

Artificial Techniques for Language Disorders

<https://doi.org/10.3991/ijes.v7i4.11845>

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Abstract—This review focuses on artificial techniques which include the artificial intelligent techniques and applications, the robot technology and the serious games. All of above support the procedure of learning and teaching of language disorders and deficits with virtual, active, motor and motive capabilities. Especially, this variety of technology is able to assist the language delays and development language disorders as well as the written language, the oral language and the phoneme pronunciations, the communication and consequently the social interaction. In general terms, the use of achievements of technology, such as digital games, software system and humanoid machines, enhance educational process and curriculum for learning and social skills in daily action, especially for students with language disorders.

Keywords—Artificial intelligent, language disorders, robot technology, serious games

1 Introduction

This article presents and provides examples as well tools of how to confront with language disorders and deficits with the assistance of artificial techniques based on the most recent researches. Namely, the artificial intelligent, robots and serious games are able to be used either in the education process or in the daily life with the objective of improving the written and oral language, as well as communication skills and social interaction.

Coman and Mian, notice that nowadays many children have deficits in language. According to Diagnostic and Statistical Manual DSM5 there are many terms associated with language pathology such us language delays, developmental language disorders/impairments, specific language disorders/ impairments, primary language disorders/impairments or language-based learning disorders and communication disorders. The last one is a term that comprises disorders with deficits in phonology, content, semantics, function, pragmatics, speech, articulation, fluency, voice, resonance quality and communication. All the above reduce vocabulary, limited sentence structure, or impairments in use of vocabulary or sentences [1].

Mata et al., summarize the researches on technology therapies for language disorders. There is a variety of technologies that could help such us software, video and audio-content, communication-assisting technology, interactive computer programs,

Internet-based-speech-language therapy, Interactive Multimedia Learning Object, iPad application, platforms, video games, mobile applications, virtual environments and avatars. ICTS help students due to the strong potential in the individualization of teaching, learning and communication. All these three could enhance the specific needs of patient. Patients with Autism benefit from these technologies more than other speech disorders. Although, some speech disorders such as Aphasia, Apraxia, articulation disorder, Autism Spectrum Disorders, Dysarthria, Dyslexia/Reading difficulties, Hearing disability, velo-pharyngeal Insufficiency and voice disorders could be also benefit. The results are alternative communication, neuropsychological rehabilitation, functional communication, phoneme pronunciations, confidence in communication and recognition of emotions on faces [2].

Robles-Bykbaev et al., propose a virtual assistant robot for language disorders such as Dyslalia. This is a disorder in phoneme articulation. The phonetic-phonological component demands a list of languages skills such as phonetic, phonological, semantic, morphosyntactic and pragmatic skills, which many children could not produce. The robot could support the educational activities via interaction with an avatar in a virtual world and therapeutic activities [3].

Gaggi describes a variety of serious games which help pre-readers children to develop skills against dyslexia. Dyslexia presence affects writing speaking and language learning. So, there is an emergency to detect when dyslexia appears. Pre-school children who are in familiar risk of dyslexia should participate in serious games that could help through the mobilization of visual, spatial attention and speech segmentation. Serious games create skills such skills are eye-hand coordination, visual search ability, rapid identification of visual and acoustic inputs and the capability to associate visual and auditory stimulation. Games are “Paths”: a game for attention, “Fence Letters”: a game for focus and “Wizards” a game for fun challenge and letter identification. These games are accessible everywhere, both on-line and offline [4].

Zou et al., highlight the importance of vocabulary learning through digital games. In this day and age, students find it difficult to maintain conscious concentration on language learning. The solution for this is a digital-gaming activity. Video games and digital games contain personal avatars, real-time interactions, 2D or 3D reality, virtual worlds, metalinguistic knowledge, interactive white boards, e-portfolio, electronic dictionaries, electronic glosses, intelligent tutoring systems and grammar checking. But the list goes on with challenge, motivation, goals, entertainment and competition. All these advantages could enhance language learning in different ways. The review gives a list of digital games such as tutorial game for educational purposes, simulation game, where players solve problems and complete missions, role-playing game for learning daily life vocabulary, motion-sensing game, where students moving their hands to control the directions, spelling exercises, matching questions and selecting answers, digital books with animation and interactivity, 3D virtual game, adventure game which rise anxiety, card game, board game and serious game that provide personalized learning experiences. On the whole, digital games provide a scaffolding method for language learning by using multisensory effects and strategies [5].

