

Mobile applications for autism

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Abstract. The rapid development of technology in recent years has increased the interest of educators, researchers, families and therapists of children with autism in the possibilities that digital technologies offer regarding the treatment, education, support and remedy for the plethora of difficulties they face. This particular interest is further enhanced by the need to provide these children with effective interventions through the use of applications that will engage and significantly assist them. For this reason, empirical studies concerning assistive technology products have been constantly increasing; such products promise that they can make up for all the deficits and meet the needs that people in the autism spectrum have in diverse areas, such as communication, social integration and skill acquisition. According to all the above, this research aims to present the mobile applications used in autism. Thus, in the first chapter, there will be a definition of autism and a presentation of its key features. Furthermore, in the second chapter, assistive technology in the context of autistic disorders will be discussed as well as the possible advantages of portable applications. Finally, in the third chapter, there will be various examples of such applications.

Keywords. Mobile, Robotics, AI, Games, Autism

1. Autistic Spectrum Disorder (ASD)

1.1 A definition of Autistic Spectrum Disorder

According to the DSM-V, the autism spectrum includes several disorders such as childhood autism, early infantile autism, Kanner autism, high-functioning autism, atypical autism, pervasive developmental disorder not otherwise specified, Asperger's disorder, and disintegrative disorder (APA, 2013). This is a group of neurodevelopmental disorders, whose main features are deficits in the areas of social interaction and communication, as well as stereotyped repetitive behaviors. The appearance of the specific symptoms occurs during early childhood, limiting the daily functionality of individuals. The manifestation of these disorders varies according to the degree of severity of autism, the age of the individuals and their level of development. These diverse manifestations have led to the use of the term "spectrum" (ARA, 2013).

ASD is now very common, with 1 in 54 children aged 8 years old being diagnosed with it. These statistics are alarming, especially when compared to previous years, when the incidence in children was 1 in 150 (CDC, 2020).

1.2 The key features of ASD

The major deficits in individuals with autism are categorized into three main areas, such as social competence and interaction, communication, and repetitive stereotyped behavior. Most of the time, difficulties are also noted in areas like concentration as well as in emotional, sensory, and cognitive functions, in general. Regarding social activity, people with autism face great difficulties in managing their social relationships, interacting with others, understanding their emotions, perceiving body language, and maintaining eye contact. The absence of knowledge about the people surrounding them and about their way of thinking and perceiving things is also typical of autism, which intensifies difficulties in social interactions (Rajendran, 2013). Moreover, there are deficits in the area of communication, due to the fact that non-verbal and verbal communication skills are not sufficiently developed. The speech of some of these people is not functional at all. More specifically, the deficits observed in non-verbal communication are the lack of eye contact and the absence of socially acceptable and appropriate gestures and facial expressions. These skills are of major importance for an individual's socialization, due to the fact that communication helps complete one's personality. In more detail, every time a person communicates with those around them, they learn about the values and standards of society and acquire experiences that contribute to the development of their personality. If this is not the case, the person becomes passive, can be rejected by others, and is unable to create positive social relationships (Allen et al., 2010).

Deficits in the areas of perceiving the feelings and thoughts of others, social and emotional reciprocity, and interactions are evident in younger children, who may demonstrate reduced or no social interactions, fail to exchange feelings, fail to adopt imitative behaviors and be unable to initiate or terminate a social imitation (Escobendo et al., 2012). Of course, in this case too, all the difficulties diversify according to the individual's language ability, age, and support they have received. Finally, another early feature of autism is the absence of joint attention, which is very important for communication within society and for the existence of interactions (Escobendo et al., 2012).

2. Assistive technology and autism

2.1 A definition of assistive technology

According to the World Health Organization (WHO, 2013) disability is a complex condition, which depends not only on physical disabilities or incapacities, but also on the way in which society deals with it. Therefore, removing social and environmental barriers can greatly improve the lives of people with disabilities and reduce their feeling of incompetence. This can also be done through assistive technologies. Assistive technologies support the performance of activities that would have been impossible or very difficult for these people to perform without using them (Bouraoui et al., 2007). For the World Health Organization, assistive technology includes some helpful and supportive products, services, and systems, developed for individuals with the ultimate goal of being able to improve their functionality and ensure their well-being (WHO, 2016). Assistive technology devices are any modified or adapted object and system of products, electronic or non-electronic, of low or high technology, that are used in order to increase, maintain and improve the functional capabilities of people with disabilities (IDEA, 1997).

Assistive technologies also include some non-technical aids, and digital and mechanical devices. There are three main categories of assistive technology, which are classified into low-tech, mid-tech and high-tech assistive technology. More specifically, the first category of assistive technology features zero or minimal assistive technology media, which are very low-cost and do not require any learning effort, nor do they include electromechanical tools. Next come the mid-tech assistive technology media, which include various devices that have batteries, but are not as complex as their high-end counterparts. Finally, there are high-tech media, which include more complex digital and electronic tools, they are high-cost, and require time to learn. This category includes all computers, software, applications, keyboards, and video cameras (Ennis-Cole & Smith, 2011).

