and virtual reality and using (3D) technologies, students were transferred from real reality to virtual reality, physical education in the metaverse environment in the current field of physical education, interest and demand for teaching and learning activities based on virtual reality or augmented reality are increasing, and they are currently being developed among

metaverse technologies, virtual reality education has achieved great publicity by fixing and supporting skills in the physical education lesson (Gurrin, Smeaton, & Doherty, 2022, p. 98) The study also directed towards the special standards for metaverse applications by designing a lesson for the skill of handstand skills, front flip, side flip, open jump on the horse, front roll in gymnastics and special Metaverse applications: (augmented reality, spatial computing, data science, virtual reality): Augmented reality: A sporting activity that creates non-real information by superimposing virtual objects or interfaces on the physical environment that the user recognizes. Through an explanation of the educational and skill steps of the skill under study (Hwang & Chien, 2022).

1. Data science: Sporting activities in a virtual space that allows users to record people's information, emotions, and behaviors directly to create data content about that skill. (Egliston & Carter, 2022, p. 80)
2. Virtual reality: A virtual sporting world that extends real sporting activities and the like builds alternative virtual models. By simulating real reality (Hwang & Chien, 2022)
3. Spatial computing: An integrated technology that reproduces the physical world realistically but extends this information into the world of sports. (Jeong, Yi, & Kim, 2022, p. 47) (Gastón Sanglier Contreras and Aurora Hernández González, 2022, p. 147)

Figure 3. Show The Technological Model For Implementing The Lesson

What is the technological model for a physical education lesson using metaverse techniques?

Metaverse techniques that work to enrich the educational process are considered among the techniques that help me innovate within the framework of the standards for those techniques in Figure (3). The design was made within the framework of technology and specific to displaying a lesson in physical education and specific to passing and shooting skills in gymnastics. The researcher confirms the innovation of this design on the following:

1. Collecting information related to the skill and technical aspect and the educational steps of the skill under study
2. Studying the real reality from the scale of the gymnastics stadium
3. Studying data related to the timing of the skill performance
4. Studying spatial computing to implement that skill through implementation in virtual reality
5. Studying the timing during the implementation of that skill
6. Implementation was carried out in electronic laboratories for schools and through programming with metaverse techniques through Figure (3)

Pre-measurements

Pre-measurements for the experimental group were conducted on Tuesday and Wednesday (8-9/10/2024) at the level of physical and skill tests for the gymnastics under study. The researcher followed the following stages in developing the content of the educational program.

The program is for (12 weeks):

1. Program timing (first period of the academic year) from 1-10-2024 to 25-12-2024Program application location (Gymnastics Hall in the College of Physical Education and Sports Sciences - University of Wasit).
2. Number of weekly teaching units (2 units) (Sunday - Wednesday).
3. Number of daily teaching times (once only).
4. Number of program units (24 teaching units).
5. Time of daily training unit (90 minutes).
6. Weekly training time (180 minutes).
7. Parts of the educational lesson (administrative work, general warm-up, general and special physical preparation, educational part, applied part, final part).
8. Parts of the educational unit:
9. Studies conducted in gymnastics agreed that the educational unit is divided into three parts
10. part in warming up and preparation, which includes physical preparation exercises for the body's systems and practicing the activities that will be included in the educational unit, divided into three parts:
11. Introduction and administrative work: (5) minutes, which includes preparation and equipping all tools and also recording attendance and absence
12. General warm-up: (5) minutes, and includes stretching and flexibility exercises to prepare the body, and also includes preparation exercises for passing and shooting
13. Physical exercises and special physical preparation: (10) minutes, and includes comprehensive and varied exercises from different positions, and serves the skills (jumping, rolling, somersaulting)
14. The educational part: (35) minutes, and includes various training exercises specific to the method of teaching these skills (jumping, rolling, somersaulting) in the game of gymnastics, and includes the exercises that need to be improved and that have the main impact in achieving the goals of the educational unit, and that By diversifying the use of exercises and tools necessary to apply the exercise so that it progresses from easy to difficult, which contributes to developing the educational status of students, and represents the largest time in the parts of the educational unit.
15. The applied part: (30) minutes, and includes various high-skill training with different teaching methods for skills (jumping, rolling, somersaulting) in gymnastics with the aim of activating the learning process and raising the level of skill performance, as well as involving students positively in the educational process and overcoming the shortcomings of various teaching, through the effectiveness of education with metaverse techniques and taking into account individual differences between different levels to make large percentages of students reach the level of advancement, in line with the age level and the nature of the skill so that students reach the level of skill performance, accuracy, focus and achieve the desired goal in the research as quickly as possible.
16. Final part: (5) minutes, and includes various exercises such as relaxation exercises that aim to return the student to his normal state. - Radwan Mustafa (2022) indicates that the use of educational activity is a new and innovative approach to improving students' productivity and increasing the effectiveness of their educational performance during virtual reality. The application of this method within educational programs requires directed standardization (Radwan, 2022, page 44)

