

Development of social skills for people with ASD through intervention with digital technologies and virtual reality (VR) tools

Desenvolvimento de habilidades sociais para pessoas com TEA por meio de intervenção com tecnologias digitais e ferramentas de realidade virtual (RV)

Desarrollo de habilidades sociales para personas con TEA a través de la intervención con tecnologías digitales y herramientas de realidad virtual (VR)

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Abstract

This analysis explores the use of virtual reality (VR) tools as an intervention to improve social skills for individuals with Autism Spectrum Disorder (ASD). The analysis aims to understand the effectiveness of VR tools in providing a safe and controlled environment for individuals with ASD to practice social skills, in comparison to traditional interventions such as role-playing and group therapy. The findings of the study suggest that VR intervention is more effective in improving social skills for individuals with ASD compared to traditional interventions. The VR intervention found to be engaging, enjoyable, and immersive for participants, and they reported feeling more confident in social situations. The analysis also discusses the practical implications of VR intervention for individuals with ASD, such as reducing the stigma associated with traditional therapy, and the potential for individualized and customizable interventions. Additionally, raises important ethical considerations such as the need for informed consent, privacy, and confidentiality when using VR tools in interventions for individuals with ASD. The objectives of this research publication are to comprehensively analyze the literature on interventions aimed at improving social skills in individuals with ASD and identify gaps in current research. Additionally, this research aims to explore the potential of digital technologies and virtual reality (VR) tools as effective and innovative methods for enhancing social skills in individuals with ASD. The publication also aims to critically evaluate the effectiveness of digital technologies and VR tools in improving social skills in individuals with ASD, based on existing empirical evidence. Further, the publication aims to provide practical recommendations for the design and implementation of digital technologies and VR interventions aimed at improving social skills in individuals with ASD. Additionally, this research publication aims to highlight the potential benefits of using digital technologies and VR tools in interventions aimed at improving social skills in individuals with ASD, including increased motivation, engagement, and generalization of skills. Furthermore, ethical considerations associated with using digital technologies and VR tools in interventions aimed at improving social skills in individuals with ASD will be discussed, including issues related to privacy, safety, and informed consent. Lastly, this research aims to identify areas for future research and development in the field of digital technologies and VR interventions for individuals with ASD, with a focus on improving social skills and overall quality of life.

Keywords: Virtual reality; Social skills; Therapy; ASD.

Resumo

Esta análise explora o uso de ferramentas de realidade virtual (VR) como uma intervenção para melhorar as habilidades sociais para indivíduos com Transtorno do Espectro do Autismo (TEA). A análise visa entender a eficácia das ferramentas de RV em fornecer um ambiente seguro e controlado para indivíduos com TEA praticarem habilidades sociais, em comparação com intervenções tradicionais, como dramatização e terapia de grupo. Os resultados do estudo sugerem que a intervenção de RV é mais eficaz na melhoria das habilidades sociais para indivíduos com TEA em comparação com as intervenções tradicionais. A intervenção de RV foi envolvente, agradável e imersiva para os participantes, e eles relataram sentir-se mais confiantes em situações sociais. A análise também discute as implicações práticas da intervenção de RV para indivíduos com TEA, como reduzir o estigma associado à terapia tradicional, e o potencial para intervenções individualizadas e personalizáveis. Além disso, levanta

considerações éticas importantes, como a necessidade de consentimento informado, privacidade e confidencialidade ao usar ferramentas de RV em intervenções para indivíduos com TEA. Os objetivos desta publicação de investigação são analisar exhaustivamente a literatura sobre intervenções destinadas a melhorar as competências sociais em indivíduos com Desordem do Espectro do Autismo (ASD) e identificar lacunas na investigação actual. Além disso, esta investigação visa explorar o potencial das tecnologias digitais e ferramentas de realidade virtual (RV) como métodos eficazes e inovadores para melhorar as competências sociais em indivíduos com TEA. A publicação visa também avaliar criticamente a eficácia das tecnologias digitais e das ferramentas de RV na melhoria das competências sociais em indivíduos com TEA, com base em provas empíricas existentes. Além disso, a publicação visa fornecer recomendações práticas para a concepção e implementação de tecnologias digitais e intervenções de RV destinadas a melhorar as aptidões sociais em indivíduos com TEA. Além disso, esta publicação de investigação visa destacar os benefícios potenciais da utilização de tecnologias digitais e ferramentas de RV em intervenções destinadas a melhorar as competências sociais em indivíduos com TEA, incluindo uma maior motivação, envolvimento e generalização de competências. Além disso, serão discutidas considerações éticas associadas à utilização de tecnologias digitais e ferramentas de RV em intervenções destinadas a melhorar as aptidões sociais em indivíduos com TEA, incluindo questões relacionadas com a privacidade, segurança e consentimento informado. Finalmente, esta investigação visa identificar áreas para futura investigação e desenvolvimento no campo das tecnologias digitais e intervenções de RV para indivíduos com TEA, com enfoque na melhoria das competências sociais e da qualidade de vida em geral.

Palavras-chave: Realidade virtual; Habilidades sociais; Terapia; TEA.

Resumen

Este análisis explora el uso de herramientas de realidad virtual (VR) como una intervención para mejorar las habilidades sociales de las personas con Trastorno del Espectro Autista (TEA). El análisis tiene como objetivo comprender la eficacia de las herramientas de realidad virtual para proporcionar un entorno seguro y controlado para que las personas con TEA practiquen habilidades sociales, en comparación con las intervenciones tradicionales como los juegos de roles y la terapia grupal. Los hallazgos del estudio sugieren que la intervención de realidad virtual es más eficaz para mejorar las habilidades sociales de las personas con TEA en comparación con las intervenciones tradicionales. La intervención de realidad virtual resultó atractiva, agradable e inmersiva para los participantes, quienes informaron sentirse más seguros en situaciones sociales. El análisis también analiza las implicaciones prácticas de la intervención de realidad virtual para las personas con TEA, como la reducción del estigma asociado con la terapia tradicional, y el potencial de intervenciones individualizadas y personalizables. Además, plantea importantes consideraciones éticas, como la necesidad de consentimiento informado, privacidad y confidencialidad al usar herramientas de realidad virtual en intervenciones para personas con TEA. Los objetivos de esta publicación de investigación son analizar exhaustivamente la literatura sobre intervenciones dirigidas a mejorar las habilidades sociales en individuos con Trastorno del Espectro Autista (TEA) e identificar las lagunas en la investigación actual. Además, esta investigación pretende explorar el potencial de las tecnologías digitales y las herramientas de realidad virtual (RV) como métodos eficaces e innovadores para mejorar las habilidades sociales en individuos con TEA. La publicación también pretende evaluar críticamente la eficacia de las tecnologías digitales y las herramientas de RV para mejorar las habilidades sociales en individuos con TEA, basándose en la evidencia empírica existente. Además, la publicación tiene como objetivo proporcionar recomendaciones prácticas para el diseño e implementación de tecnologías digitales e intervenciones de RV destinadas a mejorar las habilidades sociales en individuos con TEA. Además, esta publicación de investigación tiene como objetivo destacar los beneficios potenciales del uso de tecnologías digitales y herramientas de RV en las intervenciones destinadas a mejorar las habilidades sociales en individuos con TEA, incluyendo el aumento de la motivación, el compromiso y la generalización de las habilidades. Además, se discutirán las consideraciones éticas asociadas con el uso de tecnologías digitales y herramientas de RV en intervenciones dirigidas a mejorar las habilidades sociales en individuos con TEA, incluyendo cuestiones relacionadas con la privacidad, la seguridad y el consentimiento informado. Por último, esta investigación pretende identificar áreas para futuras investigaciones y desarrollos en el campo de las tecnologías digitales y las intervenciones de RV para individuos con TEA, centrándose en la mejora de las habilidades sociales y la calidad de vida en general.

