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Developing an Augmented Reality Technology Acceptance Model in Sports Science Education: A Mix Model of TRI 2.0 and UTAUT

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A B S T R A C T

In recent years, augmented reality technology has gained attention as an innovative technology in various fields, including education. This technology can help improve learning and teaching, reduce costs, and increase students' motivation to learn. The current research aims to develop an optimal model by combining the Technology Readiness Index 2.0 (TRI 2.0) and the unified theory of acceptance and use of technology (UTAUT) models to investigate the acceptance of augmented reality technology in sports science education. This research is applied-descriptive. The statistical population of this study included all physical education teachers in Kashan City during the academic year 2022-2023. A non-probability sampling method was used. The research model was examined through an online questionnaire, and data analysis as well as hypothesis testing were conducted using structural equation modeling. The results of the present study demonstrate that the combined model of TRI 2.0 and UTAUT accurately predicts the adoption of augmented reality technology in sports science education. In this model, optimism and innovation were identified as motivating and attractive factors driving user engagement with augmented reality technology. Additionally, expected performance, expected effort, and facilitating conditions were identified as factors that facilitate the adoption of augmented reality technology in sports science education. The results of this research demonstrate that increasing the acceptance of augmented reality technology in sports science education requires attention to the psychological and social factors influencing technology acceptance. Specifically, efforts should be made to foster user optimism towards augmented reality technology and perceive it as an innovative and engaging technology. Furthermore, providing convenient and conducive conditions for users to easily utilize augmented reality technology should be prioritized.

Keywords: *Augmented reality, Technology acceptance, Sports science education, TRI 2.0 model, UTAUT model.*

1. Introduction

The progress of any society depends on its educational capabilities. An advanced higher education system enhances operational abilities and adapts to contemporary needs through foundational education. This productivity improvement creates opportunities for growth, development, and a constant rise in competition (Andam et al., 2015). In recent decades, remarkable advances in new technologies have transformed the teaching and learning

processes and addressed issues such as educational inequalities, disregard for local conditions, and low quality in the educational system (Pahlevanloo, 2023). New technologies have been able to reshape thinking patterns in education, enrich educational models, and enhance the teaching and learning process (Farajollahi, 2010). One of the most important technologies in the field of education is Extended Reality, which brings together various types of reality, including virtual reality, augmented reality, and mixed reality, under one umbrella. This technology has proven to be a highly effective educational tool. Virtual reality aims to provide users with a completely realistic virtual environment that conveys a sense of reality. On the other hand, augmented reality presents the physical environment in real time, overlaying virtual components onto it through software based on data received from the physical environment. Mixed reality combines digital objects with the real world, allowing them to coexist and interact with each other (Abdulzadeh, 2023). By utilizing these technologies in the field of augmented reality, it becomes possible to offer suitable educational options for online and blended learning (Rajaee et al., 2021; Shin, 2017).

This implies that the teaching and learning process should be designed in a way that allows individuals to gradually become integrated members of educational classes (Beveridge et al., 2016). and provides them with opportunities to innovate and acquire knowledge (Blevins, 2018). Additionally, learning in augmented reality environments can aid in enhancing memory and recall, boosting individuals' learning motivation, and improving overall learning outcomes (Koutitas et al., 2021; Krokos et al., 2019). Although extended reality technology is used in various fields, its scientific and practical applications are particularly valuable in sports science. Augmented reality, for instance, enables the creation of simulations that allow students to practice and improve their skills within a safe and controlled environment. Another noteworthy application of extended reality in sports science is its ability to establish communication with virtual environments and objects, which may not be possible in the real world. This aspect holds significant potential, especially for athletes with disabilities or physical impairments, as it offers unique benefits by providing a more interactive and accessible environment. Furthermore, it is important to acknowledge that in our rapidly evolving world, where new technologies have permeated every aspect of our lives, organizations and individuals are compelled to adopt and embrace these new digital technologies to survive (Bigne et al., 2016) and new technologies enter organizations at a cost, and they must be properly implemented and embraced by users (Saleh Ahmadi et al., 2011). The results of Taleb and Mahmoudi's research (2017), titled "Expanded Reality and Its Concepts and Applications in Education," show that despite its weak points, this technology assists learners in comprehending the material and enhancing their thinking capabilities (Mehedi et al., 2017). This is extremely significant given the current societal needs, as it necessitates a creative mindset to generate new and effective ideas (Pahlevanloo, 2023). In the research conducted by Birgani et al. (2016), the utilization of applied technologies and virtual reality in sports was thoroughly examined (Arzani-Birgani et al., 2021). This technology has the potential to assist both beginners and professional athletes in their sports training, playing a crucial role in shaping the future of sports training (Bigne et al., 2016). Additionally, in another study, Palmas and Klinker (2020) emphasized the significance of incorporating new technologies, including augmented reality, virtual reality, and mixed reality, to update educational methods in the field of education (Palmas & Klinker, 2020).

