Views of Educators about the Utilization of Virtual Reality in Special Education and Training

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Abstract

The technology of virtual reality has been applied in various sectors of education and training, with the possibility of its incorporation in study programs. The aim of this research is the exploration of the views of educators regarding the use of this technology in the teaching of special education students. The approach of quantitative research was followed, which included 100 PE70[1] educators and postgraduate students of the Department of Sports Organization and Management of the University of the Peloponnese and it has focused on the use of virtual reality, its potential utilization in special education and on the obstacles that restrict it. The results demonstrated the positive stance of the educators vis-à-vis its utilization, but obstacles were recognized as regards its practical application, which was detected as being restricted, with the educators expressing a desire for further education.

[1] PE70 is a category of Primary Education teachers – Translator's note.

Key words: views of educators, virtual reality, special education

Introduction

The term “virtual reality” (VR) was contrived by John Lanier in 1989 (Steuer, 1992; Gandhi & Patel, 2018; Alizadeh, 2019) and it refers to a concept of a quasi reality (Sagnier, Loup-Escande, & Valléry, 2021). It is considered to be a technology of virtual sinking into a digital environment through a simulation of electronic graphics, which allows the entry to an interactive three-dimensional world, where different types of sensory and emotional experiences meet (Everson, McDermott, Kain, Fernandez, & Horan, 2018; Drigas, Mitsea, & Skianis, 2022a; Villena-Taranilla, Tirado-Olivares, Cózar-Gutiérrez, & González-Calero, 2022).

The three basic characteristics of virtual reality are immersion, presence and interactivity (Mütterlein, 2018). Immersion is described as the state of mind, in which the user, while participating physically and mentally (Carù & Cova, 2006), at the same time moves away from reality, escaping to the environment of virtual reality (Hudson, Matson-Barkat, Pallamin, & Jegou, 2019). Presence is referred to as the mental existence of the user in an environment regardless of where they are physically (Mütterlein, 2018), resulting in their reaction to virtual stimuli in a manner corresponding to their reaction to similar stimuli actually (Slater, 2018). Interactivity is defined as the degree of influence of the user towards the form or contents of the virtual environment (McMillan & Hwang, 2002; Mütterlein, 2018). It is distinguished in interactivity with the objects that pertain to gestures (Han & Kim, 2017; Lee, Kim & Kim, 2017; Lum, Greatbatch, Waldfogle, & Benedict, 2018; Angelov, Petkov, Shipkovenski, & Kalushkov, 2020) and its position (Angelov et al., 2020), as well as with navigation, namely its locomotion in the virtual environment (Boletsis, 2017).

The systems of virtual reality consist of a variety of peripheral devices, display devices, motion and position capture devices, proprioceptive and cutaneous feedback devices, and sound input and presentation devices. The display devices mobilize vision (Sagnier et al., 2021) and the more familiar ones are the head-mounted display (HMD) (Gandhi & Patel, 2018; Alizadeh, 2019) and the cave (Gandhi & Patel, 2018). The motion and position capture devices provide information about the actions and position of the user (Fuchs & Mathieu, 2011), whereas the sound input and presentation devices respectively recognize vocal commands (Tsingos & Warusfel, 2006) and they produce sound at the appropriate volume (Sagnier et al., 2021). Finally, the proprioceptive and cutaneous feedback devices consist of sensorimotor interfaces, such as gloves (Gandhi & Patel, 2018; Sagnier et al., 2021) and exoskeletons (Sagnier et al., 2021), haptic devices (Benali-Koudja & Hafez, 2006) and motion simulation devices (Fuchs, 2006).

Virtual Reality and Special Education and Training

Virtual reality as an emerging technology of the future (Direction Générale des Entreprises, 2016) can be applied in various sectors and it can enhance the experiences of the users in learning and training (Mendes, Almeida, Mohamed, & Giot, 2019), since it is able to deal differently with various problems and provide the user with additional information that they would not be able to obtain only by using their senses (Rebbani, Azougagh, Bahatti, & Bouattane, 2021). For this reason, its contribution to educational services for students with disabilities is decisive, since through multi-sensory learning by using adapted tools and strategies, it is able to offer solutions for the enhancement of the quality of the educational material, the improvement of their learning performances and the enhancement of their academic, but also their social self-esteem, and self-efficacy (Buzio, Chiesa, & Toppan, 2017).