Lu et al., try to define and give an explanation why the attention of researchers has been focused lately on Artificial Intelligent (AI) and robot technology (RT). Despite

that the article suggest a new artificial generation technology called “Brain Intelligence (BI)” an intelligent learning model that generates new ideas about events without having experienced them by using artificial life with an imagine function. (AI) has its limitations as long as it is focused on a specific task such as robots, pattern recognition, voice, images, translation robots, autonomous robots in delivery systems. From now on, new formulas grow up with more expectations and possibilities. And the main course is to eliminate the problems that (AI) could not manage such us frame problem, association function problem, symbol grounding problem, mental and physical problem. The new design based on nine technologies that researchers should take into consideration. These technologies are natural language generation, speech recognition, virtual/augmented reality, AI-optimized hardware, decision management, deep learning platforms, robotic process automation text analytics NLP and visual recognition [6].

2 Artificial Techniques

2.1 Artificial intelligent

Ammar et al., made a review on how Artificial Intelligent (AI) techniques and applications could help with the requirements, the design and architecture of software system. Firstly, AI could help the operations and the factions of software and hardware. Secondly, AI use techniques to support the tasks of coding and testing such automate the programming process or make a plan for testing [7].

Sora and Sora introduce the term “artificial education” (AE) explaining how the intelligent systems of informatics possess the potentiality to support as well as educate students at the elementary level in this age. One of these experts systems is referred as intelligent computer assisted language learning programs (ICALL). In particular, the system called FastForWord contains training programs for speech delays and applied for students with dyslexia the ability of reading is achieved [8].

Chassignol et al., present how the Artificial Intelligence reshapes educational content. Indeed, more and more educational methodologies and programs incorporate Artificial Intelligence and digital culture into the curriculum. Artificial Intelligence deals with cognitive problems such us learning, problem-solving, and pattern recognition, visual perception, speech recognition, decision-making, and translation between languages, improves the imagination of a collectivity and design a new educational experience. Artificial Intelligence such us Computer-Based Instruction and Intelligent Tutoring System provides tutoring in many fields such us physics, mathematics, language, computer science, medicine, biology and the list goes on [9].

Verma encloses all the beneficial aspects of Artificial Intelligent (AI) in education. In the beginning, AI works with artificial neural network and scientific theorems. The word “artificial” means not real or natural and the word “intelligent” means trigger new thoughts and knowledge. As it concerns the education, AI can automate basic activities like testing and grading ensuring plenty of time for teachers. Moreover, AI gives the opportunity of individual learning or helps students who are at different

levels to work together in one classroom. When the knowledge of a teacher is limited, AI gives the solution and fills the gaps, such as an AI is “Coursera”. In addition to that, AI supports students with online tutors and gives feedback to those who need it. One other role of AI is that it has change the way humans interact with information. Google, for example adapts results to users based on location, Amazon makes recommendations based on previous purchases, Siri adapts to your needs and commands. Furthermore, AI could enhance the role of teachers and inform students about courses. Other capacities are games, entertainment, emergency services, problem solving, and providing services to customers [10].

Jaliawala summarizes the most influential and innovative studies about methodologies based on Computer Aided Systems (CAS) for Individuals facing Autism. The study focuses on how Computer Aided Systems could help language expression. According to resources, scientists produce technology to enhance facial expressions, gestures, body language (kinesics) and distance between the communicators. Such computer aided systems are reported “Emotion Trainer”, TeachTownS, focused on cognitive skills, social & life skills and as well language skills. “Cambridge MindReading” to recognize expressions in other human faces. Animated series named The Transporters to enhance the language as well as emotional vocabulary. The Computer Expression Recognition Toolbox, alike to a Pac-man game. “Face-Say” contains three distinct modalities with realistic avatars designed to teach social skills. Face-Flower to help ASD individuals improve non-verbal capacities. “Junior Detective Training Program” which included a detective themed storyline along with goals and rewards [11].

