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Virtual Reality Technology as a Factor to Improve University Sports
La tecnología de realidad virtual como factor de mejora del deporte universitario

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Abstract. The development of innovative means for university sports teaching is a growing research topic today. This study aims to determine the effect of the VR-assisted instruction on student performance in 10 sport disciplines across three universities in Western Kazakhstan. The study sample had 210 students from three different universities in Western Kazakhstan. The correlation analysis revealed a strong relationship of VR-assisted training with higher performance at the city tournament and the higher quality of the sports practice work. The proposed solution allows universities to create an effective training program for student-athletes.
Key words: effectiveness; sport; student; technology; university; VR

Resumen. El desarrollo de medios innovadores para la enseñanza del deporte universitario es un tema de investigación en auge en la actualidad. Este estudio tiene como objetivo determinar el efecto de la instrucción asistida por VR en el rendimiento de los estudiantes en 10 disciplinas deportivas en tres universidades en el oeste de Kazajstán. La muestra del estudio tenía 210 estudiantes de tres universidades diferentes en el oeste de Kazajstán. El análisis de correlación reveló una fuerte relación del entrenamiento asistido por RV con un mayor rendimiento en el torneo de la ciudad y una mayor calidad del trabajo de práctica deportiva. La solución propuesta permite a las universidades crear un programa de formación eficaz para los estudiantes-atletas.
Palabras clave: efectividad; deporte; alumno; tecnología; universidad; realidad virtual

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Introduction

Now innovative technologies actively influence the development of education. Innovations determine not only the direction of education but also affect the social, economic, and scientific landscape of the present (Kodirova, 2020). The Internet and digital technologies have facilitated access to knowledge and changed the traditional approach to university education. Online courses, open educational resources, video lectures, and interactive platforms allow students to study remotely, expanding the geography of the educational process (Kavilova, Isanova, & Ravshanova, 2020).

Innovative technology in modern higher education significantly impacts the performance of university students (Fayzievna, Narmuratovna, Mamurjanovna, Mavlyanovna, & Shukhratovna, 2020). This impact is one of the key aspects to consider. Firstly, innovative technologies expand access to learning resources. Students can develop and engage in self-study due to the large amounts of data provided by technologies (Kharatova & Ismailov, 2022). Secondly, innovative technologies promote interaction and cooperation between students and teachers. Online forums, AI, and social networks create opportunities for active communication even with online education (Tuksanova & Nazarov, 2020). Third, analytics and progress tracking allow students and teachers to track academic performance and learning effectiveness. This feature helps identify problems in time and improve teaching methods (Yusupova & Nomoanjonova, 2022).

The popularization of sports in higher education began with digitalization (Muñoz-Bullón, Sanchez-Bueno, & Vos-Saz, 2017). University sports face a range of challenges that remain understudied in the available literature. These challenges include gendered social issues, effects on students' mental health, university funding, and so forth (Yukhymenko-Lescroart, 2018). Some universities were using innovative technologies to improve physical education and make students more interested in joining some kind of sports club. Among these technologies were Virtual Reality (VR), Augmented Reality (AR), and Artificial Intelligence (Soulliard, Kauffman, Fitterman-Harris, Perry, & Ross, 2019). At the same time, the adoption of technology in sports is not a common practice, even though it could revolutionize the way we train and compete (Singh et al., 2019). One explanation is that the technologies themselves are still evolving, so it is possible that new technologies will emerge that will be more suitable for adoption in sports (Abdallah & Alriyami, 2022; Chiva-Bartoll et al., 2019; Lovin, Busila, & Sava, 2023).

Although digitalization is becoming increasingly popular in education, this process interacts less actively with physical education (O'Neil, Amorose, & Pierce, 2021). In general, the implementation of technology in more applied disciplines, such as swimming or choreography, was much more challenging during the forced transition to online learning due to the coronavirus pandemic. In these disciplines, the traditional contact between the teacher and the student is vital. In addition, it is crucial to establish the practical or technical (as in sports) context of task performance (González-Serrano, Añó Sanz, & González-García, 2020). There is a need to introduce digital practices in student sports since this area remains less researched than other disciplines (Kim & Chiu, 2018).

Furthermore, it is worth noting the implementation specifics of technologies, in particular, virtual reality and

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AI, in certain regions. The process of implementing innovative technologies in education is slower in countries with a low level of development (Aly, 2020). Thus, Kazakhstan, which is a post-Soviet country, belongs to the states with an increased number of challenges regarding innovations in the education system. The implementation of virtual technologies in higher educational institutions in Kazakhstan has faced various problems. These problems include insufficient technical resources and infrastructure, the need to train teachers and update the education strategy, as well as issues of data security and confidentiality (Abdallah & Alkhrabsheh, 2019; Gough, Duffell, & Eustace, 2021). High-tech countries have largely overcome these barriers since the innovation process began much earlier (Samonina, 2021).