Figure 4. Shows Part Of The Research Sample During The Educational Units.

The percentage of contribution of metaverse applications to the development of the physical education lesson. The first stage: Analysis stage: The researcher reviewed specialized scientific studies and references, in order to learn about the technical stages, educational steps, technical errors, and how to fix them in the basic skills of gymnastics, in addition to studying the sample on which the program will be applied, in order to learn about their abilities and educational levels so that the path of metaverse technologies is in the right technological direction. The second stage: Design requirements preparation stage: In this stage, the program design requirements that will be used in the design process were prepared, as follows: Preparing still images: The images for the program were prepared in their various forms (illustrative drawing images - motion sequences) where they were entered into the computer using the scanner (Acer scanner) via the Mira Scan program, then the images were processed through the Adobe Photoshop program. Preparing video clips (animated images): The researcher prepared video files in their various forms, where they were entered into the computer via a video card (TV Tuner Card) brand (Life View) using the Windows Movie Maker program, and modifications and montage were made through the Director 6.1 program. Audio preparation: The program's audio files were prepared in various forms (music - voiceover - sound effects), and were entered into the computer through the Jet audio 4.7 program.

The third stage: The scenario writing stage: The researcher wrote the program's scenario according to the previously specified content so that the program contains (1) educational unit, and takes (12) weeks at a rate of one educational unit per week, the duration of the educational unit is (120) minutes. The fourth stage: The design stage: The researcher used the following programs in designing the program: (Avtar) program. Augmented reality program. Virtual reality programs. The researcher designed the educational unit so that it consists of several parts, which are: The main screen: which contains the skills referred to in the gymnastics unit, a background for simulating virtual reality and simulating the gymnastics field, and the students do not control it. The fifth stage: The initial experimentation and evaluation stage: The researcher presented the program content in its final form to a group of experts in teaching methods and gymnastics, to learn their opinions on the suitability of the program for application.

Post-measurements

Post- measurements were conducted for the experimental group on Tuesday and Wednesday (24-25/12/2024) at the level of physical and skill tests for the gymnastics under study.

Statistical Methods

The researchers processed the study results electronically using the Statistical Package for the Social Sciences (SPSS), taking into consideration the scientific method in analyzing the results to achieve the research objectives.

RESULTS AND DISCUSSION

Results

Table 5. Table 5. Results of Statistical Differences in the Pre-test Scores of the Experimental Group on Physical and Skill Tests

No.	Tests	Measuring unit	Arithmetic mean	Standard deviation
1	Standing Broad Jump	cm	198.14	3.44
2	Sargent's Vertical Jump	cm	32.16	2.66
3	Low prone	Count	29.14	3.13

4	Pushing a medicine ball weighing 800 grams	meter	10.92	1.35
5	Vertical jump from standing with half bent knees	Count	33.45	2.88
6	Handstand	Count	12.7	2.16
7	Front somersault	meter	23.79	2.85
8	Side somersault	Count	2	1.13
9	Open jump on pony	Count	21	2.22
10	Front roll	degree	3.42	0.65