2.2 Assistive technology in autism

In recent years, assistive technologies have been increasingly used to develop the skills of people with autism. For this reason, they are a constantly evolving field, which can improve their lives. People with autism spectrum disorders make particular reference to the use of portable digital assistive technologies, as they are considered valuable tools meeting their communication and educational needs (Bauminger et al., 2007). Assistive technology can improve the daily life skills of many people by providing them with the ability to visualize information, making it easier for them to understand (Alcorn et al., 2011).

The use of assistive technologies promises to meet all the needs of individuals on the autism spectrum and help them ensure independent learning. It facilitates their access to their surroundings and significantly reduces the need for direct support from their trainers or carers. Therefore, assistive technology is beneficial for individuals on every level, as it has various applications, it is very easy to use, and allows for improvement in all areas where deficits may occur (Ennis-Cole & Smith, 2011). More specifically, the advantages of using new technologies in the education and support of people diagnosed with ASD are the following:

- Existence of clear and limited boundaries.
- Limited stimuli for all senses.
- Error control and utmost predictability.
- Possibilities for improvement and personalization.
- Possibilities for verbal and non-verbal communication.
- Achievement of unimodality.
- Improvement of interaction (Hayes et al., 2010).

Regarding the applications for mobile devices in particular, they are used to enhance the communication of children with autism. They can be very effective when used for providing prompts, as they promote correct and independent responding and at the same time reduce the need for external prompting by staff during activities. In addition, they encourage organization and time management through different programs, especially for children facing challenges in the cognitive domain (Van Laarhoven et al., 2009).

2.3 Benefits of using portable electronic devices for people with autism

Mobile devices along with the applications they include, the functionality they promise and their ability to adapt to individual needs can significantly improve the daily lives of people with autism (McNaughton & Light, 2013). Their advantages, including accessibility, portability, plethora of applications available for social interaction and real-time communication, fluency, ease of use, reduced cost, ability to support personalization, and meeting the needs of individuals, have changed the way

services are provided, making them much more attractive in terms of design and functionality (Meder & Wegner, 2015).

3. Digital applications for people with autism

There are various digital applications that have been created to significantly help meet the needs of people with autism. One of them is "Capture My Emotion", which helps children with autism take various videos and photos and record sounds, while detecting their emotional state through the use of a wireless sensor. The aim is to improve their emotional education using their own material and to further assist the work of caregivers. It is a valuable tool that enables these children to identify and express their feelings. It uses the Q sensor from Affectiva, which can measure various parameters, such as conductivity and skin temperature, and as a result, indications are given about the emotional state of the users. These measurements will then be combined with the visual and audio material captured by the children along with various other information such as time, date, and location. This particular combination creates a personalized and individualized tool, which will help children discuss their feelings. This application can be used on Android tablets and smartphones (Leijdekkers et al., 2013).

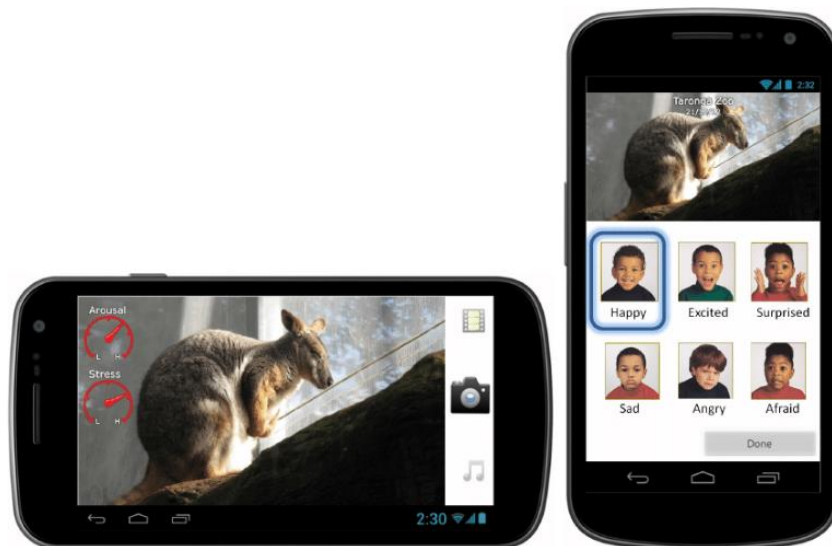


Image 1: Capture My Emotion Application

Another important application includes three-dimensional animations and trains autistic children to identify and perceive emotions and facial expressions. It is based on the movie Toy Story. Its simplicity and predictability, combined with the well-known cartoon character it features, make it very attractive

and familiar to children. The possibilities that this application provides are particularly encouraging, since it facilitates children in their effort to identify the feelings of others through their facial expressions (Fergus et al., 2011).