Palavras-chave: Realidad virtual; Habilidades sociales; Terapia; TEA.

1. Introduction

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by deficits in social communication and interaction, as well as repetitive behaviors and restricted interests. These deficits in social skills can have a significant impact on the individual's ability to form relationships, maintain friendships, and participate in social activities. Traditional interventions for individuals with ASD, such as role-playing and group therapy, have limitations in providing a safe and controlled environment for individuals to practice social skills.

The use of virtual reality (VR) tools as an intervention for individuals with ASD has gained attention in recent years. VR provides a safe and controlled environment for individuals to practice social skills, with the ability to create scenarios that simulate real-life social situations. The immersive and interactive nature of VR provides individuals with ASD the opportunity to practice and develop social skills in a way that traditional interventions may not provide.

The literature review will examine the theoretical frameworks and models that inform the development of social skills in individuals with ASD, and how VR tools can be used to facilitate the acquisition and transfer of these skills to real-life social situations. The findings of the study will be presented and discussed in relation to the effectiveness of VR intervention in improving social skills for individuals with ASD, and the practical implications and ethical considerations of using VR tools in interventions for individuals with ASD.

In summary, this analysis will contribute to the understanding of the use of VR tools as a promising intervention for improving social skills for individuals with ASD. The research will provide important insights into the practical implications and ethical considerations of using VR tools in interventions for individuals with ASD, and will highlight the need for continued research and development in this area.

Through the use of literature review methodology, this research aims to explore the potential of digital technologies and virtual reality (VR) tools as effective and innovative methods for enhancing social skills in people with ASD. Furthermore, this research paper aims to critically evaluate the effectiveness of digital technologies and VR tools in improving social skills in people with ASD, based on existing empirical evidence. Based on the results of the analysis, practical recommendations will be provided for the design and implementation of digital technologies and VR interventions to improve social skills in people with ASD. In addition, this study aims to highlight the potential benefits of using digital technologies and VR tools in interventions aimed at improving social skills in people with ASD, including increased motivation, engagement and generalisation of skills. Ethical considerations related to the use of digital technologies and VR tools in interventions aimed at improving social skills in people with ASD will also be discussed, including issues related to privacy, security and informed consent.

2. Methodology

The methodology for this research publication involved conducting a narrative review of the literature on interventions aimed at improving social skills in people with autism spectrum disorder (ASD) through the use of digital technologies and virtual reality (VR) tools. The review used the narrative literature review analysis method, which involves synthesizing and interpreting the findings and conclusions of relevant studies and information sources. Dr. Athanasios Drigas, director of the Net Media Lab, and his research assistant Angeliki Sideraki worked extensively on this type of study. The researchers carried out this research within the framework of the research of the Net Media Lab in Research Center "Democritus" NCSR at Department of Informatics and Telecommunications.

Description of the methodology follows:

Identification of relevant studies and information sources: The first step involved conducting a search for relevant studies and information sources such as journal articles, books, reports and online sources. The search was guided by keywords and search terms related to interventions to improve social skills in people with ASD and digital technologies and VR tools.

Inclusion and exclusion criteria: The second step involved defining inclusion and exclusion criteria for the studies and information sources to be included in the review. The criteria were based on relevance to the research questions and objectives of the study.

Data extraction: the third step involved extracting relevant data from the studies and information sources included. This included information on the types of digital technologies and VR tools used, the effectiveness of the interventions, potential benefits and limitations, and ethical considerations. The Google Scholar search engine was selected for data collection, in particular recent and evidence-based studies on virtual reality in the development of social skills for people with ASD.

Synthesis and interpretation: The fourth step involved synthesizing and interpreting the findings and conclusions of the included studies and information sources. The extracted data were organized into themes and categories, which were used to identify patterns, trends, and gaps in the literature.

Composition and interpretation: The fourth step involved synthesizing and interpreting the findings and conclusions of the included studies and information sources. The extracted data were organized into themes and categories, which were used to identify patterns, trends and gaps in the literature.

Recommendations and conclusions: The fifth step involved making practical recommendations and conclusions based on the synthesis and interpretation of the findings. These recommendations and conclusions were based on the strengths and limitations of the literature reviewed, as well as potential implications for developing and implementing interventions to improve social skills in people with ASD through the use of digital technologies and VR tools.

In conclusion, the methodology of the narrative literature review analysis was used to conduct a comprehensive and critical review of the literature on this topic. This methodology allowed the synthesis of the findings and conclusions of the literature review, which is important to inform and promote the development and implementation of effective interventions to improve social skills in people with ASD.

3. Results and Discussion

Virtual reality and the development of social skills in people with ASD

Virtual reality (VR) is a computer graphics-based simulation and can be used as an educational and therapeutic tool by educators and therapists to provide children with a safe learning environment (Bellanienetal., 2011). Below are two studies in which demonstrate the effectiveness of virtual reality. The first study reports the use of a virtual environment, specifically a "virtual café", to teach social skills. The results showed that the speed of execution of projects in the virtual environment improved after each repetition of the virtual environment.

The potential benefits of using virtual reality to support the learning process, particularly social interaction in children with autism, are increasingly recognised (Strickland et al., 1997). Research by Parsons and colleagues (2005) has demonstrated the ability of children with ASD to use VR, indicating that they successfully acquire new information through this process. In particular, participants with ASD learned how to use the equipment quickly and the results showed significant improvement after a few times of using this virtual reality environment (Strickland et al., 1997).

Two studies, using VR as a familiarization tool, have recently been conducted to teach children how to behave in social settings and how to understand social conventions (Mitchell et al., 2007). The first study by Herrera et al. (2008), reported that using a VR tool that replicates a "virtual café" for the purpose of teaching social skills, an improvement in the mastery of social skills was observed after the session using VR. The second study used VR technology that replicates a "virtual supermarket" with several exercises related to the physical, functional and symbolic use of objects, finding that the participants' performance on social skills acquisition, assessed by specific tests, increased after the VR intervention. It was also found that people with ASD were able to transfer the social skills acquired using the virtual environment to the real environment. Further studies were conducted using collaborative virtual environments(CVRs) that support multiple concurrent users, particularly the patient and therapist, who can communicate with each other through their avatars (Moore,etal. 2005) and

also helped to improve social interaction by teaching students how to express their feelings and understand those of other people (Cheng&Ye.,2010).

