TECHNIUM
SOCIAL SCIENCES JOURNAL

Vol. 31, 2022

A new decade for social changes

www.techniumscience.com

ISSN 2668-7798

Technium Social Sciences Journal
Vol. 31, 228-240, May, 2022
ISSN: 2668-7798
www.techniumscience.com

Ict's and Dysgraphia

Eugenia Gkeka, Athanasios Drigas

Net Media Lab Mind - Brain R&D IIT - N.C.S.R. "Demokritos" , Athens, Greece

eugkeka@yahoo.gr, dr@iit.demokritos.gr

Abstract. The aim of this review is the recognition of characteristics of “Dysgraphia” or “Dysorthography”, as specific learning disorder in written. Concretely, the diagnostic technological tools enable to recognize the particular characteristics of this disorder. As well as, the offer of the intervention technological tools is been evident with the effectiveness of the different applications. Indeed, the activities and the exercises of these tools on educational and game environment using augmented reality assist the children’s and the adults’ handwriting with Dysgraphia and enhance the writing skills.

Keywords. diagnostic, dysorthography, handwriting, intervention

1 Introduction

According to this article[1] “Dysgraphia” is a disorder of writing ability that comes from the Greek "dys" meaning "impaired" and "graphia" meaning "making letter forms by hand". Dysgraphia has also different names such as: dysorthography, linguistic dysgraphia or graphomotor loop. According to DSM-5 dysgraphia does not exist as a separate category but falls under the category of specific learning disorder. Autism spectrum disorder, attention deficit-hyperactivity disorder, developmental coordination disorder, and cerebral palsy are some of them. But what are the causes and etiologies that lead to this difficulty? Research models and neurobiological-genetic studies demonstrate that injury to the cerebellum of the brain could lead to dysgraphia or specific genes including chromosome 6 linked to phonemic awareness or chromosome 15 linked to poor reading and spelling. On the other hand diagnosis can be made by professionals with an educational evaluation. Some of criteria for a diagnosis of dysgraphia, are illegible handwriting, decreased writing speed, discrepancy between verbal IQ and spelling achievement and processing deficits in orthographic awareness, graphomotor planning, and/or rapid automatic naming, evaluations of posture, pencil grip, tremor, and observed writing habits.

Chung et al., define dysgraphia as a disorder with specific characteristics. Some of them are: letter formation or legibility, letter spacing, spelling, fine motor coordination, rate of writing, grammar, and composition and in general difficulty in written communication skills. Dysgraphia has been categorized as “motor”, “peripheral” or “spatial Dysgraphia”.DSM-5 includes dysgraphia under a specific learning disorder category. Writing is a task that requires the coordination of more than one cognitive processes such us working memory, motor planning, spelling, attention, visual and auditory process. The study suggests an intervention

model that consists of 3 levels. The first level is a preventing screening for difficulties. The second consists of targeted intervention and the third consist of intensive treatment. In general, the study suggest motor activities for increasing hand coordination and strength include tracing, drawing in mazes, playing with clay as well as exercises like finger tapping and rubbing/shaking the hands, teaching grip control and good writing posture. Although there are several ICTs for intervention such as Zaner-Bloser Apps writing games, Handwriting without Tears,Big Strokes for Little Folks, Sensible Pencil, Loops and Other Groups a kinesthetic approach to teach writing[2].

Brown focuses on characteristics of dysgraphia. More specifically, dysgraphia has an alternative diagnostic pattern from other disabilities. It is a disorder concerning handwriting, concretely, a 'disorder of written expressions'. More specifically, this disorder involves difficulties such us motor coordination, problems with letter order, flow and formation patterns. Symptoms can include also poor spatial planning, inconsistency in letter and word spacing, unusual body position while writing, awkward pencil grip, difficulty articulating thoughts onto paper and a significant difference between spoken and written comprehension. In addition, there are seven stages of writing, the research finds out that children with dysgraphia could get stranded in any of these stages, because their brain does not process writing like a typical student's brain would. There are three types of dysgraphia: Dyslexia Dysgraphia, Motor Dysgraphia, Spatial Dysgraphia. Moreover, dysgraphia cause unfavorable outcomes in the self-esteem and increase feelings of failure [3].

Vlachos & Avramidis define and confirm the neurobiological distinction between “Dyslexia” and “Dysgraphia”. Between these two difficulties there are similarities in the brain specifically in neural network involved in handwriting and reading. A part of this graphomotor network is brought into play during the identification of letters through visual reading. Although, there are differences as individuals with Dysgraphia have dysfunctions in extensive supraspinal networks, involving cortical areas of the brain dysfunction may be also restricted to either the cerebellum or specific cortical sites [4].

This article [5] investigates how much Dysgraphia increased over the last few years. Statistics and research present elements show a high level of Dysgraphia in children in the last few years. Some of the reasons are a deficient level of development of brain mechanisms that naturally affect cognitive processes, individual peculiar ways of processing information and psychophysiological mechanisms. The most popular kind of dysgraphia is mixed- Dysgraphia meaning to the lack of development of phonetic-phonemic, lexical and grammatical components of oral speech, cognitive functions.