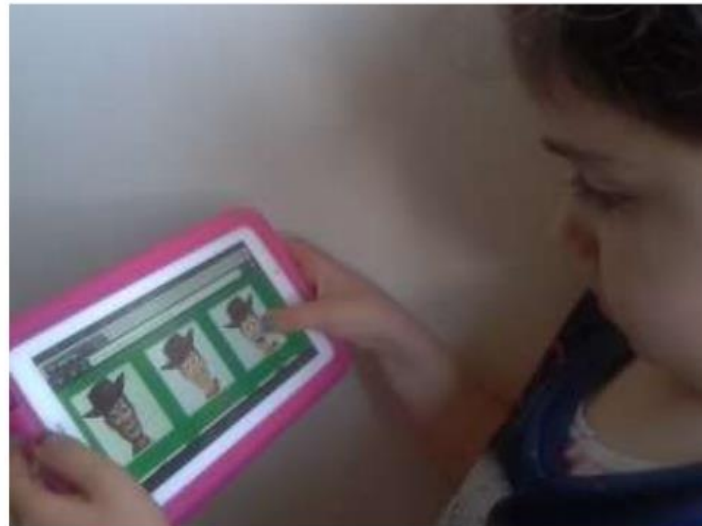


Image 2: Toy Story Application

Next comes the Social Compass Curriculum, which is an educational and behavioral program that helps improve the social skills of children with autism. In this application social stories are combined mostly with visual supporting material so as to achieve its objective (Boyd et al., 2013).

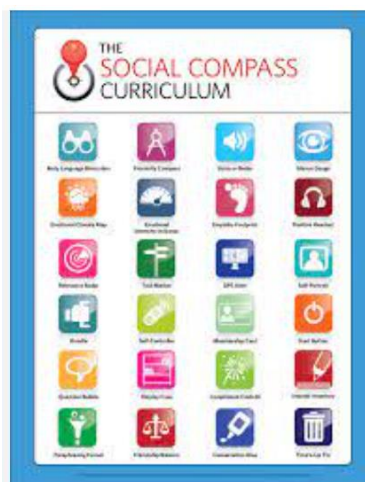


Image 3: The Social Compass Curriculum

In their own study Escobedo et al. (2012) presented the mobile-supported application MOSOCO that introduces children to various real-life social situations. This application includes various interactive features that encourage children to get in touch with other people through their own eyes, engage in conversations, be able to maintain good space boundaries, and gain the ability to share interest, be able to control their interactions, and understand the basic rules of communication. This software can operate on Android smartphones, which should be connected wirelessly to a server. This application uses the camera to simulate real social situations through visual support. After each interaction, the children using the application can fill out various self-assessment forms. It has been shown that behavioral issues of students with autism can be reduced and interactions with their peers can be increased.



Image 4: MOSOCO application

Another important application is Speech Blubs. It is an ad-free application that significantly helps educate children with autism at the beginning of their school years. Speech therapists adopt Speech Blubs as a tool to complement the daily therapy sessions for children with autism, Down syndrome and apraxia. With the aid of facial recognition technology and by encouraging the child to imitate what they see, Speech Blubs teaches them to produce new sounds and motivates them while having fun. Thus, they acquire new vocabulary and participate in various games, quizzes, and puzzles. For students with autism, it can be used to encourage vocal imitation (Heni & Hamam, 2016).



Image 5: Speech Blubs Application

Finally, another application for mobile phones is Dino Tim: Kids' Addition and Subtraction. This is a very good application for developing the mathematical ability of autistic children. It teaches them geometric shapes, vowels and consonants with the aid of a reading software for autism. This application can be very exciting, as children can solve puzzle games and learn fundamental math concepts. It allows users to switch between languages and helps primarily young children learn foreign languages. This innovative tool enhances the understanding of children with autism through the help of an adorable dinosaur, called Tim. It was created to assist children from the age of 2 to set the foundations for their mathematical skills. It is supported by iPhone and iPad devices (Zoerner et al., 2016).



Image 6: Dino Tim: Kids' Addition and Subtraction

4. Conclusions

Finally we underline the importance of the digital technologies in education domain and language comprehension that is very productive and successful, facilitates and improves the assessment, the intervention and the educational procedures via Mobiles which brings educational activities everywhere [27-35], various ICTs applications which are the core supporters of education [36-70], AI, STEM & ROBOTICS which raise educational procedures into new levers of performance [71-89], and games which transforms the education in a very friendly and enjoyable interaction [90-95]. Additionally, the enhancement and combination of ICTs with theories and models of metacognition, mindfulness, meditation and emotional intelligence cultivation [96-140] as well as with environmental factors and nutrition [23-26], accelerates and improves more over the educational practices and results, especially in the language comprehension domain and its practices like assessment and intervention.

The aforementioned details highlight the major importance of the use of assistive technology and its applications in particular, in improving the daily life of children with autism. As already pointed out, most of the difficulties they face are in the area of interactions with others and for this reason it was made clear that most of these applications focus on the smooth socialization of these children. In light of the above, these applications are valuable tools in the hands of all people supporting these children, helping them deal with the difficulties they face in the best possible way and opening the way to their independence.