Framework

The introduction of virtual reality (VR) into the sports educational sphere is a promising direction but has received insufficient attention in the literature. This area faces challenges and limitations and, therefore, requires deeper consideration and development. Firstly, the physical aspect is essential in sports training activities. Virtual reality, despite its potential, cannot always accurately convey physical actions and reactions. Nevertheless, these features are important for sports training since every movement and touch can be decisive (Palamarchuk et al., 2020). Secondly, the creation of virtual models for various sports and training requires time and resources. VR content is a costly and complex development that is impossible without specialized knowledge and skills (Yuldashev, 2021). Thirdly, teachers and coaches may need additional education and training to use virtual reality in sports education. However, the resources of some countries do not have the potential for additional effective training (Kiryakova, Kargapoltseva, Belonovskaya, & Duzhnikov, 2021). Yet, the current research seems to focus more on the usage of innovative technologies as a means to reduce certain risks that students, teachers, and the university's administration may otherwise encounter. At the Summer Olympic Games in Tokyo, Kazakhstan took the 83rd place. It is the most unsuccessful performance of Kazakh athletes in the history of the Olympic Games. Consequently, the Kazakhstani government ordered to revise their current approaches to the training of professional athletes and national teams (Sports KZ, 2021).

Research Purpose

Given the above, the purpose of the current study is to determine the effect of VR-assisted instruction on student performance in different sports disciplines across three universities in Western Kazakhstan.

Research objectives:

(1) to evaluate student performance at the city tournaments;

(2) to engage students in a VR-assisted training program for student-athletes; (3) to assess the effectiveness of the program by analyzing students' progress at the city tournaments the following year.

VR-based training was reasonable for this study because it is a relatively new and innovative technology capable of revolutionizing the way students learn. VR-based training can provide students with immersive and interactive learning experiences that are difficult to replicate with traditional teaching methods. This study analyzes the state and efficacy of university sports in Western Kazakhstan. It also explores the role of VR in student-athlete performance. Results can be useful for university coaches seeking to prepare their teams for competitions. Student-athletes can utilize the present findings to choose an innovative training strategy.

Literature overview

University sports in Kazakhstan

The advent of different approaches to teaching, along with other challenges, had a considerable impact on the system of university sports (Olkhovsky, Filimonova, Zhdanovich, & Eremina, 2021), especially in Kazakhstan. Sports facilities in the state-owned universities in Kazakhstan are poorly equipped (Baiketaev, 2017; Mambetalina et al., 2022; Zheleznyak & Petrov, 2002). The Federal Law aimed at improving university/school sports provides definitions of university sports and student leagues (The Legislation of the Russian Federation, 2007). The Law came with broad prospects for the sports clubs, which now include student sports organizations. It also touches upon funding and construction of sports facilities in educational institutions (Bakhareva & Golovina, 2021; Dzyubich & Olkhovskaya, 2016; Zotova & Faizullin, 2015). One way to motivate students to join a sports club is to engage them in competitions where the main thing is not victory, but dedicated participation. This approach requires coaches to shape a proper mindset in young people (Gennadieva, 2017; Tyukalova, 2019). The functional performance testing of student teams from the St. Petersburg State University revealed the need to improve their functional training using motivational strategies (Minvaleev & Shadrin, 2014). Some researchers, however, argue that the actual problem is the training conditions (Avladadeev, 2016; Vashchuk & Medvedeva, 2018), that is, the education system itself, for it minimizes student contact with sports, limiting it to PE lessons. The main direction universities take, in this case, is the strengthening of the mental and physical health of the students (Sabekov, 2010; Zykina & Proskurina, 2021). Some researchers emphasize the need to connect different student leagues within a single information environment; it is achievable with Internet technologies (Izotov, 2017; Turovsky, 2019). As long as the student leagues exist independently from one another, the PE department will be able to organize the learning process and engage in research (Sabitov, 2002). The sports clubs are responsible for sport activities and events, and they ensure that university teams perform well (Maltseva et al., 2022).

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Virtual Reality technology

Virtual reality (VR) is a computer-generated simulation of a three-dimensional environment that can be interacted with in a seemingly real or physical way using special electronic equipment, such as a helmet with a screen inside or gloves fitted with sensors (Luo, Li, Feng, Yang, & Zuo, 2021). It can be used in sports training and rehabilitation applications, as well as for entertainment (Siegle, 2019).

VR is a valuable tool for boosting education, including in the sports industry. Through simulations, this technology allows athletes to practice without the risk of getting injured (Marks & Thomas, 2022). For instance, it helps soccer players learn how to tackle and basketball players practice their shot mechanics (Maas & Hughes, 2020).

VR is able to provide athletes with feedback on their performance (speed, accuracy and technique) by tracking their movements. This information can help athletes improve and avoid injury in the future (Peng, Yen, & Siswanto, 2020). Researchers increasingly report on the effectiveness of VR as a tool for enhancing student achievement. For instance, the VR-assisted instructions proved effective in improving the shooting speed and accuracy of basketball players (Alfalah, 2018). The body of research on VR-assisted training and its beneficial effect on the punching force of athletes seems to grow as well (Jensen & Konradsen, 2018).

Materials and methods

Study design

The study took place between 2021 and 2023 and covered two academic years. The research process consists of several steps, as depicted in Figure 1.