Table 6. Shows The Significance of Statistical Differences in The Pre-Measurement of The Experimental Group in The Percentage of Contribution of Metaverse Applications in Developing The Physical Education Lesson

Variables	Impact extent	Regular Physical Education Lesson		Physical Education Lesson with Metaverse Technologies		Improvement Rates with Metaverse Technologies
		Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation	
Augmented Reality	Physical education lesson	1.3	0.1	2.3	0.12	%20
Spatial Computing		2.5	0.5	4.3	0.24	%40
Data Science		3.85	0.4	5.6	1.2	%50
Virtual Reality		0.89	0.0	00	000	%50
Gymnastics Skills		0.45	0.0	2.6	0.1	%40

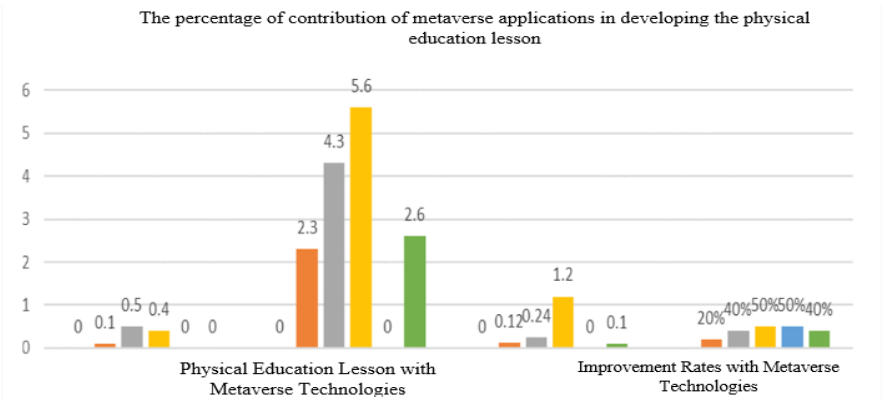

Figure 5. Shows The Percentage of Contribution of Metaverse Applications in Developing The Physical Education Lesson

Discussion

It is clear from tables above and Figure (5) that the sum of the average arithmetic mean for the regular physical education lesson (1.79), that the sum of the average arithmetic mean for the physical education lesson with metaverse applications (2.96), thus there is a kind of high average ratio in the numerical value that gives a kind of improvement in the use of technology towards change, and this is consistent with both (Egliston & Carter, 2022; Hwang & Chien, 2022; Jeong, Yi, & Kim, 2022), and the improvement rates came through the use of technologies and standards for metaverse applications as follows in the augmented reality standards by (20%) and this is an advanced percentage within the framework of digital transformations in the use of augmented reality and this is consistent with the reference studies of (Hwang & Chien, 2022).

Spatial computing by (40%) and this is an advanced percentage within the framework of the use of artificial intelligence technologies and this is consistent with the reference studies of (Hwang & Chien, 2022; Salloum, 2022; Hirsh-Pasek, 2022). Data Science by (50%), which is an advanced percentage in the framework of striving to work on modeling and time series and behind the continuous assessment of technological skills and performance prediction, and is consistent with (Jeong, Yi, & Kim, 2022) (Gurrin, Smeaton, & Doherty, 2022), Virtual Reality Standards by (50%), which is an advanced percentage, Spatial computing and the link between reality and virtuality in teaching the physical

education lesson are consistent with the reference studies of (Lee, 2022) (Jeong, Yi, & Kim, 2022) (Gurrin, Smeaton, & Doherty, 2022).

CONCLUSION

The total average arithmetic mean for the physical education lesson with metaverse applications (2.96). The highest percentage of technological influence on the physical education lesson is data science standards by (5.6). Virtual Reality Standards by (50%). The percentage of improvement in the use of applications Metaverse (40%). Recommendations: Encouraging the use of technological innovations in the educational process. Integrating Metaverse technologies into the educational process. Applying Metaverse technologies in various sports education games. Future research could explore the implementation of Metaverse-based educational programs and compare them with conventional methods in physical education classes.

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AUTHOR CONTRIBUTION STATEMENT

Ameen Atta Hassan Responsible for the entire script.

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