2 Diagnostic technological tools

This study [6] focuses on discrimination characteristics of dysgraphia due to a new tool “Support Vector Machine”. More specifically, the article detects characteristics in dysgraphia similar to Developmental Coordination Disorder. The diagnostic tool divides the patients into three categories, light, moderate, and severe. The division is based on the characteristics such as holding a pencil in wrong ways, the size of letter, the letter writing form, how slow is the writing process and how quickly children getting tired. Moreover the tool detects the form of time, pressure, the distance between letters, ideal or not the size of a letter, the position of letters (up or down), consistency of the boundary line, and text form. The tool compared with other similar tools in order to show the construction of the tool. After that the researchers show how they collect the data throughout the application.

Technium Social Sciences Journal
Vol. 31, 228-240, May, 2022
ISSN: 2668-7798
www.techniumscience.com

Dimauro et al., consider which dysgraphia may be related to dyspraxia, characterized by a difficulty to reproduce alphabetical, numerical signs. The article focuses on "TestGraphia", a software system that can support doctors in making diagnoses. The software analyses specific characteristics in writing that show difficulties in writing process. The size of some letters is above the norm, in others, letters are so close to each other that is difficult to figure out the meaning. Pictures also present texts with insufficient spaces between the words, texts with collisions between two letters, texts with sharp angles, texts with irregular size of letters, texts with broken links between words, and texts with sharp angles in letters, texts with traced letters or letters with innocent heights. The main purpose of TestGraphia is to automatically evaluate certain features and easily set the remaining features to simplify the diagnosis. Doctors must check only a few features that need to be interpreted. At the conclusion of the evaluation procedure, the final report describes anomalies, features score and total score and lead to a specific diagnosis [7].

Asselbom et al., are interested in the diagnosis of dysgraphia by a new tablet program. As long as handwriting is a complex task which involves attention, perceptual, linguistic, and fine motor skills is difficult to achieve. Handwriting is the basis of core educational activities, such as taking notes, composition, and self-expression. So it is very important to detect and remediate any handwriting difficulties as early as possible. The design of the diagnostic tool relies on previous work and clinical relevance in pediatrics. The data which have been collected came from children who have been clinically diagnosed with Dysgraphia. To validate the test researchers measured more than one time the participants in order to predict correctly characteristics of Dysgraphia. . The tablet tool includes 53 criteria of a child's handwriting to make a specific writing profile. This specific tool explores the handwriting pathology in order to analyze the handwriting characteristics and bring a special treatment more closely [8].

Rosenblum & Dror describe a diagnostic tool for Dysgraphia. Two groups consisting of 99 third graders aged eight and nine years old, 50 proficient handwriters, and 49 non-proficient, all came from Israel. The aim of study was to develop and test a statistical model for discriminating between dysgraphic and prescient handwriting based on writing characteristics. They used a ten-item questionnaire and a computerized evaluation tool. They observe whether the pen is "writing" or just "moving" above the paper by using the value of the pressure as long as all the participants wrote the same text. Four tasks also were used to extract feature and different information of hand-writters. This tool enables not just identification of Dysgraphia but also indicates the individual's features for an effective intervention [9].

Raza et al., propose a new testing mobile tool to detect characteristics of dysgraphia in early childhood. As long as Smartphones and tablets have become an enormous part of our daily routine there is a need to use them for actual problems. The article, furthermore, provides an overview of software tools and mobile applications to help children with Dysgraphia such us series of games, digital notepad device called JollyMate, mobile application, computers and a Fuzzy Expert System. On the other hand the article describes the mobile application which they promote. It is intended for kids specifically of ages 5 to 12. It has animations for fun. The user uses a stylus to write spelling of words on the screen, a handwriting-recognition software technology analyzes the user's handwriting and recognize the spelling. There is a test with twenty words and after that there is a score which detect the type: phonological or surface Dysgraphia. Technologies such as HTML 5. CSS3, Javascript, Cordova and MyScript were used in the development of the application [10].

Technium Social Sciences Journal
Vol. 31, 228-240, May, 2022
ISSN: 2668-7798
www.techniumscience.com

3 Intervention technological tools

A. Children's handwriting

Harris focuses on children with autism who have also Dysgraphia and propose a Video self-modeling (VSM) intervention. Along with other positive effects VSM improves academic performance. Participants are between five to nine years old with the same diagnoses. The ability to write is often problematic for children with ASD because handwriting requires simultaneous processing of motor and cognitive demands. VSM improves learning through observation by teaching the observer with a video recording. The study describes the intervention where participants asked to write his or her name, as well as the word cat and the word apple. The intervention phase lasted 5 days for each participant. The results prove that VSM is an effective teaching tool for children with Dysgraphia [11].