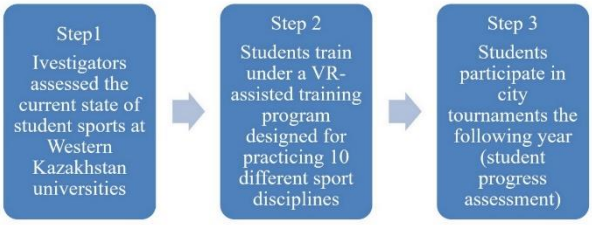

Figure 1. The flowchart diagram of the research process

The study put forward the following hypothesis:

H0: Virtual reality technologies do not have a positive impact on the success of students of sports disciplines at the universities of Western Kazakhstan

In contrast, the alternative hypothesis was as follows:

H1: Virtual reality technologies have a positive impact on the success of students of sports disciplines based on universities of Western Kazakhstan

Thus, the dependent variable was *the performance of student-athletes*, and the independent variable was *innovative technology*.

Participants

The study involved student participants (first to fourth year) from three universities in Western Kazakhstan: [BLINDED] University, [BLINDED] University, and [BLINDED] University. The sample included 35 female (mean age, 22.3; SD, 15) and 35 male (mean age, 23.1; SD, 11) students per university, with a sampling error (p) of less than 4.73. The study used the usual random sampling. Given the total number of students who studied sports at these universities, the margin of error does not exceed 4.66. Therefore, the sample was reliable and representative for this study.

Survey

Students took part in city tournaments in 10 sports before and after being involved in an experimental training program. Each of the universities specialized in different sports. Therefore, not all groups of students can be compared. The sports disciplines included taekwondo, basketball, boxing, freestyle wrestling, table tennis, sambo, football, Kazakh kuresi (Kazakh traditional wrestling), karate, and togizkumalak (a traditional mancala family game). City tournaments in various sports were the main way to assess student performance. Participants competed in these tournaments and took places depending on their performance. The results of the city tournaments before and after the experiment determined changes in the participants' sports achievements. Scores in the tournament ranged from 1 to 12, where 1 was the lowest score and 12 was the highest. The scores were based on the average score from 5 experts. The experts nominated teachers from other universities in Kazakhstan for the reliability of the assessment. The experts considered technique and skills, physical fitness, strategy, tactics, team interaction, emotional interaction, team ethics, and so forth.

The experimental 16-week training program rested on advanced virtual reality (VR) technology to improve sports training. Program participants used special VR headsets that launched them into the exciting world of virtual reality. This virtual world was carefully designed with the help of advanced software tools, including EyeJack and Cospaces Edu, which guaranteed high quality and realism. The first two lessons of this program introduced VR technology and its capabilities to students. This stage ensured that all participants mastered the necessary skills and understood how to use VR headsets in sports training effectively.

The videos for this program were selected from the YouTube platform. The platform allowed for the inclusion of multifunctional and diverse virtual material. In addition, participants could adjust and create virtual content using the built-in graphic editor. This feature expanded their opportunities in the sports training program.

In addition, only experienced coaches who were members of the university sports industry planned and conducted the training program. The process of introducing VR technology into sports training was monitored by a

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qualified technical specialist to ensure the correct functioning of headsets and software. The virtual reality application created innovative conditions for improving the efficiency and effectiveness of sports training for university students. The following year, city tournaments demonstrated the academic performance of the students. The results allowed for the comparison of their basic and post-training achievements.

Data collection process

Data analysis was done in SPSS Statistics and Microsoft Excel 2007. To reveal the statistical significance and correlation between the two variables, the study utilized the results of descriptive statistics, p-value, and t-value. The researchers also determined the relationship between student progress and learning using VR.

Data analysis

The survey relied on multistage quota sampling. The sampling error was calculated using the following formula:

$$SamplingErrorFormula = Z \times \frac{\sigma}{\sqrt{n}}$$

where: Z is the Z score based on the confidence interval (95%); n is the size of the sample; σ is the standard deviation.

The sampling error was 0.885, or approximately 1%, meaning that the data obtained is reliable. The interdependence of academic performance and tournament achievements is determined using the formula below:

$$r_a = \frac{ad-bc}{\sqrt{(a+b)(c+d)(a+c)(b+d)}}$$

where: a is the quantity of best results; b is the quantity of worst results; c and d represent the amount of intermediate results, respectively.

Ethical issues

All participants were informed about the goals and objectives of the study. Students gave their consent to the analysis of the survey data. The personal (age and ethnicity) and professional (specialty) details were collected, but never disclosed in any way. The study protocols were approved by the Ethical Committees of the participating universities.

Results

The goodness of fit of the VR-assisted training program was evaluated by the Kolmogorov-Smirnov test. Table 1 shows conditions at which the research hypothesis is rejected or accepted.

Table 1.
VR-assisted training program effectiveness based on data from the Kolmogorov-Smirnov test

T_1	T_2	T_3
0.25	0.25	0.03
$T_1 > T_{crit}$, hypothesis is FALSE; students enrolled in the VR-assisted and standard training programs show different performance outcomes	$T_2 > T_{crit}$, hypothesis is FALSE; the performance outcomes of VR-engaged students do not follow the same distribution	$T_3 < T_{crit}$, hypothesis is TRUE; tournament results after VR-assisted training are not lower than baseline

Based on the responses, the proposed training course is reliable for analyzing the effect of sporting activities at the university. The baseline information on student performance includes the results of city tournaments obtained in the 2021/22 academic year.