Students with a disability and special educational needs are considered to be those students who for the entire or certain period of their school life face significant learning difficulties that are the result of specific problems or disorders, such as mental disability, sensory disabilities of vision and hearing, motor disabilities, chronic incurable diseases, speech and language disorders, special learning difficulties, attention deficit disorder with or without hyperactivity, pervasive developmental disorders, mental disorders and multiple disabilities. Furthermore, students with composite cognitive, emotional and social difficulties and deviant behaviour are also numbered among individuals with special educational needs, since they too have one or more cognitive abilities and talents, developed to a degree that considerably exceeds what is anticipated for their age group (Law 3699/2008, article 3).

For the enhancement of the welfare of these students, additional assistance is provided through structured school programs, whose aim is to support both their academic and daily functional skills (Chronopoulou & Fokides, 2020) and which are developed in parallel with the growth of technology (Kellems, Yakubova, Morris, Wheatley, & Chen, 2022). The three-dimensional simulations, such as virtual reality, are regarded as teaching tools (Merchant, Goetz, Cifuentes, Keeney-Kennicutt, & Davis, 2014), as they ensure environments that are safe, structured, controlled (Park, Kim, Lee, Na, & Jeon, 2019), individualized (Lagos Rodríguez, García, Loureiro, & García, 2022), interactive and multi-sensory (Papanastasiou, Drigas, Skianis, Lytras, & Papanastasiou, 2019; Drigas et al., 2022a). These environments use attention and visualization as restoration tools, achieving either the distraction of students' attention from stressful stimuli or their being appropriately directed towards significant information (Drigas & Mitsea, 2020a; Drigas, Mitsea, & Skianis, 2021; Drigas et al., 2022a), but also replacing verbal stimuli with visual ones (Drigas et al., 2021; Drigas et al., 2022a), enhancing reasoning (Huang, Rauch, & Liaw, 2010), creative imagination and complex problem-solving skills (Huang et al., 2010; Papanastasiou et al., 2019). Moreover, through

cooperative environments, social interaction (Huang et al., 2010), the flexibility and sociability of students (Pan, Cheok, Yang, Zhu, & Shi, 2006) are promoted, as well as cooperation and the exchange of ideas and experiences (Huang et al., 2010). Through learning based on problems, which is implemented in those environments, the development of independent thinking is achieved (Huang et al., 2010; Drigas et al., 2022a), through learning that is based on games the innate motives of the students are enhanced and they are motivated to learn new skills without pressure (Ulmer, Braun, Cheng, Dowey, & Wollert, 2022), whereas through avatars and role-playing self-regulated behaviours are developed (Drigas et al., 2022a).

Virtual Reality, Special Education and Training and Views of Educators

Educators can use virtual reality in the educational process when traditional methods do not yield the required results. Its utilization can offer them flexibility in the provision of individual feedback, facility in exploration and incorporation of sectors of particular interest, the possibility of providing timely services in moments of crisis, as well as the possibility of changing social and environmental requirements (Kellems et al., 2022). However, its acceptance and degree of its utilization are always contingent on the attitude, perception and sensitization of each respective educator to it, particularly when the latter himself or herself works in the field of special education and training (Lee & Joo, 2019).

Despite the rapid increase in the integration of new technologies in human daily life, the application of virtual reality in the educational framework for students with disabilities proves to be limited. Only 7% of special education teachers reported its introduction into the education process in the USA (Yakubova et al., 2022), 28% in San Francisco (Nussli, 2014), whereas it was only 7.5% in Monmouth County, New Jersey (Gleason, 2017). However, along with the absence of exposure to the new technologies, the majority of the educational community appears to be supportive and is prepared to acquire the necessary knowledge in order to achieve

the introduction of virtual reality into the educational process. The same population reports that the difficulty is not found in the willingness of the educators for integration, but rather in the absence of their organized further training, the limited resources provided for its utilization and the absence of the suitable formulation of school programming (Yakubova et al., 2022).