Giordano & Maiorana present an intervention for Dysgraphia. The article analyzes the design of a mobile web-based serious game for improving children's handwriting. The specific game mentiones as "runner game" is recommended because the players have to design the letters with digital tools. This is very important according to the article because handwritting activates the left fusiform gyrus, the inferior frontal gyrus and the posterior parietal cortex of their brain since children have to plan and execute the action. The game's design based on Montessori methods and on the Visual, Aural, Read/write, Kinesthetic (VARK) theory. The game addressed to children between 4 and 12 years old. The game was tested by three children and the results shown that the game activates the willingness of writing [12].

Rahim & Jamaludin describe a Dysgraphic application which support children with Dysgraphia. This technological tool contains activities and exercises which provide an interactive experience for writing skills. Write-Ride can help children enhance their self esteem and create motivation Firstly the application can help teachers produce exercises for individual needs. More specifically the tool keeps scores and stores writing data, has level difficulties and personalized activities. The participants are five children aged 7 to 12 with Dysgraphia. The intervention, which took place in schools with tablets, was an alphabetic exercise that focuses on letter formation, direction, size of the letter, spacing and punctuality between the lines. The researchers observe the children before and after intervention to see eventually that the effectiveness of this application program was up to 80% [13].

This study [14] focuses on web game environment. This game is able to diagnose and provide treatment to learning disabilities. Dyslexia, Dyscalculia and leter-numeric Dysgraphia supposed to be detected and treated. To detect symptoms and produce intervention, researchers adapt strategies based on multisensory approach, e-apps, levels, graphical cards, action via playing, training through pictures and satisfactory screen for children. The application was tested on pre-diagnosed children with those disabilities. The game was presented through tablets. According to the results both detection and intervention were precisely right for these three learning disabilities.

Abid et al. display a mobile-android application called Peppy using augmented reality to assist children with Dysgraphia. This tool is useful for children as it combines paper-based exercises and game. It makes an enjoyable educational environment and the aim is to improve hand dexterity, motor skills challenge, concentration, cognitive strength and attention. The participants were 60 children from different schools aged 3 to 5. The game based on 4 aspects including visual guidelines, complete the task, how neatly are the lines and the coloring done and how well does the student understand the task. The design also incorporates video, audio, touch and 3D presentation to make the application easier and more interactive. The results show

Technium Social Sciences Journal
Vol. 31, 228-240, May, 2022
ISSN: 2668-7798
www.techniumscience.com

that, users felt that the application was effective and highly pleasing as the children were interested in using the application both at home and school [15].

John and Renumol analyze how Dexteria, digital software for computer and tablets can provide a scaffolding education to Dysgraphic children. This software based on touch paper-pen and pencil activities. The participants were nine elementary school students in an age group of 5 to 10 and they had writing difficulties (Dysgraphia). They were given 3 tasks such us Alphabet recognition from white board, written by their teacher, copy the alphabets (from 'A' to 'Z) written in the first line of each page of the given tablet-notebook. Retrieve the letters from memory. According to pretests and protests the application helps in handwriting legibility, speed and motor skills [16].

Obatta et al., prove that Dysgraphia is a neurological disorder and concludes inability to express oneself in writing which scaffolding strategy seeks to solve. The study focuses on adolescences and students in academic level, who have Dysgraphia. The experiment took place in Nsukka Education Zone. A structured instrument titled: "Creative Writing Test (CWT)" developed by the researcher and used for data collection. In addition, 59 secondary schools participate. The results show that the use of scaffolding strategy helps adolescents improve creative writing abilities and become self-regulating learners and problem solvers. That leads to the suggestion that Special Education teachers and curriculum planners should plan a program of intervention based on scaffolding strategy for in-school adolescents [17].

B. Adults' handwriting

Clark et al., explore the aspects of illiteracy in Unites States. As the causes and effects of illiteracy are analyzed, it is observed that Dysgraphia is a common phenomenon in adults. "When present in children, Dysgraphia is classified as a learning disability. When it occurs as an acquired condition in adults, it is typically the result of damage to the brain (as from stroke or trauma)." The article suggests a numerous of solutions to fill in the gap between adults and illiteracy. One of them is the use of technological tools and ICTS in their work. Technological tools seem to be innovative by providing text-to speech, speech-to-text, organizational apps and vocabulary development. These achievements lead to improvement decoding, comprehension, and writing skills so adults can use them in their workplace when they need them the most[18].

Khan et al., consider which is it is necessary to discover innovative solutions. The article suggests Augmented reality. It is similar to virtual reality but this one integrates virtual object or virtual view in real object or real environment. The system called AR-DAWE and provides real-time spelling assistance based on user voice input. The system requires internet connection and then can convert easily speech into text. It is an alternative and ideal teaching, especially for students with Dysgraphia who usually get bore early and consider writing as a hard and uninteresting work. Except from augmented reality article suggest some other alternatives such us cloud computing, word processors and oral answer facility, remediation strategy with muscle training, daily practice of alphabets, voice-recorded notes, speech-totext, simultaneous recording & typing handwritten notes, Pencil grip, Slant board, Raised Paper and highlighted paper. Therapeutic hand exercises are also a good alternative solution. Moreover, ICTS which include word processing, word predictions, spell check and speech recognition could help also students with Dysgraphia [19].