Table 2.
student performance in city tournaments throughout the 2021/22 academic year (places in the tournaments)

Sport disciplines	[blinded] university		[blinded] university		[blinded] university	
	male	female	male	female	male	female
taekwondo	4	3	2	5	6	10
basketball	4	6	5	8	10	3
boxing	3	5	9	10	4	14
Freestyle wrestling	6	5	7	9	8	2
table tennis	1	6	5	2	9	3
sambo	7	3	2	5	4	8
togyz kumalak	3	6	4	2	7	11
soccer	3	10	6	7	2	9
kazakh kuresi	2	5	6	4	1	8
karate	4	7	2	5	9	9

Data in Table 2 above show that participants achieved successive results in the tournaments, and this observation is true for each sport under consideration. The first places were taken by male students in table tennis ([BLINDED] University) and Kazakh kuresi ([BLINDED] University). While the [BLINDED] University took just on silver medal, the [BLINDED] and [BLINDED] Universities earned two and five silver medals, respectively. The worst-performing student was a female boxer from the [BLINDED] University who took the 14th place.

After participating in the VR-assisted training, male and female competitors were able to perform on higher level, as evidenced by the tournament results obtained the following year (Table 3). As can be seen from data in Table 3 below, only a small number of students performed worse than last year.

Table 3.
student performance in city tournaments throughout the 2022/23 academic year (places in the tournaments)

sport disciplines	[blinded] university		[blinded] university		[blinded] university	
	male	female	male	female	male	female
taekwondo	3	3	2	2	6	9
basketball	2	4	5	7	8	3
boxing	2	4	7	6	9	10
Freestyle wrestling	5	3	4	8	3	2
table tennis	1	4	2	5	7	3
sambo	6	4	1	5	3	7
togyz kumalak	3	5	4	9	6	10
soccer	2	8	10	3	1	13
kazakh kuresi	5	4	6	3	1	7
karate	2	3	4	5	6	8

The biggest difference in performance was observed

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among female students competing in the game of Togyz kumalak who fell from the 2nd place to the 9th place in the tournament. Slight differences were present in the performance of male boxers, freestyle wrestlers, female sambo wrestlers, male soccer players, male karatists, and male kuresi wrestlers. Note that training with VR is more likely to be an impediment to sport performance among male rather than female teams, as evidenced by the results of the post-training tournaments (Table 4).

Table 4.
Correlation of the percentage of prize-winning places between baseline and post-VR tournaments

	2021/22	2022/23	P-value	t-value
[BLINDED] University	35%	50%	0.002*	2.222
[BLINDED] University	25%	30%	0.033*	2.363
[BLINDED] University	25%	35%	0.0048*	2.351

* differences are statistically significant at p<.05.

Results show a significant increase in student performance across the given universities as compared with the 2021/22 academic year. The [BLINDED] University displays the largest increase (+15%) in the percentage of prize-winning prizes compared to the previous year. The relationship between students' progress and VR-assisted training is presented in Table 5.

Table 5.
The relationship between students' progress and VR-assisted training

Variables	Positive correlation	Negative correlation	Sum
Students' responses to VR-assisted instruction (indicative outcomes)	$a = 38$	$b = 8$	$a + b = 46$
Qualitative improvement of sportive work at the university	$c = 13$	$d = 13$	$c + d = 32$

Data in Table 5 above show a positive correlation between students' progress and VR-assisted training. To validate this finding, the following critical value of the correlation coefficient was obtained: $r_{acrit} = 0.25$, with a significance level of 0.05 and the degree of freedom $= N - 2$. The next step was as follows:

$r_{acrit}\sqrt{N-1} = 0.25 \cdot \sqrt{62-1} = 0.25 \cdot 7.81 = 1.95$, with $r_a\sqrt{N-1} > r_{acrit}\sqrt{N-1}$ (2.7335> 1.9525)

Based on these calculations, the relationship between students' progress in competitions and the quality of university training is considered correct $(r_a = 0.35, \mathrm{p} < 0.05)$.

Discussion

The results of this study indicate that the introduction of innovative technologies in sports gives effective results. The vast majority of students showed significantly better results after training with virtual reality compared to the basic level. The possible reason is the increased motivation due to the interaction with virtual reality (Shivrinskaya & Bertseva, 2014).

The introduction of new technologies at all levels of education is vital. Some researchers claim that VR is useful for the development of motor skills and distance learning (Ding, Li, & Cheng, 2020). It can also assist students with special needs and disabilities (Kang & Kang, 2019). In addition to motor skills, the use of virtual reality can improve their coordination, balance, and other skills. As mentioned earlier, the use of digital technologies in physical education has several potential advantages, such as increased student motivation, improved learning and understanding, support for inclusivity and differentiation, and the development of digital literacy. However, it is important to use digital technologies in combination with other teaching methods and ensure that all students have equal access to technology and support (Adilova et al., 2021; de Souza Júnior, de Oliveira, & de Araújo, 2022). At the same time, the article emphasizes an integrated approach to the implementation of these programs. The duration of the course and the training of students and teachers remains the most important criterion of efficiency and effectiveness.