To the extent that virtual reality managed to permeate the educational process, according to special education teachers, it demonstrated that the virtual worlds promise much for the support of handicapped students. The virtual environments with the experiential and sensory applications that they use reinforce the development of social, communication, behavioral, academic skill sets and life and living skills and they provide opportunities for generalization and repetition (Gleason, 2017). The interactive platforms that they have provide students with opportunities for safe practicing in social interactions, as the sense of fear or stress evoked by interactions with the real world is absent (Gleason, 2017; Nussli, 2014; Stichter, Laffey, Galyen, & Herzog, 2014; Nussli & Oh, 2016). Through various prospects, they reinforce collaborativeness, cohesion and synchronization, facilitating their growth in real life as well (Nussli, 2014). With the replacement of real sensory information by digital sensory information, riveting, interactive and controlled simulations of various social and everyday life skills are offered, corresponding to the social stories that reinforce learning and the behaviour of children found in the spectrum of autism (Gleason, 2017; Adjorlu & Serafin, 2019). With the gamification of the educational interventions, where in fact there is also the possibility of avoiding the consequences of the mistakes that they experience in a real environment, the incentives, the mood and interest of the students for learning are augmented (Adjorlu & Serafin, 2019; Kongsilp & Komuro, 2019).

Simultaneously with its numerous and multidimensional benefits, the incorporation of virtual reality into the educational process also presents several challenges. The playful nature and the attractive characteristics provided by a virtual environment pose a risk of distracting

students' attention from the main purpose of the educational process. Consequently, a major issue for educators is that of controlling the movements of the students within such an environment, doubting their prompt intervention in cases of disorientation of the students or their exposure to unsuitable content (Nussli, 2014; Nussli & Oh, 2016). The inadequacy of expressiveness presented by the avatars constitutes a significant challenge, seeing that provided the expressions and movements that would correspond to a living body are absent, then the subconscious transfer of those skills to real everyday conditions would be wanting (Nussli, 2014). Finally, the sudden occurrence of technical problems (Nussli, 2014; Nussli & Oh, 2016; Newbutt, Bradley, & Conley, 2020; Yakubova et al., 2022), the lack of knowledge on the part of the educators, their inadequate instruction and support, in conjunction with the absence of time and state funding reinforce their concerns and fears regarding the incorporation of new technologies and virtual reality in the educational framework of special education (Gleason, 2017; Yakubova et al., 2022).

Method

Purpose

The purpose of the research study is the exploration of the views of the teachers of general and special education, who carry out educational work in the regional unit of Laconia, as well as the postgraduate students of the Department of Sports Organization and Management of the University of the Peloponnese as regards the utilization of the technology of virtual reality in the teaching of special education students. The objective of the research endeavor is the examination of the participants' views concerning the utilization of the technology of virtual reality in special education and training, the degree of its potential utilization and the detection of the obstacles that prevent its exploitation in school practice.

Research questions

The research questions that are addressed in the present study are the following:

1. What are the views of the teachers of general and special education, but also of the postgraduate students of the Department of Sports Organization and Management of the University of the Peloponnese as regards the utilization of the technology of virtual reality in special education and training?
2. What is the degree of use and potential utilization of virtual reality?
3. Which possible obstacles foil the pedagogical utilization of virtual reality?

Population and Sample

Due to the difficulty of selecting a stratified random sample, the method of convenience sampling was selected, following a non-probability sampling strategy, owing to the small scale of the study (Creswell, 2011; Robson, 2010). Constituting the population of the research were educators of the primary and secondary general and special education of the regional unit of Laconia and postgraduate students of the Department of Sports Organization and Management of the University of the Peloponnese. The research sample consists of 100 respondents, of whom 55 are men (55%), 45 women (45%), 55% general education teachers, 23% special education teachers and 22% postgraduate students, with the main age range being 31-40 years (38%).

Research tool

For the collection of the data, an electronic questionnaire was drawn up, by utilizing research tools that were pinpointed from a bibliographical survey (Gleason, 2017; Lee & Joo, 2019; Berdeklis, Kostas & Sofos, 2021; Newbutt et al., 2020; Nussli, 2014; Nussli & Oh, 2016;

Stichter et al., 2014; Yakubova et al., 2022). The questionnaire was structured around four main axes:

- **1st axis:** Demographic data *(gender, age, specialization, degree title, training in virtual reality)* with closed-ended questions.
- **2nd axis:** Use and utilization of virtual reality in the educational process, *(4 questions from the 5-point Likert scale)*
- **3rd axis:** Risks and limiting factors in the implementation of virtual reality in the school environment of special education *(3 questions from the 5-point Likert scale)*.

Research Process

Pilot and main research

In order to check the questionnaire, a pilot study was conducted on a sample of N=10 teachers to test the questionnaire. After the pilot research and the necessary modifications to the questionnaire, the main research ensued. The distribution of the questionnaire took place by forwarding it via e-mail to each primary and secondary education school unit in the regional unit of Laconia, with relevant briefing of the recipients about the aim, goals and safeguarding of the personal data of the participants. During the period from 1/9/2022–10/9/2022, N=100 answers, which comprised the research sample, were collected.