In 2015, Parasurman and Colby updated and streamlined the Technology Readiness Index named TRI 2.0. This theory explicates individuals' willingness to accept and adopt advanced technologies and defines it as a psychological factor that influences users' motives, including both beneficial and hedonistic aspects, for utilizing new technologies (Parasuraman & Colby, 2015) . Factors influencing technological readiness encompass four dimensions: optimism, innovation, discomfort, and insecurity (Roy et al., 2020). Notably, optimism and innovation are positive and compelling factors that drive users to embrace new technologies (Pillai et al., 2020). In addition to the aforementioned model, one of the most recent theories in the field of technology acceptance is the unified theory of acceptance and use technology (UTAUT), which was proposed by Venkatesh in 2003. UTAUT provides a useful tool for managers needing to assess the likelihood of success for new technology introductions and helps them understand the drivers of acceptance to proactively design interventions (including training, marketing, etc.) targeted at populations of users that may be less inclined to adopt and use new systems. This model aims to predict the acceptance and willingness to use new technology by considering variables such as expected performance, expected effort, social impact, facilitating

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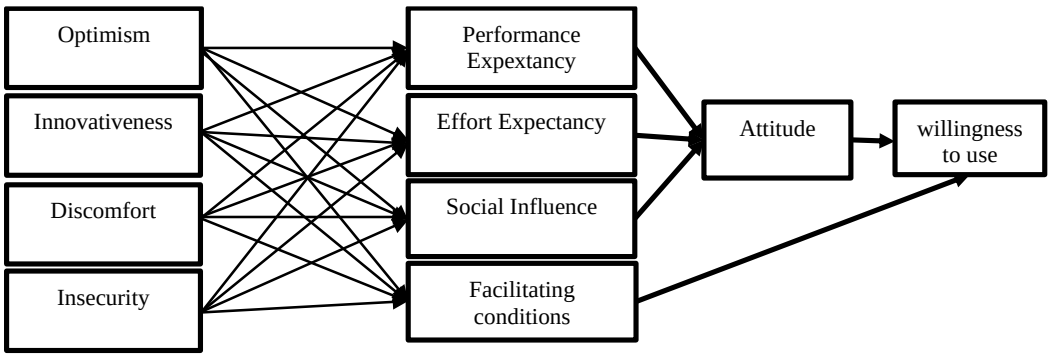
conditions, and attitude (Venkatesh et al., 2003). With the increase in investment in new information and communication technologies, research related to accepting these technologies has garnered significant attention. Various researchers are making efforts to identify the influential factors in the acceptance of these technologies. The acceptance of such technologies is a multidimensional phenomenon that encompasses key variables such as perceptions, beliefs, attitudes, and the level of engagement with information technology. The significance of adopting new and digital technologies in the field of physical education and sports sciences is heightened due to the nature of this discipline, which is intricately connected to the human body and soul (Naghavi, 2009).

Due to the highly competitive nature of sports and the sports industry, this field is considered a major catalyst for innovation and adoption of new technologies. Whether these technologies are focused on training or geared toward consumers, sports audiences have displayed a strong inclination to embrace the latest technological advancements (Ratten & Ferreira, 2017).

For example, in addition to educational and research aspects in the field of movement behavior, sports physiology, biomechanics, and sports pathology, the correct treatment of skeletal abnormalities and program management can be enhanced in this field by utilizing modern technologies and new methods. Such advancements have the potential to not only make progress in the field but also increase its impact globally. The country has played a significant role in establishing communication with the world (Gharibi et al., 2022). The integration of new technologies in the field of physical education appears to be crucial in fostering learning (Masouminejad, 2023). Additionally, prior empirical studies have validated the utilization of the technology readiness index to determine the user's inclination toward embracing such technology in the sports domain (Davis, 1989). The utilization of digital and virtual technologies, such as augmented reality, virtual reality, and mixed reality, is reshaping the sports-watching experience and enhancing interactions with clubs and sports leagues (Uhm et al., 2020). Spectators of these technologies are also actively engaged in enhancing the exercise experience through data and game statistics. They now can view sports events from previously inaccessible angles, experience increased physical presence in the stadium, and gain access to captivating content dedicated to sports through applications (Kim & Ko, 2019). Therefore, what remains immensely important is that in the era of communication and technology, particularly in the realm of education, it becomes crucial and unavoidable. Considering the nature and objectives of organizations, they ought to employ information technology in a manner that enables them to swiftly achieve their goals; otherwise, they risk being marginalized in an environment characterized by rapid changes and transformations (Jafarzadeh Zarandi et al., 2021). This article discusses the development of the augmented reality technology acceptance model in sports science education using a mixed model of TRI 2.0 and UTAUT. This development presents a theory-rich model that can enhance the understanding and utilization of augmented reality technology by professors, teachers, coaches, students, and athletes. Thus far, studies focusing on the use of augmented reality technology in sports science have been limited and often concentrated on other technologies such as virtual reality. Consequently, there is a pressing need to explore the application of augmented reality technology in sports science education. The proposed conceptual model of the research is presented in Figure 1.