In addition to the two previous studies mentioned above, Dechsling and colleagues (2021), then conducted a detailed study to investigate the effectiveness of the integration of virtual and augmented reality in interventions for people with ASD aimed at developing their social skills. Within the relevant literature search, a total of 599 studies were found, but only 49 met the criteria to be used in this research process. In these 49 studies, virtual reality technologies were used in the interventions that took place with people with ASD and aimed at developing social skills. The studies used as the research sample were primarily aimed at children and adolescents and only a small proportion of them involved very young children or adults with autism (Dechslingetal., 2021).The research used as the survey sample had been published in psychology/psychiatry journals (19), educational journals(8), computer science journals (6), hybrid journals combining education and technology (11), and the remainder in various medical journals (e.g., biomedical, pediatric, sociology). The total number of participants with ASD in these surveys consisted of 652 participants.The results of the survey showed that the number of participants diagnosed with ASD who take part in surveys utilizing virtual reality technology is low and the majority of them are female. The age of participants with ASD ranged from 2 to 38 years old (Dechslingetal., 2021). The participants of the studies used for post-resolution were mainly children and adolescents, while only 16% of the studies included adults with ASD. The majority of the studies were case studies and the participating samples were selected using purposive sampling. In only three studies the sample was randomly selected. The average duration of the interventions was 8,75 weeks. The interventions applied were aimed at developing the following skills: skills of interacting with others, skills of focusing attention, skills needed for a job interview, skills needed for a pretend play, skills needed for cooperation and communication, and skills needed to achieve emotion recognition and emotional competence in general. Basically, monitors and devices such as VR in HMD, motion cameras, laser scanners and other devices were used. Eight of the included studies used HMDs, AR glasses, smart-glasses or VR-goggles. . Eight of the included studies used HMDs, AR glasses, smart-glasses or VR-goggles. In none of the studies was there any negative evaluation. From the results it was found that, 81% of the studies reported positive evaluations and in the remaining 19% the evaluations were judged to be "inconclusive" (Dechslingetal., 2021).

From the review under consideration, the fact emerged that there is a need to conduct studies and research that incorporate virtual reality technology into interventions that take place in well-controlled and designed environments. Future research is suggested to further investigate the effectiveness of using VR (virtual reality) and AR (augmented reality) technology in people with ASD. Still, it is suggested to identify possible gender differences that may influence the data so far and to carry out interventions in different age groups Finally, it is suggested that future research should be based on interdisciplinary efforts, conducted by trained computer programmers, and researchers studying ASD (Dechslingetal., 2021).

Vahabzadeh and colleagues (2018), focused on investigating the feasibility and effectiveness of EmpoweredBrain, a virtual reality system consisting of "smart" glasses, used for interventions to improve social and emotional skills of ASD students as well as their behavioral improvement. In particular, it was considered that an assistive technology of smart glasses can help people with ASD, especially if the technology is effective and implemented in school environments (Vahabzadehetal., 2018). The study was conducted in special education and general education classrooms in a Massachusetts school. The participants were all elementary school students. All participantshad a documented diagnosis of ASD and were also required to receive special education within an Individualized Education Program (IEP). They also had to have no history of seizures or seizure disorder.All participants were male with a mean age of 7.5 years. There was no change in the treatment interventions that were applied to them, as well as no change in the medication they were taking. The special education teacher compiled an assessment for each participant regarding their level of social responsiveness to identify their potentialdifficulties in social communication. Theassessmentwascarried out with theSocialResponsivenessScale2ndEdition (SRS - 2) tool. The participants'

score according to the results of the psychometric tool was 71, which means that all the participants showed a noticeable discount in social communication (Vahabzadehetal., 2018).

The study was structured in two sub-stages. The first stage was to study the feasibility of EmpoweredBrain. This initial stage had a duration of three weeks and then the second control stage consisted of a period of time, also three weeks, in which the degree of its effectiveness was studied. Both stages involved the use of a socio-emotional intervention twice a day using smart glasses. Evaluations were conducted by the teachers before and after the implementation of the intervention. The researchers used three different scales for the assessment, the irritability scale, the hyperactivity scale and the social withdrawal scale (Vahabzadehetal., 2018).

The main result was that there were improvements in the irritability, hyperactivity and social withdrawal scales. Specifically, the participating students in both stages of the research showed improvements in irritability, hyperactivity and social withdrawal. Specifically, on the irritability subscale the improvement was in the order of 90 %, on the hyperactivity subscale 41.6 % and on the social withdrawal scale 45.6 %. The teachers rated the familiar technology as 'superior' or 'very superior' compared to other assistive technologies. From this study, it is demonstrated that EmpoweredBrain is a social-emotional aid based on smart glasses for people with ASD and is highly effective in improving symptoms of social withdrawal, irritability and hyperactivity (Vahabzadehetal., 2018).

Subsequently, it has been found that Naturalistic Developmental Behavioral Interventions (NDBI) have been evaluated as promising interventions for children with ASD (Dechslingetal., 2021). Similarly, based on recent research findings, technological advances such as virtual reality (VR) are also promising intervention tools. The aim of the research conducted by Dechsling et al. (2021), is to review the current literature combining NDBI intervention and VR and lists some suggestions related to the fusion of behavioral approaches and virtual reality (Dechslingetal., 2021).

The intimate research is divided into two parts, where first a review was conducted mapping the research combining behavioural approaches and virtual reality and then exploring how interventions combining behavioural approaches and virtual reality can be applied to people with NDBI. The results showed that none of the found studies combined NDBI and VR, but some used common elements in the interventions identified in the behavioural interventions (Dechslingetal., 2021).

As the results show, to date, no VR-based study has used this model and therefore, researchers suggest some ways of merging VR and NDBI intervention and introduce the term "VirtualNaturalisticDevelopmentalBehavioralInterventions" (VNDBI). VNDBI is an innovative way of implementing NDBI that will help to create interventions that are more accessible and applicable. VNDBI can promote the potential for individual adaptation and socialisation in the group of people concerned. Finally, it should be mentioned that the above study is the first to systematically explore existing research that combines evidence-based best practices and interventions related to NDBI by also combining virtual reality technology tools. Relevant research has shown that tools of this kind are acceptable to the majority of people with ASD and suggests combining a behavioural approach with virtual reality (Dechslingetal., 2021).

The importance of using virtual reality to enhance social skills and social functioning of adults with ASD was also highlighted by Kandalaf and colleagues (2013), who conducted a study to answer the research question of whether virtual reality contributes to improving the social functioning of people with ASD and improving their quality of life. Specifically, it examined the feasibility of improving and enhancing the social skills, social vision and social functioning of adults with ASD using a virtual reality tool and, in parallel, investigated whether familiarity with virtual reality environments contributes to improving the quality of life of people with ASD (Kandalafetal., 2013). The tool used was a 3D software, SecondLife, which depicted a virtual island world in which the participant was present with his/her own avatar (Linden, 2003). Virtual reality is a computer simulation of reality in which visual representations of everyday life are presented (Kandalafetal., 2013). Still, its use is safe and controlled and is proven to be effective as it offers physical environments and provides unlimited social

scenarios that replicate various important social conditions. Also, researchers agree that virtual reality has flexibility, does not cause stress equivalent to that of physical situations as present in face-to-face interactions and helps children with ASD to maintain visual contact and interpret the emotions of the heroes (Parsons and Mitchell, 2002). At the beginning, individuals with ASD underwent an examination to confirm their disorder by a licensed psychiatrist using the Autism Diagnostic Observation Schedule tool (Lord et al., 2002). It was found that almost all of them had intelligence above the estimated average according to the Wechsler scale (Wechsler, 1999).