5. BIBLIOGRAPHY

- [1] Alcorn, A., Pain, H., Rajendran, G., Smith, T., Lemon, O., Porayska-Pomsta, K., Bernardini, S. (2011). Social communication between virtual characters and children with autism. *Lecture Notes in Computer Science*, 6738, 7–14.
- [2] Allen, K., Wallace, D., Renes, D., Bowen, S. & Burke, R. (2010). Use of Video Modeling to Teach Vocational Skills to Adolescents and Young Adults with Autism Spectrum Disorders. *Education and Treatment of Children*, 33 (3), 339-349.
- [3] American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders, DSM-V*, 5th edition. APA Publishing, Washington, DC London, England.
- [4] Bauminger, N., Gal, E., Goren-Bar, D. (2007). Enhancing social communication in high functioning children with autism through a collocated interface. 6th International Workshop on Social Intelligence Design.
- [5] Bouraoui, A., Jemni, M. & Laabidi, M. (2007). A model driven framework to provide accessible e-learning for students with disabilities. In *Proceedings of The first International Conference on ICT & Accessibility*. Accessed from http://www.esstt.rnu.tn/utic/tica2007/sys_files/medias/docs/p24.pdf
- [6] Boyd, L., McReynolds, C., & Chanin, K. (2013). *The social compass curriculum: A story-based intervention package for students with autism spectrum disorders*. Paul H. Brookes Publishing Company.

- [7] Centers for Disease Control and Prevention (CDC). (2020). Data & Statistics on Autism Spectrum Disorder. Accessed from <https://www.cdc.gov/ncbddd/autism/data.html>
- [8] Ennis - Cole, D. & Smith, D. (2011). Assistive technology and autism: Expanding the technology leadership role of the school librarian. *School Libraries Worldwide* 17(2), 86- 98.
- [9] Escobedo, L., Tentori, M., Quintana, E., Favela, J. & Garcia-Rosas, D. (2014) Using augmented reality to help children with autism stay focused. *IEEE Pervasive Computer*, 13, 38-46.
- [10] Fergus, P., Abdulaimma, B., Carter, C., & Round, S. (2014, January). Interactive mobile technology for children with autism spectrum condition (ASC). In 2014 IEEE 11th Consumer Communications and Networking Conference (CCNC) (pp. 1-4). IEEE.
- [11] Hayes, G., Hirano, S., Marcu, G., Monibi, M., Nguyen, D., & Yeganyan, M. (2010). Interactive visual supports for children with autism. *Personal and Ubiquitous Computing*, 14(7), 663-680.
- [12] Heni, N., & Hamam, H. (2016, March). Design of emotional educational system mobile games for autistic children. In 2016 2nd International Conference on Advanced Technologies for Signal and Image Processing (ATSIP) (pp. 631-637). IEEE.
- [13] IDEA (1997). Accessed from <https://www2.ed.gov/offices/OSERS/Policy/IDEA/index.html>
- [14] Leijdekkers, P., Gay, V., & Wong, F. (2013, June). CaptureMyEmotion: A mobile app to improve emotion learning for autistic children using sensors. In Proceedings of the 26th IEEE International Symposium on Computer-Based Medical Systems (pp. 381-384). IEEE.
- [15] McNaughton, D. & Light, J. (2013). The iPad and Mobile Technology Revolution: Benefits and Challenges for Individuals who require augmentative and alternative communication. *Augmentative and Alternative*, 29(2), 107-116.
- [16] Meder, A.M & Wegner, J.R (2015). iPads, Mobile Technologies and Communication Applications: A survey of family wants needs and preferences. *Augmentative and Alternative Communication*, 31 (1) 27-36.
- [17] Rajendran, G. (2013). Virtual environments and autism: a developmental psychopathological approach. *Journal of Computer Assisted Learning*, 29(4), 334-347.
- [18] Shattuck, P. T., Narendorf, S. C., Cooper, B., Sterzing, P. R., Wagner, M., & Taylor, J. L. (2012). Postsecondary education and employment among youth with an autism spectrum disorder. *Pediatrics*, 129(6), 1042-1049.
- [19] Van Laarhoven, T., Johnson, J. W., Van Laarhoven-Myers, T., Grider, K. L., & Grider, K. M. (2009). The effectiveness of using a video iPod as a prompting device in employment settings. *Journal of Behavioral Education*, 18, 118-41.
- [20] World Health Organization (2013). Disabilities. Accessed from <http://www.who.int/topics/disabilities/en/>
- [21] WHO. (2016). Improving access to assistive technology (Vol. EB139/4). Geneva, Switzerland. Accessed from https://apps.who.int/gb/ebwha/pdf_files/EB139/B139_4-en.pdf
- [22] Zoerner, D., Schütze, J., Kirst, S., Dziobek, I., & Lucke, U. (2016, July). Zirkus Empathico: Mobile training of socio-emotional competences for children with Autism. In 2016 IEEE 16th International Conference on Advanced Learning Technologies (ICALT) (pp. 448-452). IEEE.
- [23] Stavridou Th., 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.
- [24] Zavitsanou, A., & Drigas, A. (2021). Nutrition in mental and physical health. *Technium Soc. Sci. J.*, 23, 67.
- [25] Driga, A.M., Drigas, A.S. 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. <https://doi.org/10.3991/ijes.v7i1.10031>
- [26] Driga, A.M., and Drigas, A.S. 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., doi:10.3991/ijoe.v15i13.11203