Figure 1

The proposed conceptual model



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2. Methods and Materials

2.1. Study Design and Participants:

The present study employed a descriptive-applied research approach to develop a comprehensive technology adoption model for sports science education. The research model combined the Mixed TRI 2.0 and UTAUT frameworks to examine the factors influencing the adoption of technology by physical education teachers. The target population encompassed all physical education teachers in Kashan City during the academic year 2022-2023. The available sampling method was utilized to select participants. The sample size was determined using Cochran's formula, resulting in 108 participants. A total of 111 teachers voluntarily completed the questionnaires.

2.2. Data Collection

Data collection was conducted through a standard Likert questionnaire developed based on the research background and existing literature (Reyes-Mercado et al., 2022; Venkatesh et al., 2003).The questionnaire comprised 36 questions, encompassing ten constructs: expected performance (4 questions), expected effort (4 questions), facilitating conditions (4 questions), social influence (3 questions), attitude (4 questions), desire to use (3 questions), optimism (4 questions), innovation (4 questions), insecurity (3 questions), and discomfort (3 questions). The Likert scale ranged from 1 (strongly disagree) to 5 (strongly agree).

2.3. Data Analysis:

The reliability of the questionnaire was assessed using Cronbach's alpha, consistently yielding alpha coefficients above 0.7 for all constructs, indicating internal consistency. To ensure formal validity, the questionnaire was administered to 10 sports management professors, who provided feedback on its clarity, relevance, and comprehensiveness. Data analysis employed structural equation modeling (SEM) with PLS 3 and SPSS V22.0 software to test the research hypotheses and examine the relationships between the constructs.

3. Findings and Results

First, the demographic status of the research samples is reported:

Table 1

Description of the demographic characteristics of the research samples

Variables		Frequency	Relative abundance percentage
Gender	Women	73	0.65
	Men	38	0.34
Age	20-30	57	0.51
	31-40	37	0.33
	41-50	15	0.13
	More than 50 years	2	0.1

The combined reliability calculated for all factors is higher than the acceptable minimum (0.7, which provides strong evidence for the reliability of the constructs) (Chin, 1998). Additionally, a Cronbach's alpha coefficient higher than 0.6 further supports the good reliability of the constructs (Taber, 2018). Furthermore, to assess the convergent validity, the average variance index extracted was found to be higher than the minimum requirement of 0.5 (Kline, 2023). Furthermore, researchers consider the measurement model to be homogeneous if the absolute value of the factor loadings of the observable variables is at least 0.7, although some have accepted a minimum of 0.4 and suggested removing variables with factor loads below 0.4 (Fornell & Larcker, 1981). The results presented in Table 2 indicate that the variables are sufficiently reliable.

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Table 2

Reliability and convergent validity coefficients and Cronbach's alpha of research variables

Variables	Factor Loading	AVE ≥ 0.5	CR ≥ 0.7	Alpha ≥ 0.7
Performance Expectancy	0.714	0.611	0.862	0.786
	0.808			
	0.833			
	0.767			
Effort Expectancy	0.656	0.517	0.809	0.686
	0.811			
	0.729			
	0.669			
Social Influence	0.751	0.649	0.847	0.729
	0.826			
	0.838			
Facilitating conditions	0.808	0.558	0.834	0.736
	0.683			
	0.789			
	0.699			
Optimism	0.786	0.658	0.885	0.825
	0.828			
	0.870			
	0.755			
Innovativeness	0.855	0.536	0.793	0.651
	0.544			
	0.741			
	0.524			
Insecurity	0.827	0.734	0.892	0.819
	0.886			
	0.856			
Discomfort	0.580	0.600	0.515	0.539
	0.856			
	0.854			
Attitude	0.807	0.555	0.832	0.733
	0.726			
	0.786			
	0.652			
willingness to use	0.868	0.746	0.898	0.830
	0.852			
	0.872			