Results

Views on utilization

The views of the educators and students of the research as to whether virtual reality could potentially be utilized in the school environment are presented in Table 1, with the larger percentage of 35% believing that it could be utilized adequately, whereas the cumulative percentage of 39% believed that it should be utilized extensively or even to a very great extent.

Table 1. Degree of potential utilization of virtual reality in the school environment.

	N	%	Cumulative %
Not at all	5	5,0	5,0
Somewhat	21	21,0	26,0
Fairly	35	35,0	61,0
Considerably	23	23,0	84,0
Quite considerably	16	16,0	100,0
Total	100	100,0	

As regards the views of the participants as to whether the use of virtual reality should be used in a personalized manner in teaching students, the cumulative percentage of 78%, as shown in Table 2, believes that it is necessary to have taken into consideration extensively or even to a very great extent the particular learning characteristics of each student prior to teaching, which should be personalized.

Table 2. Personalized use of virtual reality.

	N	%	Cumulative %
Not at all	2	2,0	2,0
Somewhat	4	4,0	6,0
Fairly	16	16,0	22,0
Considerably	38	38,0	60,0
Quite Considerably	40	40,0	100,0
Total	100	100,0	

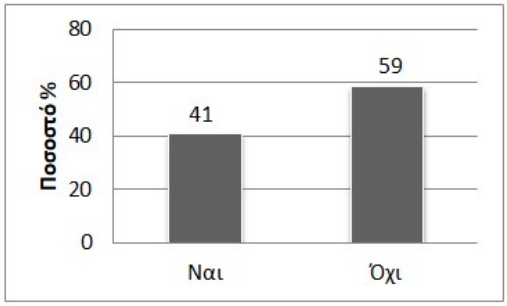
Concerning the views of the subjects of the research as regards the evaluation of the learning result after using virtual reality in teaching, from the cumulative percentage of 86%, as shown in Table 3, they stated that the evaluation should be carried out extensively or to a very great extent.

Table 3. Evaluation of the use of virtual reality.

	N	%	Cumulative %
Not at all	1	1,0	1,0
Somewhat	0	0,0	1,0
Fairly	13	13,0	14,0
Considerably	37	37,0	51,0
Quite considerably	49	49,0	100,0
Total	100	100,0	

Degree of use and desire for incorporation

Out of the total of 100 educators and students that participated in the study, according to Bar Graph 1, the 59 (59%) stated that they have never used virtual reality, while the other 41 (41%) claim that they have come into contact with it and have used it.



Γράφημα 1. Χρήση εικονικής πραγματικότητας

Bar Graph 1. Use of virtual reality[2]

As far as the degree of desire of the subjects of the study regarding incorporation of virtual reality in the school process is concerned, from Table 4 one can discern the keen desire (quite considerably) of the 41% to include it in the school environment, with the other 36% following and maintaining that it desires it considerably.

Table 4. Desire for incorporation of virtual reality in the school environment.

	N	%	Cumulative %
Not at all	1	1,0	1,0
Somewhat	3	3,0	4,0
Fairly	19	19,0	23,0
Considerably	36	36,0	59,0
Quite considerably	41	41,0	100,0
Total	100	100,0	

Possible obstacles

Table 5 presents the percentage distribution regarding the necessity for each teacher to be aware of the technical limitations, before they incorporate virtual reality into school practice, with the

[2] On the left it shows the percentage. The bar on the left indicates the number of those saying "Yes" and the one on the right those saying "No".

cumulative percentage of 74% acknowledging the necessity of having very good to excellent knowledge of these technical aspects before incorporating it into their teaching.

Table 5. Technical limitations of virtual reality.

	N	%	Cumulative %
Not at all	1	1,0	1,0
Somewhat	2	2,0	3,0
Fairly	23	23,0	26,0
Considerably	37	37,0	63,0
Quite considerably	37	37,0	100,0
Total	100	100,0	

The percentages regarding the level of risk associated with the use of virtual reality during teaching in special education settings, which are shown in Table 6, indicate that most respondents (38%) believe the risks associated with its implementation are minimal, while those who consider them to be significant (35%) are not far behind.

Table 6. Level of risk when using virtual reality.