Despite the advantages of virtual reality, high results imply the need for eye contact with the coach without using additional resources (Cheng, 2021). Therefore, in the problem statement, this aspect is one of the key factors. The research in this field of sports and innovative technologies is insufficient. On the other hand, many countries, especially rapidly developing ones, plan to employ artificial intelligence (AI) to accelerate the implementation processes (Li et al., 2021).

A bibliometric analysis of VR-based practices in physical education showed a gradually growing interest in VR among universities (Calabuig-Moreno, González-Serrano, Fombona, & Garcia-Tascon, 2020). This trend is also most noticeable in countries with a high level of development, such as the United States, Spain, and the United Kingdom. At the same time, this study shows that with a step-by-step approach, innovative technologies, such as VR, can drive the sports training of students even in less developing countries. For instance, in Kazakhstan, this approach can be effective despite the limitations described in the initial sections. AR can collect data on the performance and progress of athletes. AR sensors can track the movements of an athlete performing an exercise and provide real-time feedback (Soltani & Morice, 2020).

Another innovative technology, augmented reality, can improve motor skills, such as throwing a ball or basketball. Some researchers reported greater interest and motivation in learning motor skills among students who received instructions in augmented reality rather than traditional instructions (Chang, Zhang, Huang, Liu, & Sung, 2020). The mentioned technology has also improved engagement. This study draws similar conclusions, indicating an increase in the efficiency of students working with a digital tool as opposed to the traditional method.

Some studies also reported that instructions in virtual reality improved students' football performance and their attitude toward physical education (Lee & Lee, 2021). The researchers found a greater engagement in the classroom, which means higher attention, satisfaction, and integration.

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By comparison, this study focused solely on the physical effect of virtual reality learning. It did not cover student engagement and satisfaction. Nevertheless, the current study also focused on the applied results of students during interaction. One of the leading aspects of education is the acquisition of knowledge and its evaluation. Sports achievements indicated the academic success of future athletes, and, therefore, were extremely important.

If one considers the efficiency in terms of sports, more complex sports show the best result of implementation. The authors found that the use of VR in physical education and sports training can be especially useful in sports that require a high level of skill and coordination, such as basketball, football, and tennis. VR can help students improve their technique, learn new strategies, and train in different game scenarios (Li, Yi, & Gu, 2021).

On the other hand, the results were similar in the context of studying social networks. Thus, scientists pointed out that Facebook in the model of sports education can be especially useful for students with different levels of physical fitness and interests. Facebook provides a platform for students to communicate, cooperate, share resources, and receive feedback from the teacher. In general, the results of the study show that Facebook in sports education can effectively increase motivation and involvement, improve communication and cooperation, as well as develop the digital literacy of students (Bernabé Martín & Fernández Río, 2021).

Research limitations

The results in the given sports disciplines may differ from those in other sports. There may also be other external factors affecting student performance. The study sample encompassed only three universities in Western Kazakhstan. The proposed VR model does not claim to be a one-for-all solution.

Conclusion

The development of innovative means for university sports teaching is a growing research topic today, especially in regions with little experience in VR/AI-assisted learning. This study aimed to determine the effect of VR on university students' sports performance across different sports groups in Western Kazakhstan. After a 16-week VR-assisted training course, participants achieved higher results in all 10 sport disciplines under study. The correlation analysis revealed a strong connection between VR-assisted training and higher performance at the city tournament. The adoption of VR is also related to the higher quality of the university's sports practice work ($r_a = 0.35, \mathrm{p} < 0.05$).

The proposed solution allows universities to create an effective training program for student-athletes. The study also outlined challenges associated with the organization of university sports in the Republic of Kazakhstan, which may be addressed in further studies. Future research can also investigate the possibility of utilizing other technologies in university sports, such as artificial intelligence or online learning.

References

Abdallah, A. K., & Alriyami, R. (2022). Changes in the education landscape caused by COVID-19: Opportunities and challenges from UAE perspective. *World Journal on Educational Technology: Current Issues, 14*(3), 544-559. https://doi.org/10.18844/wjet.v14i3.7193

Abdallah, A., & Alkhrabsheh, A. (2019). The best leadership styles for preventing the educational crisis. *Opción: Revista de Ciencias Humanas y Sociales, 20*, 90-105.

Adilova, E., Aimaganbetova, O., Kassymova, L., Sadvakassova, Z., Ryskulova, M., & Sagnayeva, T. (2021). Value orientations of modern Kazakhstanis. *The Open Psychology Journal, 14*(1), 150-162. http://dx.doi.org/10.2174/1874350102114010150

Alfalah, S. F. (2018). Perceptions toward adopting virtual reality as a teaching aid in information technology. *Education and Information Technologies, 23,* 2633-2653. https://doi.org/10.1007/s10639-018-9734-2

Aly, H. (2020). Digital transformation, development and productivity in developing countries: is artificial intelligence a curse or a blessing? *Review of Economics and Political Science, 7*(4), 238-256. https://doi.org/10.1108/REPS-11-2019-0145

Avladadeev, A. A. (2016). Concepts for university sports development in Russia. *Young Scientist, 10*(114), 430-434. https://moluch.ru/archive/114/30252/