O'Halloran aims to determine the effectiveness of an app to treat Dysgraphia. Five participants took part in the experiment. Interviews and observations took place and the app based on an algorithm. The app, according to results, reduces written errors and enhances

Technium Social Sciences Journal
Vol. 31, 228-240, May, 2022
ISSN: 2668-7798
www.techniumscience.com

memory. Training was given on the use of the iPad. The algorithm applies a step by step program and follows a path similar to a therapist's intervations. 52 words used in the test, the test has also homophone spelling, non-word spelling and a large assessment with words matched in pairs. Furthermore, it combined comprehension of spoken words and written words, repetition of words and naming objects and spoken picture descriptions. The positives effects of this app are: visual scanning, neglect, recognition of mistakes, sense of independence, self-esteem, feeling of liberation, and gaining free time for other activities [20].

Mullally describes the several types of Dysgraphia such us Deep Dysgraphia, Surface Dysgraphia, Phonological Dysgraphia and Peripheral Dysgraphia. But the question remains how we deal with this disorder? There is limited research into intervention approaches for writing disorders although computers, especially tablets and iPads in a therapy sessions appears to be advantageous to both clients and therapists and that is why they provide rapid feedback with screen options. Five adults participants and five iPads took part in the experiment. There were used also some tests such us CAT (Comprehensive Aphasia test) and CLGT (Cognitive Linguistic Quick Test), words based on pictures and words that verbalized by researchers. The therapy last for 5 weeks. They select interviews for each participant and the results analyzed through SPSS. The results showed that the app is an intervention tool for Dysgraphia [21].

Ahmed et al., present a writing aid in computer for intervention in Dysgraphia. The specific aid uses patterns according to a hand movement instrument which will stimulate the forearm muscles to carry out all types of finger movements and present them on computer. The most promising thing in BCI is that the individual does not have to actually perform the movement instead he has to imagine it. The article describes extensionally the function and the device's mechanism and how it could help people with Dysgraphia express themselves through this new technological tool [22].

4 Conclusions

Concluding this article we should underline in information age era, the role of ICTs in general and special education and in other related domains [33-49, 77-92]. The mobiles play an important role [23-32] in making more accessible the educational procedures. The serious games make the educational applications more attractive to students and pupils [72-76]. The artificial intelligence is a powerful tool in procedures for diagnosis and adaptable interventions and moreover in design of educational applications [66-71]. Finally there are several applications that support educational procedures based on metacognition, mindfulness, meditation and emotional intelligence cultivation strategies [50-65, 93-108].

All the above mentioned applications of information age era, facilitate and accelerate both the assessment and diagnosis as well as the intervention and rehabilitation procedures within education. People with dysgraphia take a big advantage of all these applications and procedures as already has been presented in this article and this is a very promising situation for the rehabilitation of their special needs on dysgraphia.

5 References

[1] Chung, P., & Patel, D. R. (2015). Dysgraphia. International Journal of Child and Adolescent Health, 8(1), 27.
[2] Chung, P. J., Patel, D. R., & Nizami, I. (2019). Disorder of written expression and dysgraphia: definition, diagnosis, and management.
[3] Brown, M. (2019). Dysgraphia