- [27] Vlachou J. and 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,
- [28] Papoutsis C., Drigas, A. S., and C. Skianis, 2018 “Mobile Applications to Improve Emotional Intelligence in Autism – A Review,” *Int. J. Interact. Mob. Technol. (iJIM)*; Vol 12, No 6,
- [29] Stathopoulou A., Loukeris D., Karabatzaki Z., Politi E., Salapata Y., and Drigas, A. S., 2020 “Evaluation of Mobile Apps Effectiveness in Children with Autism Social Training via Digital Social Stories,” *Int. J. Interact. Mob. Technol. (iJIM)*; Vol 14, No 03,
- [30] Stathopoulou, et al 2018, Mobile assessment procedures for mental health and literacy skills in education. *International Journal of Interactive Mobile Technologies*, 12(3), 21-37,
- [31] Drigas, A., Kokkalia, G. & Lytras, M. D. (2015). Mobile and Multimedia Learning in Preschool Education. *J. Mobile Multimedia*, 11(1-2), 119–133.
- [32] Kokkalia G, AS Drigas, A Economou 2016 Mobile learning for preschool education. *International Journal of Interactive Mobile Technologies* 10 (4)
- [33] Stathopoulou A, Karabatzaki Z, Tsiros D, Katsantoni S, Drigas A, 2019 Mobile apps the educational solution for autistic students in secondary education *Journal of Interactive Mobile Technologies* 13 (2), 89-101
- [34] Drigas A, DE Dede, S Dedes 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
- [35] Alexopoulou A, Batsou A, Drigas A, 2020 Mobiles and cognition: The associations between mobile technology and cognitive flexibility *iJIM* 14(3) 146-156
- [36] Drigas, A. S., & Ioannidou, R. E. (2011, September). ICTs in special education: A review. In *World Summit on Knowledge Society* (pp. 357-364). Springer, Berlin, Heidelberg.
- [37] Drigas, A. S., J.Vrettaros, L.Stavrou, D.Kouremenos, 2004. E-learning Environment for Deaf people in the E-Commerce and New Technologies Sector, *WSEAS Transactions on Information Science and Applications*, Issue 5, Volume 1, November
- [38] Drigas, A.S., Vrettaros, J. and Kouremenos, D. (2004) ‘Teleeducation and e-learning services for teaching English as a second language to deaf people, whose first language is the sign language’, *WSEAS Transactions on Information Science and Applications*, Vol. 1, No. 3, pp.834–842.
- [39] Drigas, A., Koukianakis, L., Papagerasimou, Y., 2011, Towards an ICT-based psychology: Epsychology, Computers in Human Behavior, 27:1416–1423. <https://doi.org/10.1016/j.chb.2010.07.045>
- [40] Charami, F., & Drigas, A. (2014). ICTs in English Learning and Teaching. *International Journal of Engineering and Science*. Vol. 2(4):4-10. DOI: 10.3991/ijes.v2i4.4016
- [41] Drigas A., Pappas M, and Lytras M., 2016. “Emerging technologies for ict based education for dyscalculia: Implications for computer engineering education,” *International Journal of Engineering Education*, vol. 32, no. 4, pp. 1604–1610,
- [42] Drigas, A. & Kokkalia, G. 2017. ICTs and Special Education in Kindergarten. *International Journal of Emerging Technologies in Learning* 9 (4), 35–42.
- [43] 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..
- [44] Drigas, A., Leliopoulos, P.: Business to consumer (B2C) e-commerce decade evolution. *Int. J. Knowl. Soc. Res. (IJKSR)* 4(4), 1–10 (2013)
- [45] Pappas M, Drigas A, Papagerasimou Y, Dimitriou H, Katsanou N, Papakonstantinou S, et al. 2018; Female Entrepreneurship and Employability in the Digital Era: The Case of Greece. *Journal of Open Innovation: Technology, Market, and Complexity*. 4(2): 15.
- [46] Papanastasiou G., Drigas, A. S., Skianis Ch., M. Lytras & E. Papanastasiou, 2018. “Patient-Centric ICTs based Healthcare for students with learning, physical and/or sensory disabilities,” *Telemat Inform*, vol. 35, no. 4, pp. 654–664, 2018. <https://doi.org/10.1016/j.tele.2017.09.002>