Baiketaev, T. (2017). *"The 'Soviet' thinking is the reason why there are no high-performance sports at the universities in Kazakhstan," says Kayrat Zakiryanov*. Inform Buro. https://informburo.kz/interview/kayrat-zakiryanov-iz-za-sovkovogo-myshleniya-v-kazahstane-net-nasto-yashchego-studencheskogo-sporta.html

Bakhareva, E. D., & Golovina, I. Y. (2021). Challenges for the development of university sports and ways to resolve thereof. *Science-2020, 5*(50), 54-59. https://cyberleninka.ru/article/n/problemy-razvitiya-studencheskogo-sporta-i-puti-ih-resheniya

Bernabé Martín, R. J., & Fernández Río, F. J. (2021). Integrating Facebook in sport education: A practical experience. *Retos, 41,* 718-727. https://doi.org/10.47197/retos.v41i0.82876

Calabuig-Moreno, F., González-Serrano, M. H., Fombona, J., & Garcia-Tascon, M. (2020). The emergence of technology in physical education: A general bibliometric analysis with a focus on virtual and augmented reality. *Sustainability, 12*(7), 2728. https://doi.org/10.3390/su12072728

Chang, K. E., Zhang, J., Huang, Y. S., Liu, T. C., & Sung, Y. T. (2020). Applying augmented reality in physical education on motor skills learning. *Interactive Learning Environments, 28*(6), 685-697.

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https://doi.org/10.1080/10494820.2019.1636073

Cheng, J. (2021). Evaluation of physical education teaching based on web embedded system and virtual reality. *Microprocessors and Microsystems, 83,* 103980. https://doi.org/10.1016/j.micpro.2021.103980

Chiva-Bartoll, O., Ruiz-Montero, P. J., Martín-Moya, R., Pérez López, I., Giles Girela, J., García-Suárez, J., & Rivera García, E. (2019). University service-learning in physical education and sport sciences: A systematic review. *Revista Complutense De Educación, 30*(4), 1147-1164. https://doi.org/10.5209/rced.60191

de Souza Júnior, A. F., de Oliveira, M. R. R., & de Araújo, A. C. (2022). The debate of digital technology in the continuing Physical Education teacher education: uses and concepts for teaching and learning. *Retos*, *46*, 694-704. https://doi.org/10.47197/retos.v46.94484

Ding, Y., Li, Y., & Cheng, L. (2020). Application of Internet of Things and virtual reality technology in college physical education. *Ieee Access, 8,* 96065-96074. https://doi.org/10.1109/ACCESS.2020.2992283

Dzyubich, D. K., & Olkhovskaya, E. B. (2016). The current state of university sports in Russia. In A. Kosykh (Ed.), *Physical culture, sport and health of students in modern conditions: problems and development prospects: materials of the Regional Student Scientific and Practical Conference, April 6, 2016, Yekaterinburg* (pp. 72-74). Yekaterinburg: Russian State Vocational Pedagogical University. https://elar.rsvpu.ru/bitstream/123456789/13010/1/fsz_17.pdf

Fayzievna, K. M., Narmuratovna, M. M., Mamurjanovna, B. U., Mavlyanovna, M. G., & Shukhratovna, A. S. (2020). Opportunities of innovation technologies in higher education. *International Journal on Integrated Education, 3*(12), 282-285. https://dx.doi.org/10.31149/ijie.v3i12.1002

Gennadieva, E. S. (2017). Analyzing the challenges of university sports development in the Russian Federation. In N. Dmitrieva (Ed.), *Proceedings of the XXXIV Student International Scientific and Practical Conference* (No. 23/34, pp. 74-77). Novosibirsk: Sibak. https://sibac.info/archive/meghdis/23(34).pdf

González-Serrano, M. H., Añó Sanz, V., & González-García, R. J. (2020). Sustainable sport entrepreneurship and innovation: A bibliometric analysis of this emerging field of research. *Sustainability, 12*(12), 5209. https://doi.org/10.3390/su12125209

Gough, L. A., Duffell, T., & Eustace, S. J. (2021). The impact of student attendance on assessment specific performance in sport degree programs. *Journal of Hospitality, Leisure, Sport & Tourism Education, 29,* 100323. https://doi.org/10.1016/j.jhlste.2021.100323

Izotov, E. A. (2017). Modern challenges of university sports. In C. Kozhalieva (Ed.), *Actual issues of psychology and pedagogy in modern conditions* (pp. 101-103). Saint Petersburg: Saint Petersburg Mining University. https://izron.ru/articles/aktualnye-voprosy-psikhologii-i-pedagogiki-v-sovremennykh-usloviyakh-sbornik-nauchnykh-trudov-po-ito/sektsiya-7-pedagogika-vysshey-professionalnoy-shkoly/sovremennye-problemy-sporta-v-vuzakh/

Jensen, L., & Konradsen, F. (2018). A review of the use of virtual reality head-mounted displays in education and training. *Education and Information Technologies, 23,* 1515-1529. https://doi.org/10.1007/s10639-017-9676-0

Kang, S., & Kang, S. (2019). The study on the application of virtual reality in adapted physical education. *Cluster Computing, 22,* 2351-2355. https://doi.org/10.1007/s10586-018-2254-4

Kavilova, T., Isanova, N., & Ravshanova, T. (2020). Innovative technologies, role and functions of the teacher. *Solid State Technology, 63*(6), 11815-11821.