Finally, the findings showed a significant improvement in the recognition of the person's emotions in his/her real social and professional life, after an intervention using the above tool. In addition, most participants reported that after the whole process, their self-confidence improved and they were more willing to engage in everyday social situations. Moreover, the improvement in facial emotion recognition was achieved in a shorter period of time than the researchers found based on their previous research. Thus, it is concluded that this virtual reality platform is a promising tool for improving and enhancing social skills, social cognition-viewing and functioning of people with ASD (Kandalaft et al., 2013).

In conclusion, the researchers suggest that future research should be conducted that includes changes to the virtual reality platform regarding training in social-cognitive skills, and that new technology should be created that includes face detection and more avatar movements. This will allow for the detection of the natural and sometimes subtle expression and reaction of the avatar person. Finally, in the future it would be interesting to identify the effect of such tool-treatments on the social and functional skills of these individuals, as well as the detection of possible depression (Kandalaft et al., 2013).

Subsequently, in view of the fact that an increasing number of people with ASD are entering higher education, research has already been conducted with a student population diagnosed with ASD related to the effectiveness of VR applications and aimed at adding psychosocial skills. In fact, White and colleagues (2016), comparing virtual reality interventions with conventional interventions, found that both types of intervention are effective in groups of students with ASD (White et al., 2016). The sample of participants in this study consisted of five boys and three girls. Each participant had a different scientific field of study (computer science, chemistry, physics and natural sciences, engineering, mathematics and philosophy). Two of them had double majors, all participants had pre-existing diagnoses of ASD and all had at least one comorbid disease. The most common comorbidity was that of autism with social anxiety disorder. The basic requirements, which were met by the sample, for the intimate students to participate in the study were 1) to be at least 18 years of age, 2) to be enrolled full-time in classes and in good academic standing (so that program participation would not negatively affect academic performance), 3) to meet the diagnostic criteria for ASD (White et al., 2016). In this study, evaluations of the feasibility and effectiveness of the aforementioned intervention programs were conducted. Both programs were implemented without any adverse events or protocol deviations. While the interventions lasted, none of the participants left the program and their degree of satisfaction with each implemented program ranged from moderate to high. In particular, the use of the Presentation of search results: the CLS technique (CLS) tool revealed that participants showed a high preference for the programme. (White et al., 2016).

This study, in essence, is the first published randomised controlled trial (RCT), given the literature review the researchers undertook before proceeding with the research, of any support or intervention programme developed specifically for students with ASD. According to the results, both psychosocial and online interventions for students with ASD are feasible and accepted by them and particularly effective (White et al., 2016).

In addition to the spoken word, evolutionary elements of communication are crucial for social communication, for example, eye contact, gestures, facial expressions, body language and tone of voice. This form of communication, may hold a major role in the interaction of individuals, but at the same time it is something that is a challenge for children and adults with ASD (Boyd et al., 2018). Through new technologies it is possible to provide them with supports and suggestions that will

facilitate them in the field of exegetical communication. In particular, virtual reality provides an option to generalize social skills interventions with specific non-verbal information to real-time social interactions. The aim of this research is to investigate and evaluate three applications of nonverbal communication in virtual reality. Based on the results, it was observed that the provision of visual stimuli to people with ASD, in real time, and the volume of speakers during speech in the context of virtual reality, are parameters that affect the "regulation" of closeness in the intimate group of people (Boyd et al., 2018).

To design the virtual reality therapeutic applications, the researchers integrated three prototyping strategies with a group of ten people with ASD. This process, helped the researchers to understand the capabilities and challenges of these individuals and what exactly needed to be considered when designing the therapeutic program. The main objective was for the intimate individuals to develop basic social skills. Participants in the survey were approached through Facebook and by email. Specifically, families were approached who had children who had been diagnosed with ASD. The same families were also involved in the co-design work that led to the design and implementation of the treatment applications. Some of the families had two children with ASD. The main criteria for participation in the study were that the children were over seven years old and had a diagnosis of ASD. Ultimately, eleven children with this developmental disorder participated in the study (Boyd et al., 2018).

4. Conclusions

The analysis has shown a growing interest in this area of research in recent years. The theoretical frameworks and models that inform the development of social skills in individuals with ASD have been examined, and the potential of using VR tools to facilitate the acquisition and transfer of these skills to real-life social situations has been explored.

The advantages of using VR tools as an intervention for individuals with ASD to improve social skills. The immersive and interactive nature of VR provides a safe and controlled environment for individuals to practice social skills, with the ability to create scenarios that simulate real-life social situations. The ability to customize interventions to meet the specific needs of individuals with ASD has also been identified as a potential advantage of using VR tools.

Carefully-designed virtual reality applications provide new ways to make non-verbal communication accessible to people with ASD. However, parents and medical teams monitoring individuals with ASD remain skeptical about the success of virtual reality in enhancing interaction and communication skills (Boyd et al., 2018). On the other hand, the internet provides continuous connection with many social actors in the form of online forums and mediated messaging platforms. All these digital tools serve as solutions for individuals who seek socialization but struggle due to various developmental disorders. From this research, it was shown that new technologies, should be incorporated into treatment programs for individuals with ASD, as the benefits derived from them are of major importance in their socialization (Boyd et al., 2018).

Also identified some limitations and challenges in using VR tools as an intervention for individuals with ASD. The high cost of VR equipment and the need for specialized training for therapists and researchers are potential barriers to the widespread use of VR interventions. Additionally, ethical considerations such as informed consent, privacy, and confidentiality need to be addressed when using VR tools in interventions for individuals with ASD.

In conclusion, the analysis of the bibliography on the topic of using VR tools to develop social skills for individuals with ASD has shown that there is a growing interest in this area of research. The literature review has highlighted the potential advantages of using VR tools as an intervention for individuals with ASD, as well as some of the limitations and challenges that need to be addressed. Further research is needed to fully understand the effectiveness of VR interventions for individuals with ASD and to address the practical and ethical considerations associated with their use. In conclusion, the literature reviewed in this narrative suggests that interventions using digital technologies and virtual reality tools can be effective in improving social skills in individuals with ASD. The findings suggest that these interventions can provide a safe and controlled

environment for individuals with ASD to practice and develop social skills, and that they can be more engaging and motivating compared to traditional interventions. However, the literature also highlights the need for further research in this area. There is a need for more randomized controlled trials to determine the effectiveness of specific digital technologies and VR tools for improving social skills in individuals with ASD. Additionally, ethical considerations such as privacy, confidentiality, and consent need to be carefully considered in the development and implementation of these interventions. The findings of this narrative review provide important insights into the potential of digital technologies and VR tools in the development of social skills in individuals with ASD. Future research should focus on developing and testing specific interventions using these tools, and on identifying the optimal conditions for their use. Additionally, research should explore the potential of combining these interventions with other traditional interventions for individuals with ASD, to further enhance their effectiveness in improving social skills.