Also, to check the divergent validity, the Fornell and Locker indices have been calculated. According to Fornell and Locker, divergent validity is deemed acceptable when the average amount of variance extracted for each construct exceeds the shared variance between that construct and other constructs in the model (Fornell & Larcker, 1981). The average variance extracted and the composite reliability coefficients are related to the quality of a measure. AVE is a measure of the amount of variance that is taken by a construct about the amount of variance due to measurement error. To be specific, AVE is a measure to assess convergent validity. Convergent validity is used to measure the level of correlation of multiple indicators of the same construct that are in agreement. The factor loading of the items, composite reliability, and the average variance extracted has to be calculated to determine convergent validity. The value of AVE and CR ranges from 0 to 1, where a higher value indicates a higher reliability level. AVE is more than or equal to 0.5 confirming the convergent validity (Fornell & Larcker, 1981). The components of the structure exhibit a greater explanatory power (as indicated by the numbers in bold) in comparison to the correlation of those structures with other research structures. Additionally, the elements of the model demonstrate excellent divergent validity. Based on the results presented in Table 3, the research variables demonstrate satisfactory divergent validity.

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Table 3

Divergent validity of research variables

	1	2	3	4	5	6	7	8	9	10
Attitude (1)	0.745									
Discomfort (2)	0.293	0.774								
Effort Expectancy (3)	0.645	0.442	0.719							
Facilitating conditions (4)	0.645	0.315	0.710	0.747						
Innovativeness (5)	0.490	0.455	0.584	0.557	0.732					
Insecurity (6)	-0.310	-0.426	-0.291	-0.306	-0.240	0.857				
Optimism (7)	0.582	0.384	0.615	0.678	0.538	-0.227	0.811			
Performance Expectancy (8)	0.738	0.335	0.739	0.737	0.590	-0.335	0.652	0.782		
Social Influence (9)	0.720	0.286	0.702	0.756	0.541	-0.365	0.606	0.627	0.806	
willingness to use (10)	0.600	0.490	0.596	0.651	0.602	-0.324	0.602	0.666	0.600	0.864

The coefficient of determination is the fundamental measure for evaluating endogenous variables. Values of 0.19, 0.33, and 0.67 are commonly considered to indicate small, medium, and large effects of one structure over another, respectively (Chin, 1998). In this study, the coefficients of determination for the variables are as follows: attitude to use (0.735), expected effort (0.492), facilitating conditions (0.532), expected performance (0.532), social influence (0.483), and willingness to use (0.432). These values demonstrate a strong fit for the structural model. In addition, the quality index of the structural model assesses its predictive capability. Positive Q2 values indicate the model's predictive ability (Hair Jr et al., 2021). In this study, the Q2 values obtained for the variables are as follows: attitude to use (0.364), expected effort (0.228), facilitating conditions (0.268), expected performance (0.286), social influence (0.281), and willingness to use (0.298). These values indicate that the structural model has appropriate predictive quality.

Table 4

Evaluation indices of the structural model

	Q2	R Square
Attitude	0.364	0.735
Effort Expectancy	0.228	0.492
Facilitating conditions	0.268	0.532
Performance Expectancy	0.286	0.532
Social Influence	0.281	0.483
Willingness to use	0.298	0.432

Table 5 shows the results of the path coefficient analysis and the significance level of this research.

Table 5

Evaluation indices of the structural model

Path			Path coefficient	Standard Deviation	T Statistics	P Values
AT	→	Wi	0.274	0.171	3.016	0.000
Dis	→	EE	0.123-	0.128	3.966	0.034
Dis	→	FC	0.176-	0.088	2.864	0.088
Dis	→	PE	0.169-	0.096	2.723	0.070
Dis	→	Si	0.125-	0.020	3.041	0.093
EE	→	At	0.005	0.077	3.064	0.049
FC	→	AT	0.784	0.112	6.975	0.000