[4] Vlachos, F., & Avramidis, E. (2020). The Difference between Developmental Dyslexia and Dysgraphia: Recent Neurobiological Evidence.
[5] Yakovleva, N. (2019). An integrated approach to the study of written communication in students with dysgraphia. In SHS Web of Conferences (Vol. 70, p. 10015). EDP Sciences
[6]Sihwi, S. W., Fikri, K., & Aziz, A. (2019, May). Dysgraphia Identification from Handwriting with Support Vector Machine Method. In Journal of Physics: Conference Series (Vol. 1201, No. 1, p. 012050). IOP Publishing.
[7] Dimauro, G., Bevilacqua, V., Colizzi, L., & Di Pierro, D. (2020). TestGraphia, a Software System for the Early Diagnosis of Dysgraphia. IEEE Access, 8, 19564-19575.
[8] Asselborn, T., Gargot, T., Kidziński, Ł., Johal, W., Cohen, D., Jolly, C., & Dillenbourg, P. (2018). Automated human-level diagnosis of dysgraphia using a consumer tablet. NPJ digital medicine, 1(1), 1-9.
[9] Rosenblum, S., & Dror, G. (2016). Identifying developmental dysgraphia characteristics utilizing handwriting classification methods. IEEE Transactions on Human-Machine Systems, 47(2), 293-298.
[10] Raza, T. F., Arif, H., Darvagheh, S. H., & Hajjdiab, H. (2017, February). Interactive mobile application for testing children with dysgraphia. In Proceedings of the 9th International Conference on Machine Learning and Computing (pp. 432-436).
[11]Harris, G. M. (2017). Evaluating the Efficacy of Video Self-Modeling for Remediating Dysgraphia in Children with Autism Spectrum Disorders
[12]Giordano, D., & Maiorana, F. (2015, May). A Mobile Web Game Approach for Improving Dysgraphia. In CSEDU (1) (pp. 328-333).
[13]Rahim, N., & Jamaludin, Z. (2019). Write-Rite: enhancing handwriting proficiency of children with dysgraphia. Journal of Information and Communication Technology, 18(3), 253-271.
[14]Kariyawasam, R., Nadeeshani, M., Hamid, T., Subasinghe, I., & Ratnayake, P. (2019, December). A Gamified Approach for Screening and Intervention of Dyslexia, Dysgraphia and Dyscalculia. In 2019 International Conference on Advancements in Computing (ICAC) (pp. 156-161). IEEE
[15]Abid, M., Bhimra, M. A., Mubeen, M., Zahid, A. B., & Shahid, S. (2019, June). Peppy: A Paper-Based Augmented Reality Application to Help Children Against Dysgraphia. In Proceedings of the 18th ACM International Conference on Interaction Design and Children (pp. 544-549
[16] John, S., & Renumol, V. G. (2018, October). Impact of fine motor skill development app on handwriting performance in children with dysgraphia: A pilot study. In Proceedings of the 2nd International Conference on Digital Technology in Education (pp. 11-16).
[17] Obatta, M. I., Adama, G. C., & Onu, V. C. EFFECT OF SCAFFOLDING STRATEGY ON CREATIVE WRITING ABILITY OF IN-SCHOOL ADOLESCENTS WITH DYSGRAPHIA
[18] Clark, A., & Haderlie, C. Illiteracy Among US Adults
[19] Khan, M. F., Hussain, M. A., Ahsan, K., Saeed, M., Nadeem, A., Ali, S. A., ... & Rizwan, K. (2017). Augmented Reality Based Spelling Assistance to Dysgraphia Students. Journal of Basic and Applied Sciences, 13, 500-507.
[20]O'Halloran, C. (2013). Using a tablet computer application to treat acquired dysgraphia and boost word output.
[21]Mullally, C. (2013). Dysgraphia therapy using iPad App with adults who have aphasia

[22] Ahmed, W., Hasan, S. U., Shoaib, S., Houlden, N., & Nestiurkina, M. (2020, January). A Writing Aid for Dysgraphia Affected People. In 2020 IEEE Conference of Russian Young Researchers in Electrical and Electronic Engineering (EIConRus) (pp. 2456-2459). IEEE.
[23] E. G. Gkeka, E. K. Agorastou, and A. S. Drigas, "Mobile multimedia education for language disorders," Int. J. Emerg. Technol. Learn., vol. 15, no. 6, pp. 50–59, 2020, https://doi.org/10.3991/ijet.v15i06.11175
[24] POLITI-GEORGOUSI S., & DRIGAS A. Mobile Applications, an Emerging Powerful Tool for Dyslexia Screening and Intervention: A Systematic Literature Review. International Journal of Interactive Mobile Technologies, 2020, 14(18): 4–17. https://doi.org/10.3991/ijim.v14i18.15315.
[25] Drigas, A., Dede, D.E., & 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), pp.18-23. http://doi.org/10.5281/zenodo.3987533
[26] C. Papoutsi, A. Drigas, and C. Skianis, "Virtual and augmented reality for developing emotional intelligence skills," Int. J. Recent Contrib. Eng. Sci. IT (IJES), vol. 9, no. 3, pp. 35–53, 2021. https://doi.org/10.3991/ijes.v9i3.23939
[27] J. Vlachou and A. Drigas, "Mobile technology for students and adults with Autistic Spectrum Disorders (ASD)," International Journal of Interactive Mobile Technologies, vol. 11(1), pp. 4-17, 2017
[28] Karabatzaki, Z., Stathopoulou, A., Kokkalia, G., Dimitriou, E., Loukeri, P. I., Economou, A., & Drigas, A. (2018). Mobile Application Tools for Students in Secondary Education. An Evaluation Study. International Journal of Interactive Mobile Technologies (iJIM), 12(2), 142-161
[29] A. Drigas, G. Kokkalia, and A. Economou, "Mobile Learning For Preschool Education," Int. J. Interact. Mob. Technol., vol. 10, no. 4, p. 57, Oct. 2016. https://doi.org/10.3991/ijim.v10i4.6021
[39] A. Drigas and P. Angelidakis, 'Mobile Applications within Education: An Overview of Application Paradigms in Specific Categories', International Journal of Interactive Mobile Technologies (iJIM), vol. 11, no. 4, p. 17, May 2017. https://doi.org/10.3991/ijim.v11i4. 6589
[31] A. Stathopoulou, D. Loukeris, Z. Karabatzaki, E. Politi, Y. Salapata, and A. Drigas, "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, 2020
[32] C. Papoutsi, A. S. Drigas, and C. Skianis, "Mobile Applications to Improve Emotional Intelligence in Autism – A Review," Int. J. Interact. Mob. Technol. (iJIM); Vol 12, No 6, 2018
[33] 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.
[34] Drigas, A., Koukianakis, L. G., & Papagerasimou, Y. V. (2005). A system for e-inclusion for individuals with sight disabilities, Mathematical methods and computational techniques in electrical engineering, 146-150
[35] Drigas, A. and Lefteris Koukianakis, ‚Convergence of Culture and ICTs: E-Culture,' Springer-Verlag Berlin Heidelberg (2010): 488-496.
[36] Pappas, M.A., & Drigas, A. (2015). ICT based screening tools and etiology of dyscalculia. International Journal of Engineering Pedagogy, 3, 61-66.
[37] Theodorou, P. and Drigas, A. (2017). ICTs and Music in Generic Learning Disabilities. International Journal of Emerging Technologies in Learning (Vol. 12, No. 4), 101-110. https://doi.org/10.3991/ijet.v12i04.6588