	N	%	Cumulative %
Not at all	7	7,0	7,0
Somewhat	38	38,0	45,0
Fairly	35	35,0	80,0
Considerably	12	12,0	92,0
Quite considerably	8	8,0	100,0
Total	100	100,0	

Regarding the types of obstacles that special education teachers are likely to encounter when using virtual reality in their teaching, as presented in Table 7, the largest percentage of participants in the study, reaching 39%, identifies the unsuitable teaching environment as the main barrier to its utilization, with 33% of them following, maintaining the required know-how as a possible obstacle. Following is the lack of suitable tools with a percentage of 18% and the time for incorporation and the absence of examples of best practices with percentages of 4% and 6% respectively.

Table 7. Obstacles during the use of virtual reality.			
	N	**%**	**Cumulative %**
Unsuitable teaching environment	39	39,0	39,0
Required know-how	33	33,0	72,0
Lack of suitable tools	18	18,0	90,0
Time for incorporation of the technologies in the teaching	4	4,0	95,0
Absence of examples of best practices	6	6,0	100,0
Total	100	100,0	

Discussion

Research question 1

The entire group of general and special education teachers, as well as postgraduate students from the Department of Sports Organization and Management at the University of the Peloponnese who participated in the study, approved the utilization and integration of virtual reality technology into special education practice, firmly believing that it has the potential to yield the best educational outcomes.

Despite the view of some that virtual reality could potentially undermine the teacher's role or create several practical challenges, the benefits of its personalized application were recognized, which is in line with the findings of the research by Yakubova et al. (2022).

Research question 2

The majority of teachers and postgraduate students in the study reported limited use of virtual reality; however, they recognized its potential effectiveness in being integrated into special education. In the studies by Yakubova et al. (2022), Nussli (2014) and Gleason (2017), the minimum involvement of special education teachers in virtual reality was likewise ascertained, as in the USA only 7% of them used it as an educational tool (Yakubova et al., 2022), whereas

in San Francisco just one-third of the educators were involved, reporting the lack of expertise with new technologies (Nussli, 2014).

Research question 3

This study defines the unsuitable teaching environments and the required know-how as primary obstacles in the adoption of virtual reality technologies by the special education teachers, with the inadequate existence of tools hampering its application in educational environments. Similar findings have been reported in previous studies as well (Nussli, 2014; Nussli & Oh, 2016; Newbutt et al., 2020; Yakubova et al., 2022), which determine various technical issues as significant obstacles in the use of virtual reality, which contribute to the difficulty in its incorporation by educators in their pedagogical practices.

Conclusions

According to the findings of the study, the participating educators and postgraduate students demonstrate a positive attitude towards the use of virtual reality technology in special education. They express a keen desire for its incorporation in the educational framework, as they believe it could help in the improvement of learning results. This optimistic prospect contrasts with its limited application in educational practices; however, the few users confirm its effectiveness.

The insufficient teaching environment, as well as the lack of appropriate resources are acknowledged as significant obstacles in the adoption of virtual reality in the classroom. The training of educators and securing the necessary resources could reduce the impact of these barriers and upgrade educational practice.

Delimitations – Limitations

This study is subject to limitations. Owing to the absence of a standardized research tool, issues arise regarding its validity, while the non-random sampling combined with the small sample size limit the generalization of the results. Nonetheless, the knowledge provided is valuable and can serve as a foundation for future large-scale research, both at the national level and in the involvement of more interest groups.

Acknowledgements

The friends in our life are wealth.

Whereas life is beautiful and happiness is found closer than we think…

A big thanks to my own friends, Christina Lampoussi and Panagiotis Koutsovassilis, for their support!

References

Foreign-language

Adjorlu, A., & Serafin, S. (2019, March). *Teachers' Views on how to use Virtual Reality to Instruct Children and Adolescents Diagnosed with Autism Spectrum Disorder.* In 2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR) (pp. 1439-1442). Osaka, Japan: IEEE Xplore. doi: 10.1109/VR.2019.8798032

Alizadeh, M. (2019). Virtual Reality in the Language Classroom: Theory and Practice. *Call-Ej*, *20*(3), 21-30. Retrieved from http://callej.org/journal/20-3.html

Angelov, V., Petkov, E., Shipkovenski, G., & Kalushkov, T. (2020, June). Modern Virtual Reality Headsets. In T. Fahrettin (Ed.), *2020 International Congress on Human-Computer Interaction, Optimization and Robotic Applications (HORA)* (pp. 1-5). Ankara: IEEE. doi: 10.1109/HORA49412.2020.9152604