- [47] Drigas, A., & Kontopoulou, M. T. L. (2016). ICTs based Physics Learning. *International Journal of Engineering Pedagogy (iJEP)*, 6(3), 53-59. <https://doi.org/10.3991/ijep.v6i3.53-59>
- [48] Papanastasiou, G., Drigas, A., Skianis, C., and Lytras, M. (2020). Brain computer interface based applications for training and rehabilitation of students with neurodevelopmental disorders. A literature review. *Heliyon* 6:e04250. doi: 10.1016/j.heliyon.2020.e04250
- [49] Drigas, A. S., John Vrettaros, and Dimitris Kouremenos, 2005. "An e-learning management system for the deaf people," AIKED '05: Proceedings of the Fourth WSEAS International Conference on Artificial Intelligence, Knowledge Engineering Data Bases, article number 28.
- [50] Pappas, M., Demertzi, E., Papagerasimou, Y., Koukianakis, L., Kouremenos, D., Loukidis, I. and Drigas, A. 2018. E-Learning for deaf adults from a user-centered perspective. *Education Sciences* 8(4)206:
- [51] Pappas, M., Eleftheria Demertzi, Yannis Papagerasimou, Lefteris Koukianakis, Nikitas Voukelatos, and Drigas, A. S., 2019. Cognitive Based E-Learning Design for Older Adults. *Social Sciences* 8, 1 (Jan. 2019), 6. <https://doi.org/10.3390/socsci801000>
- [52] Drigas, A. S., Lefteris Koukianakis 2009: Government online: An e-government platform to improve public administration operations and services delivery to the citizen. *WSKS (1)*, volume 5736 de *Lecture Notes in Computer Science*, 523–532. Springer,
- [53] Theodorou, P.; Drigas, A. 2017, ICTs and Music in Generic Learning Disabilities. *Int. J. Emerg. Technol. Learn.* 12(4), 101–110
- [54] Pappas, M.A., & Drigas, A.S. (2015). ICT based screening tools and etiology of dyscalculia. *International Journal of Engineering Pedagogy*, (5)3, 61-66.
- [55] 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), pp-46. <http://dx.doi.org/10.3991/ijes.v2i4.4204>
- [56] 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 and Biomedical Engineering (iJOE)*, vol. 15, no. 14, pp. 78.
- [57] Drigas, A. & Ioannidou, R. E. (2013). Special education and ICT's. *International Journal of Emerging Technologies in Learning* 8(2), 41– 47.
- [58] Drigas, A., & Papanastasiou, G. (2014). Interactive White Boards in Preschool and Primary Education. *International Journal of Online and Biomedical Engineering (iJOE)*, 10(4), 46–51. <https://doi.org/10.3991/ijoe.v10i4.3754>
- [59] Drigas, A. S. and 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.
- [60] Lizeta N. Bakola, Nikolaos D. Rizos, Drigas, A. S., 2019 "ICTs for Emotional and Social Skills Development for Children with ADHD and ASD Co-existence" *International Int. J. Emerg. Technol. Learn.*, 14(5), 122-131.
- [61] Kontostavrou, E.Z., & Drigas, A.S. (2019). The Use of Information and Communications Technology (ICT) in Gifted Students. *International Journal of Recent Contributions from Engineering, Science and IT*, 7(2), 60-67. doi:10.3991/ijes.v7i2.10815
- [62] Drigas, A. S., and Vlachou J. A., 2016. "Information and communication technologies (ICTs) and autistic spectrum disorders (ASD)," *Int. J. Recent Contrib. Eng. Sci. IT (iJES)*, vol. 4, no. 1, p. 4, <https://doi.org/10.3991/ijes.v4i1.5352>
- [63] Drigas, A. S., Koukianakis, L., Papagerasimou, Y. (2006) "An elearning environment for nontraditional students with sight disabilities.", *Frontiers in Education Conference, 36th Annual. IEEE*, p. 23-27.
- [64] Drigas A., and Koukianakis L. 2006 An open distance learning e-system to support SMEs e-enterprising. In proceeding of 5th WSEAS Internationalconference on Artificial intelligence, knowledge engineering, data bases (AIKED 2006). Spain

- [65] Drigas A, Petrova A 2014 ICTs in speech and language therapy *International Journal of Engineering Pedagogy (iJEP)* 4 (1), 49-54
- [66] Bravou V, Oikonomidou D, Drigas A, 2022 Applications of Virtual Reality for Autism Inclusion. A review *Retos* 45, 779-785
- [67] 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
- [68] Bravou V, Drigas A, 2019 A contemporary view on online and web tools for students with sensory & learning disabilities *iJOE* 15(12) 97
- [69] 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
- [70] Chaidi I, Drigas A, C Karagiannidis 2021 ICT in special education *Technium Soc. Sci. J.* 23, 187
- [71] Drigas, A. S., Rodi-Eleni Ioannidou, 2013 A Review on Artificial Intelligence in Special Education, Information Systems, Elearning, and Knowledge Management *Research Communications in Computer and Information Science* Volume 278, pp 385-391, http://dx.doi.org/10.1007/978-3-642-35879-1_46
- [72] Drigas, A., Vrettaros, J. (2004): An Intelligent Tool for Building e-Learning Content-Material Using Natural Language in Digital Libraries. *WSEAS Transactions on Information Science and Applications* 5(1) 1197–1205
- [73] Drigas, A.S., Vrettaros, J., Koukianakis, L.G. and Glentzes, J.G. (2005). A Virtual Lab and e-learning system for renewable energy sources. *Int. Conf. on Educational Tech.*
- [74] Drigas AS, Argyri K, Vrettaros J (2009) Decade review (1999-2009): artificial intelligence techniques in student modeling. In: *World Summit on Knowledge Society*. Springer, pp 552–564
- [75] 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. *World Summit on Knowledge System (WSKS)*, 49, 164-170. http://dx.doi.org/10.1007/978-3-642-04757-2_18
- [76] Drigas, A., Dourou, A. (2013). A Review on ICTs, E-Learning and Artificial Intelligence for Dyslexic's Assistance. *iJet*, 8(4), 63-67.
- [77] 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*, 15(6), 95-107. <https://doi.org/10.3991/ijet.v15i06.11231>
- [78] Pappas, M., & Drigas, A. (2016). Incorporation of artificial intelligence tutoring techniques in mathematics. *International Journal of Engineering Pedagogy*, 6(4), 12–16. <https://doi.org/10.3991/ijep.v6i4.6063>
- [79] Lytra N, Drigas A 2021 STEAM education-metacognition–Specific Learning Disabilities *Scientific Electronic Archives* 14 (10)
- [80] Mitsea E, Lytra N, A Akrivopoulou, A Drigas 2020 Metacognition, Mindfulness and Robots for Autism Inclusion. *Int. J. Recent Contributions Eng. Sci. IT* 8 (2), 4-20
- [81] Stavridis S, D Papageorgiou, Z Doulgeri 2017 Dynamical system based robotic motion generation with obstacle avoidance, *IEEE Robotics and Automation Letters* 2 (2), 712-718
- [82] Kastritsi T, D Papageorgiou, I Sarantopoulos, S Stavridis, Z Doulgeri, 2019 Guaranteed active constraints enforcement on point cloud-approximated regions for surgical applications 2019 *International Conference on Robotics and Automation (ICRA)*, 8346-8352
- [83] Stavridis S, Z Doulgeri 2018 Bimanual assembly of two parts with relative motion generation and task related optimization 2018 *IEEE/RSJ International Conference on Intelligent Robots and Systems ...*
- [84] Stavridis S, P Falco, Z Doulgeri 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)*