[38] Drigas, A. and J. A. Vlachou, "Information and communication technologies (ICTs) and autistic spectrum disorders (ASD)," Int. J. Recent Contrib. Eng. Sci. IT (iJES), vol. 4, no. 1, p. 4, 2016. https://doi.org/10.3991/ijes.v4i1.5352
[39] Drigas, A. and Kostas S. Ioannis, "Online and other ICTs Applications for Teaching Math in Special Education", International Journal of Recent Contributions from Engineering, Science & IT, Vol 2, No. 4,2014.
[40] Vrettaros J, Tagoulis A, Giannopoulou N, Drigas A (2012) Case study in using Web 2.0 tools by Greek educators. Int J Soc Humanist Comput 1(4):363–374
[41] 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. https://doi.org/10.3991/ijet.v15i14.12509.
[42] Drigas,A., & Dourou,A.: A review on ICT based applications for intervention and assistance of people with memory deficits. I-JET 8, pp. 1-3(2013). http://dx.doi.org/10.3991/ijet.v8i5.3009
[43] Drigas, A. S., Kokkalia, G. K., Economou, A., & Roussos, P. (2017). Intervention and diagnostic tools in preschool education. International Journal of Emerging Technologies in Learning, 12(11).
[44] Drigas, A., & Gkeka, E., G. (2017). ICTs and Montessori for learning disabilities. International Journal of Recent Contributons from Engineering, Science, & IT, 5(3), 77-84
[45] A. Kamakari and A. Drigas, Advanced E-Learning Services for Teachers, International Journal of Knowledge Society Research, 3(4), 2012, pp. 85–96.
[46] Bravou, V., & Drigas, A. (2019). A contemporary view on online and web tools for students with sensory & learning disabilities. International Journal of Online and Biomedical Engineering, 15(12), 97–105. https://doi.org/10.3991/ijoe.v15i12.10833
[47] 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.
[48] A.S.Drigas, J.Vrettaros, L.Stavrou, D.Kouremenos, 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 2004.
[49] Drigas, A.S., Vrettaros, J. and Kouremenos, D. (2004a) '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.
[50] Drigas, A. and M. Karyotaki, "A Layered Model of Human Consciousness," International Journal of Recent Contributions from Engineering, Science & IT (IJES), vol. 7, no. 3, pp. 41-50, September 2019. Available: https://doi.org/10.3991/ijes.v7i3.11117. [Accessed: January 28, 2020]
[51] 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
[52 Pappas M, Drigas A. 2019 Computerized Training for Neuroplasticity and Cognitive Improvement. International Journal of Engineering Pedagogy. (4):50-62
[53] Drigas, A., & Papoutsi, C. (2019). Emotional intelligence as an important asset for HR in organizations: Leaders and employees. International Journal of Advanced Corporate Learning, 12(1). https://doi.org/10.3991/ijac.v12i1.9637