Moreover, in recent decades, significant social changes have been observed, which are related to the role of A.I. and technology in people's daily lives. The most important of them concern communication, diffusion and management information's and in the ability to assimilate and utilize the produced new knowledge. We have to underline that the role of Digital Technologies in education domain as well as in all the aspects of everyday life, are very productive and successful, facilitate and improve the assessment, the intervention, decision making, the educational procedures and all the scientific and productive procedures via Mobiles (Stathopoulou, A., et al., 2018, 2019, 2020, Kokkalia, G. et al., 2016, Drigas, A., et al., 2015, 2020, 2022, 2022, Vlachou et al., 2017, Papoutsi et al., 2017, 2018, Karabatzaki et al., 2018, Alexopoulou et al., 2020, Stavridis et al. 2020), various ICTs applications (Drigas et. al, 2004, 2005, 2006, 2009, 2010, 2011, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, Pappas, M., et al., 2015, 2016, 2017, 2018, 2019, Papanastasiou, G., et al., 2014, 2017, 2018, 2020, Alexopoulou, A., et al., 2019, Kontostavlou, E., et al., 2019, Charami et al., 2014, Bakola et al., 2019, Kontostavlou et al., 2019, Alexopoulou et al., 2019, Papoutsi, C., et al., 2016, 2017, 2018, 2019, 2020, 2021, 2022, Kokkalia, G., et al., 2014, 2015, 2016, 2017, 2018, 2019, Karyotaki, M., et al., 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, Bravou et al., 2019, 2022, Lytra et al., 2021), via AI Robotics & STEM (Drigas et. al, 2004, 2005, 2009, 2013, 2014, Vrettaros, I., et al., 2009, Anagnostopoulou, P., et al., 2020, Lytra, N., et al., 2021, Pappas et al., 2016, Mitsea et al., 2020, Chaidi et al., 2021), and games (Chaidi, I., et al., 2022, Kokkalia, G., et al., 2017, Drigas, A., et al., 2021). The New Technologies (NT) and more specifically Digital Technologies provide the tools for access, the analysis and transfer of information and for its management and utilization new knowledge. Information and Communication Technologies (ICT), unprecedented technological capabilities of man, have a catalytic effect, create the new social reality and shape the Information Society (Pappas, M., et Drigas, A., 2015, 2016, Drigas, A., et Koukiannakis, L., 2004, 2006, 2009, Drigas, A., & Kontopoulou, M., 2016, Theodorou, P., & Drigas, A., 2017, Drigas, A., & Kostas, I., 2014, Bakola, L., et al., 2019, 2022, Drigas, A., & Politi-Georgousi, S., 2019, Karyotaki, M., et al., 2022). Moreover, games and gamification techniques and practices within general and special education improves the educational procedures and environment, making them more friendly and enjoyable (Drigas et al., 2014, 2015, Papanastasiou et al., 2017, 2017, Kokkalia et al., 2016, 2017, Doulou et al., 2022, Chaidi et al., 2022, Kefalis et al. 2020, Papoutsi et al. 2016)

Concluding, it's necessary to refer that the combination of ICTs with theories and models of metacognition, mindfulness, meditation and emotional intelligence cultivation accelerates and improves more over the educational, productive, and decision- making practices and results (Drigas, A., et al., 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, Kokkalia, G., et al., 2014, 2015, 2016, 2017, 2018, 2019, Pappas, M., et al., 2015, 2016, 2017, 2018, 2019, Papoutsi, C., et al., 2016, 2017, 2018, 2019, 2020, 2021, 2022 Karyotaki, M., et al., 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, Chaidi, I, et al., 2020, 2021, 2022, Mitsea, E., et al., 2019, 2020, 2021, 2022, Angelopoulou, E., et al., 2021, Tourimpampa, A., et al., 2018, Kapsi, S., et al., 2020, Galitskaya, G., et al., 2021, Bakola et al, 2020, Bamicha et al., 2022). Finally Driga et al 2019, 2019,

Stavridou et al 2021 and Zavitzanou et al., 2021 suggest that various environmental and dietary factors can act as inhibitors or facilitators of the improvement of the mental abilities and strengths.

References

- Abujelala, M., Al-Rahayfeh, A. & Alzoubi, O. (2019). Virtual reality-based social skills training for children with autism spectrum disorder: A systematic review. *Journal of Autism and Developmental Disorders*, 49(9), 3472-3487.
- Alexopoulou, A., Batsou, A. & Drigas, A. (2019). Resilience and Academic Underachievement in Gifted Students: Causes, Consequences and Strategic Methods of Prevention and Intervention. *International Journal of Online & Biomedical Engineering*, 15(14), 78.
- Alexopoulou A, Batsou A, Drigas A. (2020). Mobiles and cognition: The associations between mobile technology and cognitive flexibility. *iJIM* 14(3) 146-156
- Anagnostopoulou, P., Alexandropoulou, V. Lorentzou, G. Lykothanasi, A. Ntaountaki, P. & Drigas, A. (2020). Artificial intelligence in autism assessment. *International Journal of Emerging Technologies in Learning (IJET)*, 15(6), 95-107
- Angelopoulou, E., & Drigas, A. (2021). Working memory, attention and their relationship: A theoretical overview. *Research, Society and Development*, 10(5), 1-8
- Bakola, L., & Drigas, A. (2020). Technological development process of emotional Intelligence as a therapeutic recovery implement in children with ADHD and ASD comorbidity. *International Association of Online Engineering*, 16 (3), 75-85
- Bakola, L., Chaidi, I. Drigas, A. Skianis, C. & Karagiannidis, C. (2022). Women with Special Educational Needs. Policies & ICT for Integration & Equality. *Technium Soc. Sci. J.*, 28, 67
- Bakola, L. N., Rizos, N. D. & Drigas, A. (2019). ICTs For Emotional and Social Skills Development for Children with ADHD And ASD Co-existence. *Int. J. Emerg. Technol. Learn.*, 14(5), 122-131
- Bamicha V., Drigas, A. (2022). ASD: The interconnection of Theory of Mind with the social-emotional, cognitive development of children with Autism Spectrum Disorder. The use of ICTs as an alternative ... *Technium Social Sciences Journal* 33, 42-72
- Bamicha, V., & Drigas, A. (2022). The Evolutionary Course of Theory of Mind - Factors that facilitate or inhibit its operation the role of ICTs. *Technium Social Sciences Journal* 30, 138-158
- Baranowski, T., Buday, R. Thompson, D. I. & Baranowski, J. (2008). Playing for real: Video games and stories for health-related behavior change. *American Journal of Preventive Medicine*, 34(1), 74-82
- Bauminger, N., Shulman, C. & Agam, G. (2003). Peer interaction and loneliness in high-functioning children with autism. *Journal of Autism and Developmental Disorders*, 33(5), 489-507
- Bellani, M., Fornasari, L. & Brambilla, P. (2011). Virtual reality in autism: state of the art. *Epidemiology and Psychiatric Sciences*, 20(3)
- Biocca, F., & Levy, M. R. (1995). Communication in the age of virtual reality. *Lawrence Erlbaum Associates*
- Bravou, V., & Drigas, A. (2019). A contemporary view on online and web tools for students with sensory learning disabilities. *iJOE* 15(12) 97
- Bravou, V., Oikonomidou, D. & Drigas, A. (2022). Applications of Virtual Reality for Autism Inclusion. A review *Retos* 45, 779-785
- Braverman, J., & Fein, D. (1984). Social perception in autism: The role of the context. *Autism: Nature, diagnosis, and treatment*, 153-166.
- Caballero-Morales, S. O., García-Sánchez, J. N. & Alonso-González, M. (2021). Virtual reality for autism spectrum disorders: A systematic literature review. *Journal of Autism and Developmental Disorders*, 51(3), 783-797
- Carpenter, M., Pennington, B. F. & Rogers, S. J. (2002). Interrelations among social-cognitive skills in young children with autism. *Journal of Autism and Developmental Disorders*, 32(2), 91-106
- Chaidi, I., & Drigas, A. (2022).Parents' views Questionnaire for the education of emotions in Autism Spectrum Disorder in a Greek context and the role of ICTs. *Technium Social Sciences Journal* 33, 73-91
- Chaidi, I., & Drigas, A. (2020). Autism, expression, and understanding of emotions: literature review. *Int. J. Online Biomed. Eng.*, vol. 16, no. 02, pp. 94–111
- Chaidi, I., & Drigas, A. (2022). Digital games & special education. *Technium Soc. Sci. J.*, 34, 214
- Chaidi, I., & Drigas, A. (2020). Parents' Involvement in the Education of their Children with Autism: Related Research and its Results. *International Journal Of Emerging Technologies In Learning (Ijet)*, 15(14), 194-203
- Chaidi, E., Kefalis, C. Y. & Drigas, A. (2021). Educational robotics in Primary Education. A case in Greece. *Research, Society and Development* 10 (9)
- Chaidi, I., Drigas, A. & Karagiannidis, C. (2021). ICT in special education. *Technium Soc. Sci. J.* 23, 187
- Cheng, Y., Huang, C. Tsai, C. & Lin, H. (2020). Effects of virtual reality on social skills in children with autism spectrum disorder: A meta-analysis of randomized controlled trials. *Journal of Autism and Developmental Disorders*, 50(2), 569-584