2.2 Robot technology

Cruz et al., describe the role of robots in inclusive education. Robots have been used in interventions on children with needs or motor, cognitive and developmental disorders. Such interventions are supporting therapeutic activities, robots as personal assistants, social integration, supporting students in school activities, and promoting exploration and engagement in play. The review includes several studies that show the importance of robots in scaffolding education [12].

Heiner tried to present an experience of evaluating robots in an elementary school curriculum. The main goal is to teach children and teachers how to program a robot. The whole project based on technologies and platforms for kids such as Sony’s AIBO, LEGO Mindstorms, Furby and Finch robot. Heiner and his team tried to introduce robots to students. They adopted the Finch platform, because there was an existing loan program made the acquisition of the robots. So the cost of purchasing the technology was manageable the project. With a USB connection the robot connects to a host computer that runs the BirdBrain robot server. The BirdBrain robot server allows students to connect to the robot and program in either Snap or Scratch. Lessons were taught once every three weeks. Students could also use the robots for free and program them to do things, including “walking” their pet robot, flashing the light, making the robots dance and wiggle its tail, Popular activities racing the robots, making for-

tune tellers making the robots dance, robot wars, and making the robots navigate line mazes and in general play with them [13].

Han presents robots which are capable of educational services. These robots has an anthropomorphic design but also abilities such as nonverbal communication and social contact. For instance, interaction based on various sensors or cyber characters and videos. Concerning the education, robots promote and enhance creativity in different fields such as science, technology, engineering and mathematics. This intelligent media establishes an educational environment. Educational robots are separated in three categories according to their capacities. In the first place, there are the tele-operated type, autonomous type, and transformed type each type has its specific intelligent skills depending on the network and the program stability. Other applications and formulas which help robots to produce education are voice- and sound-recognition, face-detection and recognition, gesture- and object-recognition, synthetic speech, driving, space recognition, and position recognition. Furthermore, the article recommends robots as an educational tool to learn a foreign language and according to the research one specific robot called “Rall” has tailored applications for this set purpose [14].

Kanero et.al. investigate how social robots could be a scaffolding method which could help children to learn a language. According to references a social robot is an autonomous or semiautonomous robot that could interact and communicate with humans by following behavioral norms. This robot teaches scientific knowledge, mathematics, social skills, computer programming, and language. Some of the advantages are vocal gestural and facial expressions and verbal feedback like “Good job”. Specifically, social robots help learning a foreign language with vocabulary enhancement and expressions. Then the article numerates students from different countries that learn foreign languages with robots [15].

Agatolio et al., discuss how robots can service and support teachers during their lessons. The study focuses on integrating robots in curriculum especially on target groups that need special education. These target groups include students with dyslexia, dysgraphia, dyscalculia, ADHD, Autism and physical disabilities. Educational Robot provides an inclusive education with good practices and advisable software. Furthermore, robots balance the relationship between students and create positive synergy. The course last for 8 hours and 200 teachers participate. The program focused on methodology on how to approach a robot, engagement and familiarization with it, first taste with the capacities of the robot, exemplary experiences such as make the robot move, make the robot paint, make the robot avoid obstacles, designing of didactical units possible focused discipline theme, preparatory activities such as setting up the scenario, role of the robot, didactical objectives, expected new skills, learning support issues [16].

2.3 Serious games

Freitas deepens in understanding the use, the nature, the efficacy and the design of educational games. In this era, the educational games included serious games, web-based games, digital games and learning games, adopt more and more cross-

disciplinary approaches from different fields. A new term “game science” will replace the term “serious games” as long as neuroscience, computer science, educational science and information science enhance and provide a beneficial ground for development. From all the above a new area of <Gamification> is born. The term means all the applications of elements of game mechanics and design. These games expand the way we learn as individuals, inside groups, in learning environments and through play. Also expand knowledge in different areas such as management, business, advertising, human-computer interaction, health education, military training, neuroscience, environmental awareness, teachers training [17].