[54] 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)
[55] A. Drigas and M. Pappas, "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, 2017. https://doi.org/10.3991/ijes.v5i3.7680
[56] Drigas A, Karyotaki M (2017) Attentional control and other executive functions. Int J Emerg Technol Learn iJET 12(03):219–233
[57] Mitsea, E., & Drigas, A. (2019). A journey into the metacognitive learning strategies. International Journal of Online & Biomedical Engineering, 15(14). https://doi.org/ 10.3991/ijoe.v15i14.11379
[58] 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
[59] Pappas, M. A., Polychroni, F., & Drigas, A. S. (2019). Assessment of mathematics difficulties for second and third graders: Cognitive and psychological parameters. Behavioral Sciences, 9(7), 76. https://doi. org/10.3390/bs9070076.
[60] Karyotaki M and Drigas A 2016 Latest trends in problem solving assessment International Journal of Recent Contributions from Engineering, Science & IT (iJES) 4 (2) p 1
[61] PAPPAS, M. A., DRIGAS, A. S., & POLYCHRONI, F. (2018). An Eight-Layer Model for Mathematical Cognition. International Journal of Emerging Technologies in Learning (iJET), 13(10), 69-82. https://doi.org/10.3991/ijet.v13i10.8633
[62] DRIGAS, A., & KARYOTAKI, M. (2019). Attention and its Role: Theories and Models. International Journal of Emerging Technologies in Learning (iJET), 14(12), 169-182. https://doi.org/10.3991/ijet.v14i12.10185
[63] 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(07), 228–242. https://doi.org/10.3991/ijet.v13i07.7909
[64] A. DRIGAS, M. KARYOTAKI AND C. SKIANIS, "Success: A 9 Layered-based Model of Giftedness," International Journal of Recent Contributions from Engineering, Science & IT (iJES), vol. 5, no.4, pp. 4-18, 2017. https://doi.org/10.3991/ijes.v5i4.7725
[65] ANGELOPOULOU, E., & DRIGAS, A. (2021). Working memory, attention and their relationship: A theoretical overview. Research, Society and Development, 10(5), e46410515288. https://doi.org/10.33448/rsd-v10i5.15288
[66] 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
[67] Kefalis C and Drigas A. (2019) Web Based and Online Applications in STEM Education. International Journal of Engineering Pedagogy (iJEP) 9, 4 (2019), 76–85.https://doi.org/10.3991/ijep.v9i4.10691
[68] Drigas, A. S., Argyri, K., & Vrettaros, J. (2009). Decade review (1999–2009): Artificial intelligence techniques in student modeling. Paper presented at the World Summit on Knowledge Society
[69] Athanasios S. Drigas, Rodi-Eleni Ioannidou, 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, 2013 http://dx.doi.org/10.1007/978-3-642-35879-1_46

[70] Drigas, A., Vrettaros, J.: An Intelligent Tool for Building e-Learning Contend-Material Using Natural Language in Digital Libraries. WSEAS Transactions on Information Science and Applications 5(1) (2004) 1197–1205
[71] 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.
[72] Kokkalia, G., Drigas, A., Economou, A., Roussos, P., & Choli, S. (2017). The use of serious games in preschool education. International Journal of Emerging Technologies in Learning, 12(11), 15-27. https://doi.org/10.3991/ijet.v12i11.6991
[73] Drigas, Athanasios S., and Marios A. Pappas. "On line and other Game-Based Learning for Mathematics." International Journal of Online Engineering (iJOE) 11.4, 62-67, 2015 https://doi.org/10.3991/ijoe.v11i4.4742
[74] Papanastasiou, G., Drigas, A., Skianis, C., & Lytras, M. D. (2017). Serious games in K-12 education: Benefits and impacts on students with attention, memory and developmental disabilities. Program, 51(4), 424-440. https://doi.org/10.1108/prog-02-2016-0020
[75] 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
[76] Papoutsi, C., & Drigas, A. S. (2016). Games for Empathy for Sensitive Social Groups. International Journal of Recent Contributions from Engineering, Science & IT (iJES), 4(3), 39–43. https://doi.org/10.3991/ijes.v4i3.5923
[77] Drigas, A., & Karyotaki, M. (2013). E Learning ICTs Application in Nutrition Science. International Journal of recent Contributions from Engineerinf, Science and IT, 1. DOI: 10.3991/ijes.v1i2.3279
[78] Drigas, A., L.G.Koukianakis, S.Domoxoudis, E-Government Structure for e-Protocol, eApplication Submission and Internal Organizational and Operational Support, WSEAS TELEINFO 2005 International Conference, Prague, Czech Republic, March 13-15, 2005
[79] Drigas, A., Electronic-Digital Culture (e-CULTURE): Information Society And Culture, Athens 2005
[80] 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
[81] Drigas, A.; Gkeka, E. (2016). Montessori method and ICTs. International Journal of Recent Contributions from Engineering, Science & IT (iJES), 4(1). http://journals.sfu.ca/onlinejour/index.php/i-jes/article/view/5481
[82] Alexopoulou, A., Batsou, A., & Drigas, A. (2020). Mobiles and Cognition: The Associations Between Mobile Technology and Cognitive Flexibility. International Journal of Interactive Mobile Technologies (iJIM), 14(03), pp. 146–156. https://doi.org/10.3991/ijim.v14i03.11233
[83] Doulou, A., & Drigas, A. (2022b). Electronic, VR & Augmented Reality Games for Intervention in ADHD. Technium Social Sciences Journal, 28(1), 159–169. https://doi.org/10.47577/tssj.v28i1.5728
[84] Kokkalia, G. K., & Drigas, A. S. (2015). Tools and E-tools for Memory and Attention Problems in Pre-school Education. International Journal of Recent Contributions from Engineering, Science & IT, 3(3), 13-19. http://dx.doi.org/10.3991/ijes.v3i3.4729
[85] Gkeka, E.; Agorastou, E.; Drigas, A. Artificial Techniques for Language Disorders. Int. J. Recent Contrib. Eng. Sci. IT 2019, 7, 68–76.
[86] Galitskaya, V., & Drigas, A. (2019). ICTs and Geometry. International Journal of Engineering Pedagogy (iJEP), 9(5), pp. 103–111. https://doi.org/10.3991/ijep.v9i5.11241