Benali-Koudja, M., & Hafez, M. (2006). Les interfaces tactiles. In P. Fuchs & G. Moreau (Eds.), *Le traité de la réalité virtuelle* (2nd ed., pp. 219-240). Paris: Mines Paris. Retrieved from https://t.ly/WVZq

Boletsis, C. (2017). The New Era of Virtual Reality Locomotion: A Systematic Literature Review of Techniques and a Proposed Typology. *Multimodal Technologies and Interaction, 1*(4), 24. doi: 10.3390/mti1040024

Buzio, A., Chiesa, M., & Toppan, R. (2017, March). Virtual reality for special educational needs. *2017 ACM Workshop on Intelligent Interfaces for Ubiquitous and Smart Learning* (pp. 7-10). doi: 10.1145/3038535.3038541

Carù, A., & Cova, B. (2006). How to facilitate immersion in a consumption experience: Appropriation operations and service elements. *Journal of Consumer Behaviour: An International Research Review, 5*(1), 4-14. doi: 10.1002/cb.30

Chronopoulou, M. I., & Fokides, E. (2020). Using a 3D Simulation for Teaching Functional Skills to Students with Learning, Attentional, Behavioral, and Emotional Disabilities. In Y. Qian (Ed.), *Teaching, Learning, and Leading With Computer Simulations* (pp. 209-233). USA: IGI Global. doi: 10.4018/978-1-7998-0004-0.ch008

Creswell, J. (2011). *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research in Education.* (translation by N. Kouvarakos). Athens: Ion/Greek.

Direction Générale des Entreprises (2016). *TECHNOLOGIES CLÉS 2020: Préparer l'industrie du futur*. Retrieved from Le portail de la Direction générale des Entreprises

website, https://www.entreprises.gouv.fr/fr/presse/industrie/politique-industrielle/publication-de-l-etude-technologies-cles-2020-preparer-l-industrie-du-futur

Drigas, A., & Mitsea, E. (2020a). The 8 pillars of metacognition. *International Journal of Emerging Technologies in Learning, 15*(21), 162-178. Retrieved from https://www.learntechlib.org/p/218360/

Drigas, A., Mitsea, E., & Skianis, C. (2021). The Role of Clinical Hypnosis and VR in Special Education. *International Journal of Recent Contributions from Engineering Science & IT, 9*(4), 4-17. doi: 10.3991/ijes.v9i4.26147

Drigas, A., Mitsea, E., & Skianis, C. (2022a). Virtual Reality and Metacognition Training Techniques for Learning Disabilities. *Sustainability, 14*(16), 10170. doi: 10.3390/su141610170

Everson, T., McDermott, C., Kain, A., Fernandez, C., & Horan, B. (2018). Astronaut Training using Virtual Reality in a Neutrally Buoyant Environment. *KnE Engineering, 2*(1) 319-327. doi: 10.18502/keg.v2i2.632

Fuchs, P. (2006). Les interfaces à simulation de mouvement et les interfaces à simulation de climat. In P. Fuchs & G. Moreau (Eds.), *Le traité de la réalité virtuelle* (2nd ed., pp. 297-316). Paris: Mines Paris. Retrieved from https://t.ly/WVZq

Fuchs, P., & Mathieu, H. (2011). Location sensors. In P. Fuchs, G. Moreau, & P. Guitton (Eds.), *Virtual Reality: Concepts and Technologies* (pp. 105-122). Boca Raton, London, NewYork, Leiden: CRC Press, Taylor & Francis Group. doi: 10.1201/b11612

Gandhi, R. D., & Patel, D. S. (2018). Virtual Reality – Opportunities and Challenges. *International Research Journal of Engineering and Technology (IRJET), 5*(1), 482-490. Retrieved from https://www.irjet.net/volume5-issue1

Gleason, L. J. (2017). *Virtual Reality Technologies and Autism Spectrum Disorder: Directors of Special Services' Perceptions* (Doctoral dissertation, Saint Peter's University). Retrieved

from ProQuest Dissertations and Thesis database: https://www.proquest.com/docview/1912715404?pq-origsite=gscholar&fromopenview=true

Han, S., & Kim, J. (2017). A Study on Immersion of Hand Interaction for Mobile Platform Virtual Reality Contents. *Symmetry*, *9*(2), 22. doi: 10.3390/sym9020022