Kharatova, S. K., & Ismailov, T. (2022). Use of innovative technologies in the educational process. *Science and Education, 3*(3), 713-718.

Kim, T., & Chiu, W. (2018). Consumer acceptance of sports wearable technology: The role of technology readiness. *International Journal of Sports Marketing and Sponsorship, 20*(1), 109-126. https://doi.org/10.1108/IJSMS-06-2017-0050

Kiryakova, A. V., Kargapoltseva, N., Belonovskaya, I. D., & Duzhnikov, S. A. (2021). University as an environment of innovative interactions. *Higher Education in Russia, 30*(8-9), 115-124. https://doi.org/10.31992/0869-3617-2021-30-8-9-115-124

Kodirova, G. A. (2020). Innovative technologies in modern education. *Theory and Practice of Modern Science,* 5(59), 29-31.

Lee, H. S., & Lee, J. (2021). The effect of elementary school soccer instruction using virtual reality technologies on students' attitudes toward physical education and flow in class. *Sustainability, 13*(6), 3240. https://doi.org/10.3390/su13063240

Li, D., Yi, C., & Gu, Y. (2021). Research on college physical education and sports training based on virtual reality technology. *Mathematical Problems in Engineering, 2021,* 6625529. https://doi.org/10.1155/2021/6625529

Lovin, D., Busila, A. V., & Sava, V. (2023). Culture shock, adaptation, and organizational performance in sport: A psychological perspective. *Technological Forecasting and Social Change, 190*, 122403. tps://doi.org/10.1016/j.techfore.2023.122403

Luo, H., Li, G., Feng, Q., Yang, Y., & Zuo, M. (2021). Virtual reality in K-12 and higher education: A systematic review of the literature from 2000 *to 2019. Journal of Computer Assisted Learning, 37*(3), 887-901. https://doi.org/10.1111/jcal.12538

Maas, M. J., & Hughes, J. M. (2020). Virtual, augmented and mixed reality in K–12 education: A review of the literature. *Technology, Pedagogy and Education, 29*(2), 231-249. https://doi.org/10.1080/1475939x.2020.1737210

Maltseva, N. A., Salugin, F. V., Bikmaev, I. A., Spataeva,

© Copyright: Federación Española de Asociaciones de Docentes de Educación Física (FEADEF) ISSN: Edición impresa: 1579-1726. Edición Web: 1988-2041 (https://recyt.fecyt.es/index.php/retos/index)

M. K., Pushkareva, L. G., & Salugina, T. V. (2022). University sports management. *Modern High Technologies, 4,* 175-179. https://top-technologies.ru/ru/article/view?id=39128

Mambetalina, A. S., Borankulovna, O. A., Kanatovna, M. S., Ukatayevna, U. G., Pamazanovna, M. A., & Tlegenovna, U. Z. (2022). The impact of complex intervention on the dynamics of children's development with ASD. *The Open Psychology Journal, 15*(1), e2205110. http://dx.doi.org/10.2174/18743501-v15-e2205110

Marks, B., & Thomas, J. (2022). Adoption of virtual reality technology in higher education: An evaluation of five teaching semesters in a purpose-designed laboratory. *Education and Information Technologies, 27*(1), 1287-1305. https://doi.org/10.1007/s10639-021-10653-6

Minvaleev, R. S., & Shadrin, L. V. (2014). University sports and mass physical education: The comparison of functional test results. In V. M. Shulyatiev (Ed.), *Physical culture and sports in the Russian education system: innovations and development prospects* (pp. 159-164). SPb.: Publishing House of St. Petersburg University. https://en.ppt-online.org/228413

Muñoz-Bullón, F., Sanchez-Bueno, M. J., & Vos-Saz, A. (2017). The influence of sports participation on academic performance among students in higher education. *Sport Management Review, 20*(4), 365-378. https://doi.org/10.1016/j.smr.2016.10.006

Olkhovsky, R. M., Filimonova, S. I., Zhdanovich, D. O., & Eremina, E. A. (2021). Improving the mechanisms of financial support for university sports clubs. *Theory and Practice of Physical Culture, 3,* 45-47. https://doi.org/10.24412/0040-3601-2021-3-45-47

O'Neil, L., Amorose, A. J., & Pierce, S. (2021). Student-athletes' dual commitment to school and sport: Compatible or conflicting? *Psychology of Sport and Exercise, 52,* 101799. https://doi.org/10.1016/j.psychsport.2020.101799

Palamarchuk, O., Gurevych, R., Maksymchuk, B., Gerasymova, I., Fushtey, O., Logutina, N., ... & Maksymchuk, I. (2020). Studying innovation as the factor in professional self-development of specialists in physical education and sport. *Revista Romaneasca Pentru Educatie Multidimensionala, 12*(4), 118-136. https://doi.org/10.18662/rrem/12.4/337

Peng, L., Yen, Y., & Siswanto, I. (2020). Virtual reality teaching material-virtual reality game with education. *Journal of Physics: Conference Series, 1456*(1), 012039. https://doi.org/10.1088/1742-6596/1456/1/012039

Sabekov, S. (2010). *The development of university sports in Kazakhstan requires special attention.* Sports KZ. https://www.sports.kz/news/vopros-razvitiya-studencheskogo-sporta-v-kazahstane-trebuet-osobogo-vnimaniya

Sabitov, R. A. (2002). *The fundamentals of scientific research: A textbook*. Chelyabinsk: Chelyabinsk State University. http://www.dissers.ru/metodicheskie-ukazaniya/a4.php

Samonina, A. N. (2021). Modern educational system of kazakhstan: traditions, experience, innovations. *Professional Education: Methodology, Technology, Practice*, *1,* 117-121.