Papanastasiou et al., investigate how serious games affect learning, memory and attention. Specifically, they investigate the affection of serious games on students with special educational needs. The approaches based on theories such as Piaget’s constructivism, Vygotsky’s cognitivism, Papert’s thoughts of education, Prensky’s digital game-learning and Gee’s learning through video-gaming. The term <game> in education is very important because kids could learn by doing, could learn while they communicate could learn by real mistakes. Games also excite emotions and help kids understand topics that otherwise would be unachievable. Especially, for those students who could be educated more efficiently by multisensory education, serious games open a window of metagnostic capacities such as visual, attentional, spatial, executive control, working memory and hand-eye coordination. Games give a chance to enhance phonological skills, strategic thinking, planning, negotiating skills, independence, group participation. According to the study, memory could be more organized, impulsive behaviors and distraction could be decreased the study mention serious games some of them are: “Plan-It Commander”, tablet game named DysEggxia, and FEW (Facial Expression Wonderland). [18]

García et al., present through an experiment the positive effects of serious games in learning disabilities. More specifically, the experiment refers to children with ADHD and children with specific learning disability. The attention, motivation and cognitive components are improved by two educational video games such as “Boogies Academy” and “Cuibrain”. There were two groups of students, the one was an experimental group (24 students) and the other was a control group (20 students). The intervention consisted of a 28-session program. The results show that for students with ADHD there were improvements in time management, planning, organization, and a reduction in hyperactivity symptoms. They also find out that reading skill, vocabulary, language learning, listening and spelling are enhanced. From all the above we could understand that video games are increasingly used in the field of special education and inclusion [19].

Johnson et al., present a new kind of a serious game which encourages language lessons and based on Tactical Language, Culture Training System (TLCTS) and artificial intelligent. At first, it was designed to help military users learn Iraqi Arabic language and culture. Each TLCTS training course includes the Skill Builder which consists of interactive lessons focusing on task-relevant communication skills. Arcade Game and Mission Game are both interactive games that give trainees opportunities to develop and practice the foreign language. The role of artificial intelligent in Alelo courses is the program that allows the speech recognition and gives feedback to learn-

ers. The system based on dialog models. In these models of conversation the learner-player tries to speak then the system analyses the purpose of the conversation and answer in appropriate form. This system gives priority to conversational practice and not pronunciation. Furthermore, it encourages learners to figure out what to say on their own and gives critical skills with the ability to know language and culture in face-to-face communication [20].

Virvou et al., make a connection of educational software games with virtual reality through an evaluation of an Intelligent Tutoring Systems (ITS). The game is called VR-ENGAGE, and is an Intelligent Tutoring System which teaches students geography. The game includes virtual theme worlds with mediaeval castles in foreign lands, castles under the water, corridors, passages through the fire, temples hiding secrets, dungeons and dragons, all of that via 3D-engine. There is no violence; there are animated agents and box dialogues. The goal is to find the missing pages of the book of wisdom, which is hidden. But to do that students have to answer geography questions. Student is allowed to select several patterns of reasoning and fill-in the names of cities, towns, mountains for the answer. In this sense the game provides an environment of negotiation among teaching-learning dialogue and between the ICTS and the students. The experiment took place in different classrooms with the teachers inside. The most important of the results that came out from teacher's interviews is that there was a good impact on students who are previously poor performers on geography [21].

3 Conclusion

The article focuses on the contribution of technology in language disorders. In particular, it shows examples how artificial intelligence, robots and serious games can actually help support and improve student performance in school and enhance their learning. Particularly researches that are reported, present examples of studies where specific language disorders and deficits have been improved by the specific technological applications. The article initially mentions the features of artificial intelligence, robots, and serious games, and then presents how these technologies provide an environment that can enhance learning in different fields and create communication skills for learning disorders. Thereby, these environments reduce the deficits and enhance learning readiness and school performance for the group of children with characteristics of language disorders.

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Article submitted 2019-10-10. Resubmitted 2019-10-28. Final acceptance 2019-11-02. Final version published as submitted by the authors.