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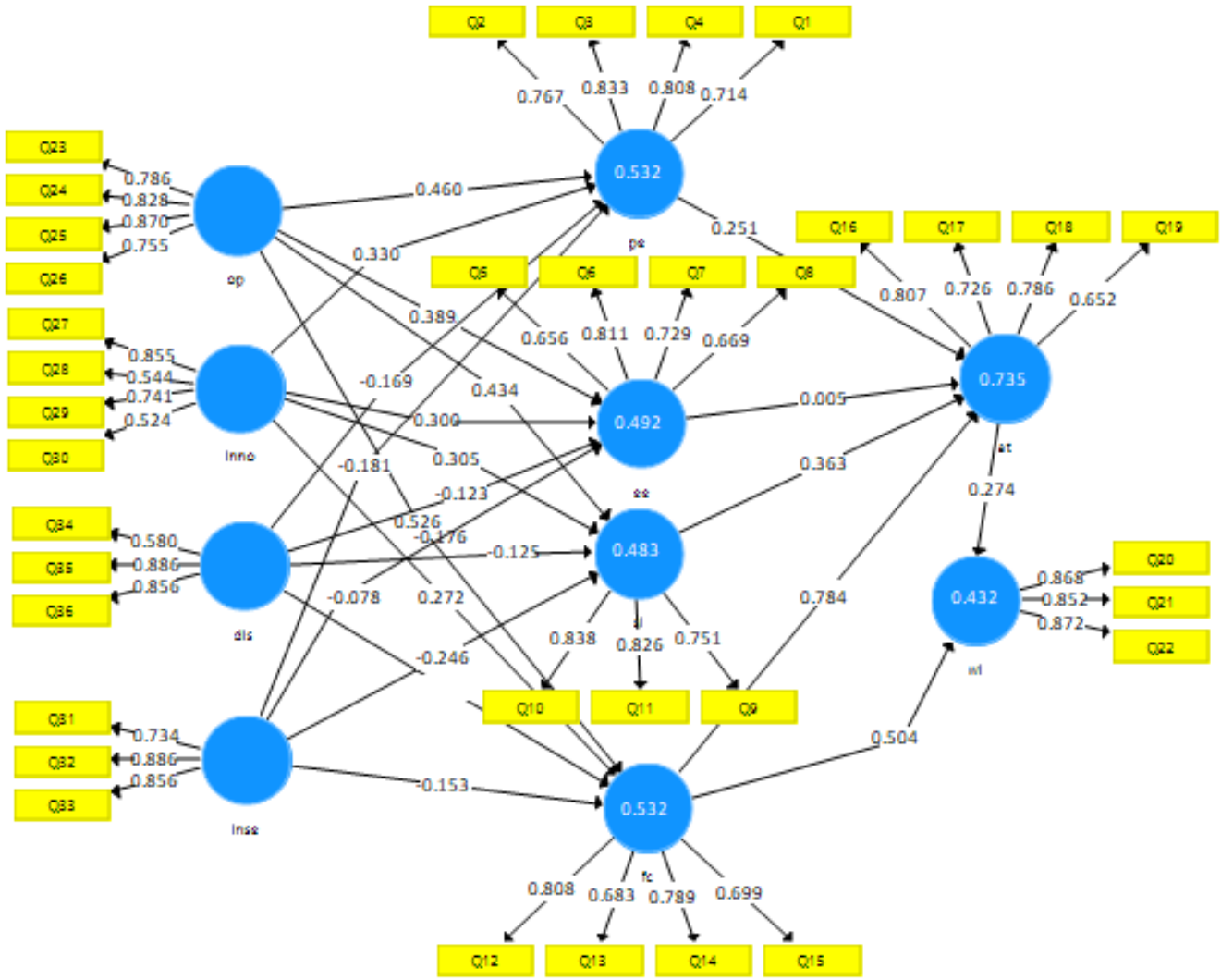
FC → Wi		0.504	0.137	3.672	0.000
Inno → EE		0.300	0.098	3.056	0.002
Inno → Fc		0.272	0.087	3.137	0.002
Inno → PE		0.330	0.089	3.703	0.000
Inno → SI		0.305	0.093	3.287	0.001
Inse → EE		0.078-	0.065	2.195	0.033
Inse → FC		0.153-	0.080	1.927	0.055
Inse → PE		0.181-	0.080	2.246	0.025
Inse → SI		0.246-	0.082	3.008	0.003
OP → EE		0.389	0.088	4.429	0.000
OP → FC		0.526	0.070	7.560	0.000
OP → PE		0.460	0.070	6.595	0.000
OP → SI		0.434	0.076	5.709	0.000
PE → AT		0.251	0.039	3.047	0.045
SI → AT		0.363	0.172	2.112	0.035

Figure 2 shows the structural equation model of this research.