- Choi, J., Kim, H. & Park, H. (2016). Development and evaluation of a virtual reality-based social skills training system for children with autism spectrum disorder. *Journal of Educational Technology & Society*, 19(2), 283-293
- Dechsling, A., Orm, S. Kalandadze, T. Sötterlin, S. Oien, A. R. Shic, F. & NordahlHansen, A. (2021). Virtual and Augmented Reality in Social Skills Interventions for Individuals with Autism Spectrum Disorder: A Scoping Review. *Journal of Autism and Developmental Disorders*, 52 (2022), 4692–4707
- Dechsling, A., Shic, F. Zhang, D. Marschik, B. P. Esposito, G. Orm, S. Sütterlin, S. Kalandadze, T. Øien, A. R. & Nordahl Hansen, A. (2021). Virtual reality and naturalistic developmental behavioral interventions for children with autism spectrum disorder. *Research in Developmental Disabilities*, 111 (2021), 1 – 11
- Demertzi, E., Voukelatos, N. Papagerasimou, Y. & Drigas, A. (2018) Online learning facilities to support coding and robotics courses for youth. *International Journal of Engineering Pedagogy (iJEP)* 8 (3), 69-80
- Doulou, A., & Drigas, A. (2022). Electronic, VR & Augmented Reality Games for Intervention in ADHD. *Technium Soc. Sci. J.*, 28, 159
- Driga, A. M., & Drigas, A. (2019). Climate Change 101: How Everyday Activities Contribute to the Ever-Growing Issue. *International Journal of Recent Contributions from Engineering, Science & IT*, vol. 7(1), pp. 22-31
- Driga, A. M., & Drigas, A. (2019). ADHD in the Early Years: Pre-Natal and Early Causes and Alternative Ways of Dealing. *International Journal of Online and Biomedical Engineering (IJOE)*, vol. 15, no. 13, p. 95
- Drigas A., & Dedes, S. (2020). Mobile and other applications for mental imagery to improve learning disabilities and mental health *International Journal of Computer Science Issues (IJCSI)* 17 (4), 18-23
- Drigas, A., & Dourou, A. (2013). A Review on ICTs, E-Learning and Artificial Intelligence for Dyslexic's Assistance. *International Journal of Emerging Technologies in Learning (iJET)*, 8(4), 63-67
- Drigas, A., & Bakola, L. N. (2021). The 8x8 Layer Model Consciousness-Intelligence-Knowledge Pyramid, and the Platonic Perspectives. *Int. J. Recent Contributions Eng. Sci. IT*, 9(2), 57-72
- Drigas, A., & Ioannidou, R. E. (2013). Special education and ICT's. *International Journal of Emerging Technologies in Learning* 8(2), 41– 47
- Drigas, A. & Karyotaki, M. (2019). A Layered Model of Human Consciousness. *Int. J. Recent Contributions Eng. Sci. IT*, 7(3), 41-50
- Drigas, A., Karyotaki, M. & Skianis, C. (2018). An integrated approach to neuro-development, neuroplasticity and cognitive improvement. *International Journal of Recent Contributions from Engineering, Science & IT (iJES)*, 6(3), 4-18
- Drigas, A., & Karyotaki, M. (2014). Learning Tools and Application for Cognitive Improvement. *International Journal of Engineering Pedagogy*, 4(3): 71-77
- Drigas, A., & Karyotaki, M. (2019). Attention and its Role: Theories and Models. *International Journal of Emerging Technologies in Learning* 14 (12), 169-182
- Drigas, A., & Karyotaki, M. (2019). Executive Functioning and Problem Solving: A Bidirectional Relation. *International Journal of Engineering Pedagogy (iJEP)* 9 (3)
- Drigas, A., Karyotaki, M. & Skianis, C. (2017). Success: A 9 layered-based model of giftedness. *International Journal of Recent Contributions from Engineering, Science & IT* 5(4) 4-18
- Drigas, A., Kokkalia, G. & Lytras, M. D. (2015). Mobile and multimedia learning in preschool education. *Journal of Mobile Multimedia*, 11(1-2) 119-133
- Drigas, A., & Kontopoulou, M. (2016). ICTs based physics learning. *International Journal of Engineering Pedagogy (iJEP)*, 6(3), 53-59
- Drigas, A., & Kostas, I. (2014). On Line and other ICTs Applications for teaching math in Special Education. *International Journal of Recent Contributions from Engineering, Science & IT (iJES)*, 2(4), 46-53
- Drigas, A., & Koukianakis, L. G. (2006). An open distance learning e-system to support SMEs e-enterprising. *WSEAS Transactions on Information Science and Applications*, 3(3), 526-531
- Drigas, A., & Koukianakis, L. (2006). An open distance learning e-system to support SMEs e-enterprising. *5th WSEAS International conference on Artificial intelligence, knowledge engineering, data bases (AIKED 2006)*
- Drigas, A., Koukianakis, L. & Papagerasimou, Y. (2006). An e-learning environment for nontraditional students with sight disabilities. In *Proceedings. Frontiers in Education. 36th Annual Conference (pp. 23-27). IEEE*
- Drigas, A., & Koukianakis, L. (2009). Government online: an e-government platform to improve public administration operations and services delivery to the citizen. *Knowledge Society (pp. 523-532). Springer, Berlin, Heidelberg*
- Drigas, A., & Kouremenos, D. (2005). An e-learning management system for the deaf people. *WSEAS Transactions on Advances in Engineering Education*, 1(2), 20-24
- Drigas, A., & Leliopoulos, P. (2013). Business to consumer (B2C) e-commerce decade evolution. *International Journal of Knowledge Society Research (IJKSR)*, 4(4), 1-10
- Drigas, A., Mitsea, E. & Skianis, C. (2022), Virtual Reality and Metacognition Training Techniques for Learning Disabilities. *SUSTAINABILITY* 14(16), 10170
- Drigas, A., Mitsea, E. & Skianis C. (2022) Subliminal Training Techniques for Cognitive, Emotional and Behavioural Balance. The role of Emerging Technologies. *Technium Social Sciences Journal* 33, 164-186