- [85] Papageorgiou D, S Stavridis, C Papakonstantinou, Z Doulgeri 2021 Task geometry aware assistance for kinesthetic teaching of redundant robots IEEE/RSJ International Conference on Intelligent Robots and Systems ...
- [86] Kastritsi T, I Sarantopoulos, S Stavridis, D Papageorgiou, Z Doulgeri Manipulation of a Whole Surgical Tool Within Safe Regions Utilizing Barrier Artificial Potentials Mediterranean Conference on Medical and Biological Engineering and Computing ...
- [87] Stavridis S, D Papageorgiou, L Droukas, Z Doulgeri 2022 Bimanual crop manipulation for human-inspired robotic harvesting arXiv preprint arXiv:2209.06074
- [88] Ntaountaki P, et al 2019 Robotics in Autism Intervention. *Int. J. Recent Contributions Eng. Sci. IT* 7 (4), 4-17
- [89] 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
- [90] Chaidi I, Drigas A 2022 Digital games & special education *Technium Social Sciences Journal* 34, 214-236
- [91] Drigas, A. S., and Pappas M.A. 2015 "On line and other Game-Based Learning for Mathematics." *International Journal of Online Engineering (iJOE)* (11)4, 62-67, <https://doi.org/10.3991/ijoe.v11i4.4742>
- [92] Drigas, A. S., & Kokkalia, G. K. (2014). ICTs in Kindergarten. *International Journal of Emerging Technologies in Learning*, 9(2). <https://doi.org/10.3991/ijet.v9i2.3278>
- [93] Doulou A, Drigas A 2022 Electronic, VR & Augmented Reality Games for Intervention in ADHD *Technium Social Sciences Journal*, 28, 159.
- [94] 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.
- [95] Kefalis C, Kontostavlou EZ, Drigas A, 2020 The Effects of Video Games in Memory and Attention. *Int. J. Eng. Pedagog.* 10 (1), 51-61
- [96] Drigas, A., & Mitsea, E. (2020). The 8 Pillars of Metacognition. *International Journal of Emerging Technologies in Learning (iJET)*, 15(21), 162-178. <https://doi.org/10.3991/ijet.v15i21.14907>
- [97] Drigas, A. S., and M. Pappas, 2017. "The Consciousness-Intelligence-Knowledge Pyramid: An 8x8 Layer Model," *International Journal of Recent Contributions from Engineering, Science & IT (iJES)*, vol. 5, no.3, pp 14-25, <https://doi.org/10.3991/ijes.v5i3.7680>
- [98] Drigas A, Karyotaki M (2017) Attentional control and other executive functions. *Int J Emerg Technol Learn iJET* 12(03):219–233
- [99] Drigas A, Karyotaki M 2014. Learning Tools and Application for Cognitive Improvement. *International Journal of Engineering Pedagogy*, 4(3): 71-77. From (Retrieved on 13 May 2016)
- [100] 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). <https://doi.org/10.3991/ijoe.v17i08.23563>
- [101] Drigas A., Papoutsi C. (2020). The Need for Emotional Intelligence Training Education in Critical and Stressful Situations: The Case of COVID-19. *Int. J. Recent Contrib. Eng. Sci. IT* 8(3), 20–35. [10.3991/ijes.v8i3.17235](https://doi.org/10.3991/ijes.v8i3.17235)
- [102] Drigas, A., & Mitsea, E. (2020). The Triangle of Spiritual Intelligence, Metacognition and Consciousness. *International Journal of Recent Contributions from Engineering, Science & IT (iJES)*, 8(1), 4-23. <https://doi.org/10.3991/ijes.v8i1.12503>
- [103] Kokkalia, G., Drigas, A. Economou, A., & Roussos, P. (2019). School readiness from kindergarten to primary school. *International Journal of Emerging Technologies in Learning*, 14(11), 4-18.
- [104] Drigas, A., & Mitsea, E. (2021). Metacognition, stress-relaxation balance & related hormones. *International Journal of Recent Contributions from Engineering, Science & IT (iJES)*, 9(1), 4–16. <https://doi.org/10.3991/ijes.v9i1.19623>