[87] Bakola, N. L. N., Rizos, N. D., & Drigas, A. S. (2018). ICTs Supportive and Therapeutic Contribution in Psychoemotional Disorders in Childhood and Adolescence. International Journal of Recent Contributions from Engineering, Science & IT (iJES), 6(2), 69-78.
[88] Drigas, A., Pappas M. A., and M. Lytras, "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, 2016.
[89] Drigas, A. & Kokkalia, G. 2017. ICTs and Special Education in Kindergarten. International Journal of Emerging Technologies in Learning 9 (4), 35–42.
[90] Drigas, A., and L. Koukianakis, A Modular Environment for E-learning and E-psychology Applications, WSEAS Transactions on Information Science and Application, Vol. 3, 2004, pp. 2062-2067.
[91] Drigas, A., & Mitsea, E. (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
[92] Drigas, A., & Mitsea, E. (2021). Neuro-Linguistic Programming & VR via the 8 Pillars of Metacognition X 8 Layers of Consciousness X 8 Intelligences. Technium Social Sciences Journal, 26, 159-176.
[93] Drigas, A., & Papoutsi, C. (2021). Nine layer pyramid model questionnaire for emotional intelligence. International Journal of Online & Biomedical Engineering, 17(7). https://doi.org/10.3991/ijoe.v17i07.22765
[94] Drigas, A., Papoutsi, C., & Skianis, C. (2021). Metacognitive and Metaemotional Training Strategies through the Nine-layer Pyramid Model of Emotional Intelligence. International Journal of Recent Contributions from Engineering, Science & IT (iJES), 9(4), pp. 58–76
[95] Drigas, A., & L. Bakola: The 8x8 Layer Model Consciousness-Intelligence-Knowledge Pyramid, and the Platonic Perspectives. International Journal of Recent Contributions from Engineering, Science & IT (iJES), 9 (2), pp. 57–72, (2021), https://doi.org/10.3991/ijes.v9i2.22497.
[96] 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
[97] Kontostavlou, E. Z., and Drigas, A. (2021). How metacognition supports giftedness in leadership: a review of contemporary literature. Int. J. Adv. Corp. Learn. 14, 4–16. doi: 10.3991/ijac.v14i2.23237
[98] Drigas, A., Kokkalia, G. & Economou, A. (2021). An 8-Layer Model for Metacognitive Skills in Kindergarten. NEUROLOGY AND NEUROBIOLOGY, 4(1), 2-10. http://dx.doi.org/10.31487/j.NNB.2021.01.01
[99] Drigas, A., & Sideraki, A. (2021). Emotional Intelligence in Autism . Technium Social Sciences Journal, 26(1), 80–92. https://doi.org/10.47577/tssj.v26i1.5178
[100] Drigas, A., & Papoutsi, C. (2015). Empathy, special education and ICTs. International Journal of Recent Contributions from Engineering, Science & IT (iJES), 3(4), 37-42. doi: 10.3991/ijes.v3i4.5192
[101] Kontostavlou, E.Z.; Drigas, A. Executive functions training and giftedness. Retos 2022, 43, 1005–1014.
[102] 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 and Biomedical Engineering (iJOE), 18(01), pp. 78–95. https://doi.org/10.3991/ijoe.v18i01.26859

[103] Papoutsi, C., Chaidi, I., Drigas, A., Skianis, C., & Karagiannidis, C. (2022). Emotional Intelligence & ICTs for Women and Equality. Technium Social Sciences Journal, 27, 253-268.
[104] 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.
[105] 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 Social Sciences Journal, 27, 230-252.
[106] Drigas, A., Mitsea, E., & Skianis, C. (2022). Neuro-Linguistic Programming, Positive Psychology & VR in Special Education. Scientific Electronic Archives, 15(1).
[107] Zavitsanou, A., & Drigas, A. (2021). Attention and working memory. International Journal of Recent Contributions from Engineering Science & IT (iJES), 9(1), 81-91. https://doi.org/10.3991/ijes.v9i1.19933
[108] Angelopoulou, E., Karabatzaki, Z., & Drigas, A. (2021). The role of working memory and attention in older workers' learning. International Journal of Advanced Corporate Learning (iJAC), 14(1), 4-14. https://10.3991/ijac.v14i1.20355