Figure 2

Importance Level of Social Acceptance or Successful Application of AI Technologies and Influencing Factors



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4. Discussion and Conclusion

This research aimed to investigate the willingness to use augmented reality technology, which is a rapidly expanding market. Understanding people's attitudes towards these new-generation consumer products is of vital importance in terms of consumer behavior. The findings of the present study revealed a positive and significant relationship between attitude and willingness to use. This result is consistent with similar prior studies (Kim et al., 2021; Latif Rasool, 2021; Mohammadian et al., 2021; Rahimizhian et al., 2020; Sukendro et al., 2020; Tussyadiah et al., 2018; Yu & Huang, 2020). Contrary to the findings of Ahmadi Deh Qutb Al-Dini (2019), who focused on computer science students familiar with new technologies, it was found that the attitude component indeed affected the willingness to use (Ahmadi-de Qutbuddini, 2010).

The results of this research demonstrate a negative and significant relationship between the discomfort variable and the expected effort variable. Specifically, an increase in discomfort with an intensity of 0.123 is associated with a decrease in expected effort. However, discomfort does not show a significant relationship with facilitating conditions, social influence, and expected performance. These findings are consistent with the prior research conducted (Chang & Chen, 2021; Pillai et al., 2020; Qasem, 2021).

One of the factors hindering the adoption of new technologies is discomfort (Pillai et al., 2020). In other words, many people feel overwhelmed and confused in the unfamiliar realm of technology (Roy et al., 2020). In this regard, Chardnas et al. (2021) defined discomfort as the sensation of being stifled as a technology users and lacking control, leading to uncertainty (Cruz-Cárdenas et al., 2021; Venkatesh & Davis, 2000). Therefore, it is crucial to pay attention to the needs and abilities of users with low technology experience when designing software and complex technologies. To alleviate user discomfort, it is necessary to provide appropriate guides and default settings in various sections. These measures contribute to users' increased comfort and ease of technology usage. Also, the results of this research demonstrate a positive and significant relationship between expected effort and attitude, consistent with the studies conducted by Sukandro et al. (2020), Yu and Huang (2019) and Nazimi et al. (2023) (Bidgoli et al., 2023; Cotrino et al., 2019; Sukendro et al., 2020; Yu & Huang, 2020). However, in the research conducted by Mohammadi and Qaidi (2020), and Kim et al. (2021), the significant and positive relationship between expected effort and attitude was not emphasized. According to them, this relationship diminishes when users possess prior knowledge and experience in using technology (Kim et al., 2021; Mohammadi & Ghaedi, 2020).

On the other hand, the expected effort is considered less significant for the younger age group, as indicated by Ha et al. (2007) (Ha et al., 2007). Based on this, the findings suggest that the expected effort may not be the decisive or crucial factor determining attitude, according to the users' ability to adapt to new technologies. Contrary to the results of this research, Kim et al. (2021) found that expected effort does not have a direct impact on attitude (Kim et al., 2021). The participants in Kim et al.'s study consisted of innovative users who were comfortable with new technologies, and they were not influenced by the ease of use in forming their attitudes. Expected effort refers to the user's perception of the system's ease of use, indicating the extent to which a user anticipates effortless usage in the future. When there is more user-friendly information technology available, users are more inclined to adopt it (Masouminejad, 2023). When users are provided with a special and appropriate training environment that enables easy usage, they are typically inclined to utilize such a space. Therefore, when designing new technologies like augmented reality, it is crucial to prioritize simplicity and user-friendliness. Special attention should be given to ensuring that users can easily access and utilize the features and functionalities of the provided programs and services without requiring assistance. Based on the findings of this research, the variable of facilitating conditions also demonstrates a positive and significant relationship with the willingness to use, which aligns with previous research conducted (Tu & Hu, 2018; Wojciechowski & Cellary, 2013; Yu & Huang, 2020). However, these results contradict the findings of Odeh (2019), and El Amin (2015), as they argued that facilitating conditions are insignificant predictors of user tendencies when the model includes the expected performance and expected effort structures (Alamin et al., 2015; Odeh, 2019). Since people often exhibit resistance towards adopting anything new, facilitating conditions become crucial as they effectively help remove this resistance. People then believe that the necessary infrastructure is in place to provide support, alleviating concerns about the lack of infrastructure and support, which are major factors underlying the rejection of technology (Songkram et al., 2023). To embrace new technologies, coaches, professors, and teachers need to

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possess skills such as computer proficiency and internet connectivity. In addition, they must have the financial capability to bear the costs associated with utilizing this type of service. If universities, as providers of new technologies, create facilitating conditions for professors, many issues can be resolved. The more facilitating conditions there are, the better teachers will be able to utilize educational programs. To ensure these conditions, first and foremost, professors must have access to the necessary equipment and hardware needed for classroom participation. Additionally, facilitating conditions can enable professors to seek assistance from the support department of the educational system when needed, and even receive training support from individuals.