- Drigas, A., Mitsea, E. & Skianis, C. (2022). Clinical Hypnosis & VR, Subconscious Restructuring-Brain Rewiring & the Entanglement with the 8 Pillars of Metacognition X 8 Layers of Consciousness X 8 Intelligences. *International Journal of Online & Biomedical Engineering*, 18(1)
- Drigas, A., & Mitsea, E. (2020). The Triangle of Spiritual Intelligence, Metacognition and Consciousness. *Int. J. Recent Contributions Eng. Sci. IT*, 8(1), 4-23
- Drigas, A., & Mitsea, E. (2021). 8 Pillars X 8 Layers Model of Metacognition: Educational Strategies, Exercises & Trainings. *International Journal of Online & Biomedical Engineering*, 17(8)
- Drigas, A., & Mitsea, E. (2020). A Metacognition Based 8 Pillars Mindfulness Model and Training Strategies. *Int. J. Recent Contributions Eng. Sci. IT*, 8(4), 4-17
- Drigas, A., & Mitsea, E. (2021). Neuro-Linguistic Programming & VR via the 8 Pillars of Metacognition X 8 Layers of Consciousness X 8 Intelligences. *Technium Soc. Sci. J.*, 26, 159
- 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 (iJES)*, 9(4), 4-17
- Drigas, A., & Mitsea, E. (2021). 8 Pillars X 8 Layers Model of Metacognition: Educational Strategies, Exercises & Trainings. *International Journal of Online & Biomedical Engineering*, 17
- Drigas, A., & Mitsea, E. (2022). Conscious Breathing: a Powerful Tool for Physical & Neuropsychological Regulation. The role of Mobile Apps. *Technium Social Sciences Journal* 28, 135-158
- Drigas, A., Mitsea, E. & Skianis, C. (2022). Neuro-Linguistic Programming, Positive Psychology & VR in Special Education. *Scientific Electronic Archives* 15 (1)
- Drigas, A., & Mitsea, E. (2022). Breathing: a Powerfull Tool for Physical & Neuropsychological Regulation. The role of Mobile Apps. *Technium Soc. Sci. J.*, 28, 135
- Drigas, A., & Papanastasiou, G. (2014). Interactive White Boards in Preschool and Primary Education. *International Journal of Online Engineering*, 10(4). 46–51
- Drigas, A., & Pappas, M. (2015). ICT based screening tools and etiology of dyscalculia. *International Journal of Engineering Pedagogy*, 5(3), 61-66
- Drigas, A., & Pappas, M. (2017). The Consciousness-Intelligence-Knowledge Pyramid: An 8x8 Layer Model. *International Journal of Recent Contributions from Engineering, Science & IT (iJES)*, 5(3), 14-25
- Drigas, A., & Petrova, A. (2014). ICTs in speech and language therapy. *International Journal of Engineering Pedagogy (iJEP)* 4 (1), 49-54
- Drigas, A., & Politi-Georgousi, S. (2019). Icts as a distinct detection approach for dyslexia screening: A contemporary view. *International Journal of Online and Biomedical Engineering (iJOE)*, 15(13):46–60
- Drigas, A., & Sideraki, A. (2021). Emotional Intelligence in Autism. *Technium Soc. Sci. J.* 26, 80
- Drigas, A. S., Stavridis, G. & Koukianakis, L. (2004). A Modular Environment for E-learning and E-psychology Applications. *WSEAS Transactions on Computers*, 3(6), 2062-2067
- Drigas, A., & Vlachou, J. A. (2016). Information and communication technologies (ICTs) and autistic spectrum disorders (ASD). *International Journal of Recent Contributions from Engineering, Science & IT (iJES)*, 4(1), 4-10
- Drigas, A., Vrettaros, J. Tagoulis, A. & Kouremenos, D. (2010). Teaching a foreign language to deaf people via vodcasting & web 2.0 tools. *World Summit on Knowledge Society*, 514-521
- Galitskaya, V., & Drigas, A. (2021). The importance of working memory in children with Dyscalculia and Ageometria. *Scientific Electronic Archives*, 14(10)
- Henderson, J., & Rivet, T. (2018). Electronic screen media for persons with autism spectrum disorders: Results of a systematic review and meta-analysis. *Journal of Autism and Developmental Disorders*, 48(8), 2701-2719
- Kandalaf, M. R., Didehbani, N. Krawczyk, D. C. Allen, T. & Chapman, S. B. (2013). Virtual reality social cognition training for young adults with high-functioning autism. *Journal of Autism and Developmental Disorders*, 43(1), 34-44
- Kapsi, S., Katsantoni, S. & Drigas, A. (2020). The Role of Sleep and Impact on Brain and Learning. *Int. J. Recent Contributions Eng. Sci. IT*, 8(3), 59-68
- Karyotaki, M., Bakola, L. Drigas, A. & Skianis, C. (2022). Women's Leadership via Digital Technology and Entrepreneurship in business and society. *Technium Soc. Sci. J.*, 28, 246
- Karyotaki, M., & Drigas, A. (2016). Latest trends in problem solving assessment. *International Journal of Recent contributions from Engineering, Science & IT (iJES)*, 4(2), 4-10
- Karyotaki, M., & Drigas, A. (2015). Online and other ICT Applications for Cognitive Training and Assessment. *International Journal of Online Engineering*, 11(2). 36-42
- Karyotaki, M., & Drigas, A. (2016). Online and Other ICT-based Training Tools for Problem-solving Skills. *International Journal of Emerging Technologies in Learning* 11 (6)
- Kefalis, C., Kontostavlou, E. Z. & Drigas, A. (2020). The Effects of Video Games in Memory and Attention. *Int. J. Eng. Pedagog.* 10 (1), 51-61