- [105] Pappas M, Drigas A. 2019; Computerized Training for Neuroplasticity and Cognitive Improvement. *International Journal of Engineering Pedagogy*.9(4):50-62
- [106] Papoutsis, C. and Drigas, A. (2017) Empathy and Mobile Applications. *International Journal of Interactive Mobile Technologies* 11(3). 57. <https://doi.org/10.3991/ijim.v11i3.6385>
- [107] Papoutsis, C. & Drigas, A. (2016). Games for Empathy for Social Impact. *International Journal of Engineering Pedagogy* 6(4), 36-40.
- [108] Karyotaki, M., & Drigas, A. (2015). Online and other ICT Applications for Cognitive Training and Assessment. *International Journal of Online and Biomedical Engineering*. 11(2), 36-42.
- [109] Papoutsis, C., Drigas, A., & Skianis, C. (2019). Emotional intelligence as an important asset for HR in organizations: Attitudes and working variables. *International Journal of Advanced Corporate Learning*, 12(2), 21–35. <https://doi.org/10.3991/ijac.v12i2.9620>
- [110] Chaidi I. Drigas, A. S., 2020. “Autism, Expression, and Understanding of Emotions: Literature Review,” *Int. J. Online Biomed. Eng.*, vol. 16, no. 02, pp. 94–111, <https://doi.org/10.3991/ijoe.v16i02.11991>
- [111] Drigas, A. S., & Karyotaki, M. (2019). A Layered Model of Human Consciousness. *International Journal of Recent Contributions from Engineering, Science & IT (iJES)*, 7(3), 41- 50. <https://doi.org/10.3991/ijes.v7i3.11117>
- [112] Drigas, A. S., 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.
- [113] Karyotaki M. and Drigas, A. S., 2016. “Latest trends in problem solving assessment,” *International Journal of Recent contributions from Engineering, Science & IT (iJES)*, vol. 4, no. 2, 4-10.
- [114] Mitsea E., Drigas, A. S., and Mantas P., 2021. Soft Skills & Metacognition as Inclusion Amplifiers in the 21st Century,” *Int. J. Online Biomed. Eng. IJOE*, vol. 17, no. 04, Art. no. 04, <https://doi.org/10.3991/ijoe.v17i04.20567>
- [115] Angelopoulou, E. Drigas, A. (2021). Working Memory, Attention and their Relationship: A theoretical Overview. *Research. Society and Development*, 10(5), 1-8. <https://doi.org/10.33448/rsd-v10i5.15288>
- [116] 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 (iJET)*. 13(7)
- [117] Drigas A, Mitsea E 2020 A metacognition based 8 pillars mindfulness model and training strategies. *International Journal of Recent Contributions from Engineering, Science & IT* 8(4), 4-17.
- [118] Papoutsis C, Drigas A, C Skianis 2021 Virtual and augmented reality for developing emotional intelligence skills *Int. J. Recent Contrib. Eng. Sci. IT (IJES)* 9 (3), 35-53
- [119] 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
- [120] 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.
- [121] V Galitskaya, A Drigas 2021 The importance of working memory in children with Dyscalculia and Ageometria *Scientific Electronic Archives* 14 (10)
- [122] 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.
- [123] 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
- [124] 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

- [125] Drigas A, Mitsea E, C Skianis 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)
- [126] Drigas A, Karyotaki M 2019 Attention and its Role: Theories and Models. *International Journal of Emerging Technologies in Learning* 14 (12), 169-182
- [127] Drigas A, Karyotaki M 2019 Executive Functioning and Problem Solving: A Bidirectional Relation. *International Journal of Engineering Pedagogy (iJEP)* 9 (3)
- [128] Bamicha V, Drigas A 2022 ToM & 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
- [129] Drigas A, Mitsea E, C Skianis 2022 Neuro-Linguistic Programming, Positive Psychology & VR in Special Education. *Scientific Electronic Archives* 15 (1)
- [130] Drigas A, Mitsea E, Skianis C. 2022 Virtual Reality and Metacognition Training Techniques for Learning Disabilities *SUSTAINABILITY* 14(16), 10170
- [131] Drigas A., Sideraki A. 2021 Emotional Intelligence in Autism *Technium Soc. Sci. J.* 26, 80
- [132] 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
- [133] Bakola L, Drigas A, 2020 Technological development process of emotional Intelligence as a therapeutic recovery implement in children with ADHD and ASD comorbidity. . *International Journal of Online & Biomedical Engineering*, 16(3), 75-85
- [134] 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
- [135] Karyotaki M, Bakola L, Drigas A, Skianis C, 2022 Women's Leadership via Digital Technology and Entrepreneurship in business and society *Technium Social Sciences Journal*. 28(1), 246-252.
- [136] Drigas A, Bakola L, 2021The 8x8 Layer Model Consciousness-Intelligence-Knowledge Pyramid, and the Platonic Perspectives *International Journal of Recent Contributions from Engineering, Science & IT (iJES)* 9(2) 57-72
- [137] 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)
- [138] Mitsea E, Drigas A., Skianis C, 2022 Breathing, Attention & Consciousness in Sync: The role of Breathing Training, Metacognition & Virtual Reality *Technium Social Sciences Journal* 29, 79-97
- [139] 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
- [140] 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