In evaluating the impact of innovation on expected effort, facilitating conditions, expected performance, and social influence, a positive and significant relationship was observed. This finding aligns with the results of previous research conducted (Adapa et al., 2020; Chang & Chen, 2021; Cruz-Cárdenas et al., 2021; Fazal-e-Hasan, 2021; Mustak et al., 2021; Shirmohammadi & Bostanmananesh, 2022). Innovativeness is a personal characteristic that greatly motivates individuals to experiment with information technology and plays a positive role in their adoption behavior. Innovativeness is seen as a strong predictor and holds a significant role in influencing people's attitudes, perception of benefits, ease of use of augmented reality technology, and overall adoption of information technology. Moreover, innovation is suggested as a key motivating factor in technology selection and utilization (Pattansheti et al., 2016). Considering that sports science education emphasizes direct feedback and active interaction, the utilization of augmented reality technology facilitates meaningful and organized learning, thereby enhancing the overall learning experience and reducing the likelihood of forgetting (Cotrino et al., 2019). In many cases, these technologies offer users the flexibility to modify multiple parameters and conduct experiments within controlled environments, providing a realistic visual experience without posing any risks (Masouminejad, 2023).

The lack of security exhibits a negative and significant correlation with expected effort, expected performance, and social influence. Specifically, a 0.078 increase in insecurity corresponds to a decrease in expected effort, a 0.181 increase in insecurity is linked to a decrease in expected performance and a 0.246 increase in lack of trust results in a decrease in social influence. However, it should be noted that there is no significant association found between the lack of security and facilitating conditions. Shirmohammadi and Bostan Menesh Fard (2022), Cardenas et al. (2021), Roy et al. (2020), and Chang and Chen (2021) have also reported similar findings (Chang & Chen, 2021; Cruz-Cárdenas et al., 2021; Roy et al., 2020; Shirmohammadi & Bostanmananesh, 2022). Insecurity is characterized by a lack of trust in technology and uncertainties regarding its capabilities (Qasem, 2021). When users experience unfavorable outcomes from using technology, it generates a feeling of insecurity, leading to hesitancy in repeating the usage (Cruz-Cárdenas et al., 2021). Individuals who experience insecurity tend to rely less on technology and often feel discouraged and frustrated during crucial moments of interaction (Pillai et al., 2020). Consequently, insecurity plays a crucial role as a hindering factor in the adoption of new technologies (Roy et al., 2020). Optimism exhibits a positive and significant correlation with expected effort, facilitating conditions, expected performance, and social influence, which aligns with the findings of Chardnas et al. et al. Additionally, the study conducted by Shirmohammadi and Bostan Manesh (2022) presents inconsistent results (Cruz-Cárdenas et al., 2021; Venkatesh & Davis, 2000). The inconsistency can be attributed to conducting research during the COVID-19 pandemic era. Optimism entails a positive mindset toward new technologies, enabling users to embrace flexibility and enhance efficiency (Chang & Chen, 2021).

Ray et al. (2020) have also defined optimism as the belief in the potential of new technology to enhance control, productivity, and flexibility (Roy et al., 2020). Optimistic individuals tend to have a positive subjective experience when using new technologies, leading to greater acceptance and usage (Pillai et al., 2020). One of the fundamental characteristics of technology-based learning environments is the favorable interaction within the learning environment. Such interactive and technological environments create platforms that facilitate deep and effective learning, as well as promote progressive thinking. These environments offer active and engaging learning opportunities, enabling learners to actively participate in the teaching and learning process, and better prepare themselves for life in the world of information and technology. In today's world, information and communication technology have become an integral part of human life (Achim & Al Kassim, 2015; Papa et al., 2020). This fact underscores the significance of creating interactive and technological learning environments in

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today's era. Consequently, experts believe that incorporating information technology into the teaching and learning process can facilitate the acquisition of knowledge and skills crucial for effective performance in the modern world. This enables students to grasp course topics more swiftly and gain improved access to up-to-date scientific resources, ultimately fostering greater motivation toward education and studying. The results of this research indicate a significant positive relationship between the expected performance variable and attitudes, aligning with previous studies conducted by Karam Chandani et al. (2019) and Kamble et al. (2019) However, the research conducted by McCoy et al. (2007) yield inconsistent findings (Kamble et al., 2019; Karamchandani et al., 2020; McCoy et al., 2007). McCoy et al. (2007) demonstrate that the components of expected effort and expected performance exhibit ineffectiveness in influencing attitudes and the acceptance of information technology. They reference cultural and educational factors (prejudices) and a general perception toward adopting new technologies (McCoy et al., 2007).