Shivrinskaya, S. E., & Bertseva, T. S. (2014). University students' interests in the field of physical education and sport activities. *International Journal of Experimental Education, 8*(1), 33-36. https://expeducation.ru/ru/article/view?id=5786

Siegle, D. (2019). Seeing is believing: Using virtual and augmented reality to enhance student learning. *Gifted Child Today, 42*(1), 46-52. https://doi.org/10.1177/1076217518804854

Singh, A. S., Saliasi, E., Van Den Berg, V., Uijtdewilligen, L., De Groot, R. H., Jolles, J., ... & Chinapaw, M. J. (2019). Effects of physical activity interventions on cognitive and academic performance in children and adolescents: a novel combination of a systematic review and recommendations from an expert panel. *British Journal of Sports Medicine, 53*(10), 640-647. http://dx.doi.org/10.1136/bjsports-2017-098136

Soltani, P., & Morice, A. H. (2020). Augmented reality tools for sports education and training. *Computers & Education, 155,* 103923. https://doi.org/10.1016/j.compedu.2020.103923

Soulliard, Z. A., Kauffman, A. A., Fitterman-Harris, H. F., Perry, J. E., & Ross, M. J. (2019). Examining positive body image, sport confidence, flow state, and subjective performance among student athletes and non-athletes. *Body Image, 28,* 93-100. https://doi.org/10.1016/j.bodyim.2018.12.009

Sports KZ (2021). *Kazakhstan made formal decisions after failure at the 2020 Olympics*. https://www.sports.kz/tokyo/news/v-kazakhstane-ofitsialno-prinyatyi-resheniya-posle-provala-na-olimpiade-2020

The Legislation of the Russian Federation (2007). *The Federal Law dated 04.12.2007 N 329-FZ "On physical culture and sports in the Russian Federation.*

Tuksanova, Z., & Nazarov, E. (2020). Effective use of innovative technologies in the education system. *Interscience, 16*(3), 30-32.

Turovsky, A. N. (2019). The development of university sports in Russia: Challenges and prospects. *The World of Science, Culture, and Education, 6*(79), 345-347. https://doi.org/10.24411/1991-5497-2019-10150

Tyukalova, E. G. (2019). *Current challenges of university sports development*. Info Urok. https://infourok.ru/aktualnie-problemi-razvitiya-studencheskogo-sporta-3844115.html

Vashchuk, A. O., & Medvedeva, D. E. (2018). University sports: state, paths of development, and sports reserve training. *Scientia Potentia Est., 2,* 1-7. https://amgpgu.ru/upload/iblock/d08/vashchuk_a_medevedeva_e_studencheskiy_sport_sostoyanie_puti_razvitiya_i_podgotovka_sportivnogo_rezer.pdf

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Yukhymenko-Lescroart, M. A. (2018). On identity and sport conduct of student-athletes: Considering athletic and academic contexts. *Psychology of Sport and Exercise, 34,* 10-19. https://doi.org/10.1016/j.psychsport.2017.09.006

Yuldashev, M. (2021). Innovative aspects for healthy lifestyle formation and development of sports. *Current Research Journal of Pedagogics, 2*(5), 102-107. https://doi.org/10.37547/pedagogics-crjp-02-05-18

Yusupova, N. X., & Nomoanjonova, D. B. (2022). Innovative technologies and their significance. *Central Asian Journal of Mathematical Theory and Computer Sciences, 3*(7), 11-16.

Zheleznyak, Y. D., & Petrov, P. K. (2002). *The fundamentals of scientific and methodological activities in physical education and sports: A textbook for university students.* Moscow: Academia. http://av.disus.ru/metodichka/1993106-1-yu-zheleznyak-petrov-osnovi-nauchno-metodicheskoy-deyatelnosti-fizicheskoy-kulture-sporte-dlya-studentovь uchrezhdeniy-visshego-professionaln.php

Zotova, F. R., & Faizullin, I. F. (2015). Physical education and university sports in the region: State, challenges and prospects. *Science and Sport: Latest Trends, 6*(1), 32-38. http://lib.sportedu.ru/Press/NiSST/2015n1/p32-38.pdf

Zykina, D. S., & Proskurina, E. F. (2021). Innovations in university sports. In A. Osin (Ed.), *Proceedings of the XIII International Student Scientific Conference* (pp. 41-42). Moscow: Russian Academy of Natural Sciences. https://scienceforum.ru/2021/article/2018023878