Huang, H. M., Rauch, U., & Liaw, S. S. (2010). Investigating learners' attitudes toward virtual reality learning environments: Based on a constructivist approach. *Computers & Education, 55*(3), 1171-1182. doi: 10.1016/j.compedu.2010.05.014

Hudson, S., Matson-Barkat, S., Pallamin, N., & Jegou, G. (2019). With or without you? Interaction and immersion in a virtual reality experience. *Journal of Business Research, 100*, 459-468. doi: 10.1016/j.jbusres.2018.10.062

Kellems, R. O., Yakubova, G., Morris, J. R., Wheatley, A., & Chen, B. B. (2022). Using Augmented and Virtual Reality to Improve Social, Vocational, and Academic Outcomes of Students With Autism and Other Developmental Disabilities. In Information Resources Management Association (Eds.), *Research Anthology on Inclusive Practices for Educators and Administrators in Special Education* (pp. 737-756). USA: IGI Global. doi: 10.4018/978-1-6684-3670-7.ch041

Kongsilp, S., & Komuro, T. (2019, November). An Evaluation of Head-Mounted Virtual Reality for Special Education from the Teachers' Perspective. In T. Trescak (Ed.), *VRST '19: 25th ACM Symposium on Virtual Reality Software and Technology* (No. 51), New York: The Association for Computing Machinery, Inc. doi: 10.1145/3359996.3364721

Lagos Rodríguez, M., García, Á. G., Loureiro, J. P., & García, T. P. (2022). Personalized Virtual Reality Environments for Intervention with People with Disability. *Electronics, 11*(10), 1586. doi: 10.3390/electronics11101586

Lee, J., Kim, M., & Kim, J. (2017). A Study on Immersion and VR Sickness in Walking Interaction for Immersive Virtual Reality Applications. *Symmetry, 9*(5), 78. doi: 10.3390/sym9050078

Lee, T. S., & Joo, K. Y. (2019). Comparative analysis on special teachers' perception toward virtual reality based intervention program for students with disabilities. *Journal of the Korea Convergence Society, 10*(6), 113-120. doi: 10.15207/JKCS.2019.10.6.113

Lum, H. C., Greatbatch, R., Waldfogle, G., & Benedict, J. (2018, September). How Immersion, Presence, Emotion, & Workload Differ in Virtual Reality and Traditional Game Mediums. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 62*(1), 1474-1478. doi: 10.1177/1541931218621334

McMillan, S. J., & Hwang, J. S. (2002). Measures of Perceived Interactivity: An Exploration of the Role of Direction of Communication, User Control, and Time in Shaping Perceptions of Interactivity. *Journal of Advertising, 31*(3), 29-42. doi: 10.1080/00913367.2002.10673674

Mendes, M., Almeida, J., Mohamed, H., & Giot, R. (2019). Projected Augmented Reality Intelligent Model of a City Area with Path Optimization. *Algorithms, 12*(7), 140. doi: 10.3390/a12070140

Merchant, Z., Goetz, E. T., Cifuentes, L., Keeney-Kennicutt, W., & Davis, T. J. (2014). Effectiveness of virtual reality-based instruction on students' learning outcomes in K-12 and higher education: A meta-analysis. *Computers & Education, 70*, 29-40. doi: 10.1016/j.compedu.2013.07.033

Mütterlein, J. (2018, January). The three pillars of virtual reality? Investigating the roles of immersion, presence, and interactivity. In R. Torres, N. Gerhart, & A. Negahban (Eds.), *Proceedings of the 51st Hawaii International Conference on System Sciences* (pp. 1407-1415). Retrieved from http://hdl.handle.net/10125/50061

Newbutt, N., Bradley, R., & Conley, I. (2020). Using virtual reality head-mounted displays in schools with autistic children: Views, experiences, and future directions. *Cyberpsychology, behavior, and social networking, 23*(1), 23-33. doi: 10.1089/cyber.2019.0206

Nussli, N. (2014). *An investigation of special education teachers' perceptions of the effectiveness of a systematic 7-step Virtual Worlds Teacher Training Workshop for increasing social skills* (Doctoral dissertation, University of San Francisco). Retrieved from University of San Francisco Scholarship repository: https://repository.usfca.edu/diss/113/

Nussli, N., & Oh, K. (2016). Teachers' perceptions of the benefits and challenges of three-dimensional virtual worlds for social skills practice. *Educational Media International, 53*(3), 198-215. doi: 10.1080/09523987.2016.1236984