Therefore, the technologies used by professors, trainers, students, and teachers must be designed to meet their needs. The user experience should allow for easy and quick information access and uploading, while also fulfilling users' expected performance to a significant extent. Additionally, practical and useful technology has the potential to motivate users to engage with it and positively influence their attitudes. The attitude towards the acceptance of information technology by users represents a generally productive response (such as love, happiness, pleasure, and satisfaction) towards technology use (Masouminejad, 2023). Social influence demonstrates a positive and significant relationship with attitude. These findings align with previous research conducted by Naranjo, Zolotov, and Oliveira (2018), while contrasting with the results of Papa et al.'s (2020) study, which focused on smart healthcare devices (Naranjo-Zolotov et al., 2018; Papa et al., 2020; Rahi et al., 2018).

According to research, social influence refers to individuals' perception and consideration of others' opinions and recommendations (e.g., from friends and family) regarding the utilization of specific technology (Naranjo-Zolotov et al., 2018). This indicates the level of significance individuals attribute to external viewpoints in contrast to their perspectives on information technology usage (Maruping et al., 2017). It is quite clear that social influence plays a role in the formation of people's attitudes toward information technologies and affects their acceptance and use behavior (Kim et al., 2007). The truth is, that individuals who have a strong acceptance of a technology and are willing to use it are more likely to recommend it to others. Those who possess a positive attitude towards augmented reality technology, as influenced by the aforementioned factors, are not only more inclined to utilize this technology but may also introduce and advocate it to others. Such practices also enhance the effectiveness of word-of-mouth advertising for augmented reality technology providers. It is important to note that the generalizability of the study may be limited due to its reliance on findings from a specific population or sample. As a result, these findings may not accurately represent broader demographics or diverse cultural contexts. Moreover, the study's use of cross-sectional data may restrict our ability to establish causality or identify long-term trends in attitudes and behaviors toward augmented reality technology.

Based on the findings and results obtained, it is crucial to highlight the aspects of profitability and the relative advantages of a new technology compared to previous methods when introducing it. Additionally, it is important to ensure that the technologies introduced to professors, teachers, and trainers are as simple and understandable as possible. Because professors, teachers, and coaches tend to rely on traditional methods with which they are familiar and feel confident in resolving any issues with their own or colleagues' assistance, it is vital to reassure them of the availability of support experts when introducing new technologies. Additionally, designers should seek users' opinions and encourage their active participation during the design and upgrade processes to foster user engagement with the technology and, ultimately, increase their willingness to utilize it.

Also, designers should work on minimizing the obstacles and challenges associated with adopting new technologies. This will help ensure that the technologies are user-friendly and easily accessible to individuals without extensive information technology expertise. Conducting regular and informative training sessions, such as short-term courses on augmented reality technology, for professors and students can promote familiarity with the technology, generate a positive attitude towards it, and encourage its utilization. In addition, it is important to develop enticing and interactive educational content that aligns with extended reality and sports science to capture students' interest. Furthermore, in the event of any issues, managers can utilize incentive mechanisms such as

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recognition and appreciation to acknowledge individuals who have achieved significant success in the training process through the use of augmented reality. After implementing augmented reality technology, it is essential to continuously monitor and evaluate progress and weaknesses to make informed decisions for improving augmented reality education. Additionally, it is important to note that the implementation stage of augmented reality technologies follows the acceptance stage. Therefore, it is recommended to investigate and research the impact of success during the acceptance stage on the implementation stage of the technology.

Authors' Contributions

A.N.B., L.H.A., and Z.S.-A. collectively conceptualized the study and designed the research model. A.N.B. led the data collection process, overseeing the distribution and collection of the online questionnaires. L.H.A. conducted the statistical analysis and hypothesis testing using structural equation modeling. Z.S.-A. contributed to the literature review and integration of the TRI 2.0 and UTAUT models. All authors collaborated on the interpretation of results and jointly wrote the manuscript. A.N.B. was responsible for final revisions and ensuring the accuracy of the data analysis. All authors reviewed and approved the final version of the manuscript, ensuring a comprehensive presentation of the findings related to the acceptance of augmented reality technology in sports science education.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethics Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

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