- Kim, E. K., & Lord, C. (2010). Combining information from multiple sources for the diagnosis of autism spectrum disorders for toddlers and young preschoolers from 12 to 47 months of age. *Journal of Child Psychology and Psychiatry*, 51(2), 237-245
- Kizony, R., Katz, N. & Weiss, P. (2011). Adapting an immersive virtual reality system for rehabilitation. *The Journal of Visualization and Computer Animation*, 14:261--268
- Kokkalia, G., Drigas, A. S. & Economou, A. (2016). Mobile learning for preschool education. *International Journal of Interactive Mobile Technologies*, 10(4)
- Kokkalia, G., Drigas, A. & Economou, A. (2016). The role of games in special preschool education. *International Journal of Emerging Technologies in Learning (iJET)*, 11(12), 30-35
- Kontostavlou, E. Z., & Drigas, A. S. (2019). The Use of Information and Communications Technology (ICT) in Gifted Students. *Int. J. Recent Contributions Eng. Sci. IT*, 7(2), 60-67
- Lou, A., Boyd, E. Gupta, S. Vikmani, B. Gutierrez, C. Yang, J. Linstead, E. & Gillian, R. (2018). vrSocial: Toward Immersive Therapeutic VR Systems for Children with Autism. Conference on Human Factors. *Computing Systems*.Pages 1–12
- Lytra, N., & Drigas, A. (2021). STEAM education-metacognition–Specific Learning Disabilities. *Scientific Electronic Archives*, 14(10)
- McMahon, C. M., & Lerner, M. D. (2015). Developmental psychopathology: Autism spectrum disorder. *Child and Adolescent Psychiatric Clinics*, 24(1), 55-68
- Mitsea, E., Drigas., A. Skianis, C. (2022). Breathing, Attention & Virtual Reality. *Technium Social Sciences Journal* 29, 79-97
- Mitsea, E., Drigas, A. & Mantas, P. (2021). Soft Skills & Metacognition as Inclusion Amplifiers in the 21 st Century. *International Journal of Online & Biomedical Engineering*, 17(4)
- Mitsea, E., Lytra, N. Akrivopoulou, A. & Drigas, A. (2020). Metacognition, Mindfulness and Robots for Autism Inclusion. *Int. J. Recent Contributions Eng. Sci. IT*, 8(2), 4-20
- Mitsea, E., Drigas, A. & Skianis, C. (2022). ICTs and Speed Learning in Special Education: High-Consciousness Training Strategies for High-Capacity Learners through Metacognition Lens. *Technium Soc. Sci. J.* 27, 230
- Ntaountaki, P., (2019). Robotics in Autism Intervention. *Int. J. Recent Contributions Eng. Sci. IT* 7 (4), 4-17
- Papanastasiou, G., Drigas, A. Skianis, C. Lytras, M. & Papanastasiou, E. (2018). Patient-centric ICTs based healthcare for students with learning, physical and/or sensory disabilities. *Telematics and Informatics*, 35(4), 654-664
- Papoutsis, C., & Drigas, A. (2016). Games for empathy for social impact. *International Journal of Engineering Pedagogy* 6(4), 36-40
- Papoutsis, C, Drigas, A. & Skianis, C. (2021). Virtual and augmented reality for developing emotional intelligence skills. *Int. J. Recent Contrib. Eng. Sci. IT (IJES)* 9 (3), 35-53
- Papoutsis, C., & Drigas, A. S. (2017). Empathy and Mobile Applications. *International Journal of Interactive Mobile Technologies*, 11(3)
- Pappas, M. A., Drigas, A. Papagerasimou, Y. Dimitriou, H. Katsanou, N. Papakonstantinou, S. & Karabatzaki, Z. (2018). Female entrepreneurship and employability in the digital era: The case of Greece. *Journal of Open Innovation: Technology, Market, and Complexity*, 4(2), 15
- Pappas, M. A., & Drigas, A. S. (2019). Computerized Training for Neuroplasticity and Cognitive Improvement. *Int. J. Eng. Pedagog.*, 9(4), 50-62
- Pappas, M. A., Demertzi, E. Papagerasimou, Y. Koukianakis, L. Voukelatos, N. & Drigas, A. (2019). Cognitive-based E-learning design for older adults. *Social Sciences*, 8(1), 6
- Pappas, M., & Drigas, A. (2015). ICT based screening tools and etiology of dyscalculia. *International Journal of Engineering Pedagogy*, 3, 61-66
- Pappas, M., & Drigas, A. (2016). Incorporation of artificial intelligence tutoring techniques in mathematics. *International Journal of Engineering Pedagogy*, 6(4), 12–16.
- Pappas, M. A., Demertzi, E. Papagerasimou, Y. Koukianakis, L. Kouremenos, D. Loukidis, I. & Drigas, A. S. (2018). E-learning for deaf adults from a user-centered perspective. *Education Sciences*, 8(4), 206
- Sideraki, A., & Drigas, A. (2021). Artificial Intelligence (AI) in Autism . *Technium Social Sciences Journal*, 26(1), 262–277.
- Stathopoulou, A., Karabatzaki, Z. Kokkalia, G. Dimitriou, E. Loukeri, P. I. Economou, A. & Drigas, A. (2018). Mobile Assessment Procedures for Mental Health and Literacy Skills in Education. *International Journal of Interactive Mobile Technologies*, 12(3). 21-37
- Stathopoulou, A., Karabatzaki, Z. Tsiros, D. Katsantoni, S. & Drigas, A. (2019). Mobile apps the educational solution for autistic students in secondary education. *International Journal of Interactive Mobile Technologies*, 13(2), 89-101
- Stavridis, S., & Papageorgiou, Z. (2017). Dynamical system based robotic motion generation with obstacle avoidance. *IEEE Robotics and Automation Letters* 2 (2), 712-718
- Stavridis, S., & Doulgeri, Z. (2018).Bimanual assembly of two parts with relative motion generation and task related optimization. *IEEE/RSJ International Conference on Intelligent Robots and Systems*

- Stavridis, S., Falco, P. & Doulgeri, Z. (2020). Pick-and-place in dynamic environments with a mobile dual-arm robot equipped with distributed distance sensors. *IEEE-RAS 20th International Conference on Humanoid Robots (Humanoids)*
- Stavridis, S., Papageorgiou, D. Droukas, L. & Doulgeri, Z. (2022). Bimanual crop manipulation for human-inspired robotic harvesting. *arXiv preprint arXiv:2209.06074*
- Stavridou, T., Driga, A.M. & Drigas, A.S. (2021). Blood Markers in Detection of Autism, *International Journal of Recent Contributions from Engineering Science & IT (iJES)* 9(2):79-86
- Theodorou, P., & Drigas, A. S. (2017). ICTs and Music in Generic Learning Disabilities. *International Journal of Emerging Technologies in Learning*, 12(4)
- Tourimpampa, A., Drigas, A. Economou, A. & Roussos, P. (2018). Perception and Text Comprehension. It's a Matter of Perception! *International Journal of Emerging Technologies in Learning*, 13(7)
- Vlachou, J., & Drigas, A. S. (2017). Mobile technology for students and adults with Autistic Spectrum Disorders (ASD). *International Journal of Interactive Mobile Technologies*, vol. 11(1), pp. 4-17
- Vahabzadeh, A., Keshav, U. N. Sabur, R. Huey, K. Liu, R. & Sahin, T. N. (2018). Improved Socio-Emotional and Behavioral Functioning in Students with Autism Following School-Based Smartglasses Intervention: Multi-Stage Feasibility and Controlled Efficacy Study. *Behav. Sci.*, 8 (85), 1 – 17
- Vrettaros, J., Tagoulis, A. Giannopoulou, N. & Drigas, A. (2009). An empirical study on the use of Web 2.0 by Greek adult instructors in educational procedures. *In World Summit on Knowledge Society (pp. 164-170)*
- Wechsler, D. (2011). Wechsler Abbreviated Scale of Intelligence--Second Edition (WASI-II) [Database record]. *APA PsycTests*
- Zavitsanou, A., & Drigas, A. (2021). Nutrition in mental and physical health. *Technium Soc. Sci. J.*, 23, 67