Pan, Z., Cheok, A. D., Yang, H., Zhu, J., & Shi, J. (2006). Virtual reality and mixed reality for virtual learning environments. *Computers & Graphics, 30*(1), 20-28. doi: 10.1016/j.cag.2005.10.004

Papanastasiou, G., Drigas, A., Skianis, C., Lytras, M., & Papanastasiou, E. (2019). Virtual and augmented reality effects on K-12, higher and tertiary education students' twenty-first century skills. *Virtual Reality, 23*(4), 425-436. doi: 10.1007/s10055-018-0363-2

Park, M. J., Kim, D. J., Lee, U., Na, E. J., & Jeon, H. J. (2019). A literature overview of virtual reality (VR) in treatment of psychiatric disorders: recent advances and limitations. *Frontiers in Psychiatry, 10*, 505. doi: 10.3389/fpsyt.2019.00505

Rebbani, Z., Azougagh, D., Bahatti, L., & Bouattane, O. (2021). Definitions and Applications of Augmented/Virtual Reality: A Survey. *International Journal, 9*(3), 279-285. doi: 10.30534/ijeter/2021/21932021

Robson, C. (2010). *Real World Research. A Resource for Social Scientists and Practitioner-Researchers* (Translation by V. Dalakou & K. Vassilikou). Athens: Gutenberg.

Sagnier, C., Loup-Escande, É., & Valléry, G. (2021). Virtual Reality: Definitions, Characteristics and Applications in the Workplace. *Digital Transformations in the Challenge of Activity and Work: Understanding and Supporting Technological Changes, 3*, 31-44. doi: 10.1002/9781119808343.ch3

Slater, M. (2018). Immersion and the illusion of presence in virtual reality. *British Journal of Psychology, 109*(3), 431-433. doi: 10.1111/bjop.12305

Steuer, J. (1992). Defining Virtual Reality: Dimensions Determining Telepresence. *Journal of Communication, 42*(4), 73-93. doi: 10.1111/j.1460-2466.1992.tb00812.x

Stichter, J. P., Laffey, J., Galyen, K., & Herzog, M. (2014). iSocial: Delivering the social competence intervention for adolescents (SCI-A) in a 3D virtual learning environment for youth with high functioning autism. *Journal of Autism and Developmental Disorders, 44*(2), 417-430. doi: 10.1007/s10803-013-1881-0

Tsingos, N., & Warusfel, O. (2006). Dispositifs et interfaces de restitution sonore spatiale. In P. Fuchs & G. Moreau (Eds.), *Le traité de la réalité virtuelle* (2nd ed., pp. 421-450). Paris: Mines Paris. Retrieved from https://t.ly/WVZq

Ulmer, J., Braun, S., Cheng, C. T., Dowey, S., & Wollert, J. (2022). Gamification of Virtual Reality assembly training: Effects of a combined point and level system on motivation and training results. *International Journal of Human-Computer Studies, 165*, 102854. doi: 10.1016/j.ijhcs.2022.102854

Villena-Taranilla, R., Tirado-Olivares, S., Cózar-Gutiérrez, R., & González-Calero, J. A. (2022). Effects of virtual reality on learning outcomes in K-6 education: A meta-analysis. *Educational Research Review, 35*, 100434. doi: 10.1016/j.edurev.2022.100434

Yakubova, G., Kellems, R. O., Chen, B. B., & Cusworth, Z. (2022). Practitioners' attitudes and perceptions toward the use of augmented and virtual reality technologies in the education of students with disabilities. *Journal of Special Education Technology, 37*(2), 286-296. doi: 10.1177/01626434211004445

Greek language

Berdeklis, F., Kostas, A., & Sofos, A, (2021). The Pan-Hellenic School Network in the "Before Coronavirus" period: Exploration of limiting factors in its implementation by PE70 educators of the Dodecanese Islands. *1st International Internet Educational Conference: From the 20th to the 21st Century within a fortnight, 1*, 164-176. doi: 10.12681/ONLINE-EDU.3224

Law 3699/2008, article 3, Special Education and Training of individuals with disabilities or with special educational needs, GOVERNMENT GAZETTE OF THE HELLENIC REPUBLIC (OFFICIAL GAZETTE FASCICLE 199/A/2-10-2008). Retrieved from https://www.e-nomothesia.gr/kat-ekpaideuse/n-3699-2008.html