



Serious Games: How do they impact special education needs children

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Abstract- Serious Games appear to benefit children with special needs and provide a multidimensional approach to learning. According to research, Serious Games can help Special Education Needs children stay interested in their study by increasing their motivation, independence, autonomy, and resulting self-esteem. In practically every subject area of the curriculum for preschool and primary education, serious game-based learning has demonstrated its contribution for students with attention, memory, and executive control issues as well as with mental or developmental disabilities.

Keywords—Serious Games, attention, memory, special education needs, curriculum, motivation, game-based learning, interactive technologies

1.INTRODUCTION

Many educators and instructors acknowledge that formal teaching using traditional learning activities has failed to match pupils' needs, preferences and expectations. For this reason, in order to reach their children and meet their needs they made a shift in their teaching and adopted immersive environments and gaming technology for educational and training purposes. The educational, therapeutic and social impact of serious games supported by the recent progress of the gaming technology facilitated pupils to go through the process of experimenting, instead of regurgitating information. With the advancement of gaming technology, educators with little to no programming experience can easily and affordably construct serious educational games. Digital games can foster the development of users' cognitive, spatial, and motor skills as well as their ICT abilities. They can also teach users how to solve complex problems, and foster creativity and genuine user collaboration. Finally, they can elicit a wide range of emotions from users, including joy, empathy, anger, frustration, and triumph. Emotions can benefit the cognitive process by aiding in memorising and helping people remember things more vividly [1].

Both mainstream and special education children benefit from the use of games in the classroom, where there is evidence of enhanced motivation, engagement, and progress in a variety of skills and abilities. The seven potential learning areas presented by serious games—*intrinsic motivation, learning by doing, social learning through engagement, located true "actual" learning, personalized learning, and learning from failure*—have a significant impact on inclusion. Serious games must be entertaining, with overt or covert educational goals. According to research, students with special needs show a higher desire, engagement, and progress in a variety of skills and abilities that result in enhanced independence, autonomy, and subsequent self-esteem. Naturally, it is time to look closely at serious games [2], [3].

Game-based learning activities in the classroom enhance positive social interactions and relationships between students and between students and their teachers. Games foster young people's need to develop their 'media literacy' competence and become creative producers of them, stimulating their design skills. Games can be seen as a persuasive medium that guide players towards learning outcomes. Furthermore, they are viewed as ideal platforms for trying out ideas where players are active in the construction of knowledge, rather than passive recipients. According to a survey of over 1,600 practicing classroom teachers in English state primary and secondary schools, the majority of them believe that computer games can help support children's motor and cognitive development (83%), their ICT skills (73%), and their higher-order thinking skills (such as logical thinking, planning and strategizing) (65%). The skills of successful gaming are seen as an interrelated set of skills and competences enhancing a range of other skills, including web research, persistence in solving challenging problems, information processing, communication, creative production, peer support and assistance for the good of the whole class [4].

The potential of using 'playful' approaches to develop navigational skills in people with disabilities is effective for their inclusion in society, as far as the quantitative and qualitative results showed an increase in self-determination, motivation and memory. It is described as a promising educational tool for people with



intellectual disabilities and related sensory impairments called digital games-based learning (DGBL). The student's ability to increase measures of decision-making, memory, math, and spatial skills is made possible by DGBL [5].

As the students explore new skills, methods and concepts, SGs construct 'serious' experiences, having learning goals and structure, that lead to changes in participants' behavior, knowledge, skills, attitudes, and/or level of functioning. SGs provide enjoyment, pleasure, motivation, gratification and emotion within a safe environment for active, critical and creative learning. A SG is a game in which learning is the primary goal, having a personalized structure for either individual users or groups. The definition of story board and graphical design elements of the GBL solution in line with the selected pedagogical approach and the instructional design is a critical aspect of SGs development that contribute to a generic theory of GBL. The integration of simulation aspects, game aspects and pedagogical elements provides sustainably enjoyable gameplay, points out an innovative methodology for the training with Serious Games, and makes an effort to meet the language and the culture of learners, according to the requirements of the end-users and stakeholders [6].

Games' pervasiveness is now been seen as a means for educating children and enriching our everyday lives with greater happiness and fulfillment. Serious games are considered as key structures for the educational practice and infrastructure over the coming years where their potential offers a new paradigm shift in education and training in the 21st Century. The shift will include multimodal interfaces, brain-computer interfaces and haptics using avatar driven scaffolded approaches, with an emphasis upon social interactive learning that can be used effectively as metaphors for achieving behavioral and attitudinal changes. Immersive experiences, placing pedagogy at the centre of the implementation and design process, have the potential to change how we learn, by creating engaging tutoring environments through personalized information when needed and adapted to the user's requirements. Serious games are a new and emerging sector of the games industry that involves all the stakeholders: educationalists, game designers and developers, researchers and centrally the learners [7].

Each learner or learner group can engage with the resource according to their own learning styles/preferences and the collaborative approaches that could support this. De Freitas and Oliver (2006) introduced the four-dimensional framework with which game designers could identify a better fit between the needs of the curriculum and the best form of use of the game to mediate the learning activities and promote increased reflection upon context, pedagogy, mode of representation and learner specification. Their approach helps tutors to be more critical about how they embed games and simulations into their lesson plans and supports learners to benefit from more self-directed and differentiated learning. The first dimension refers to the particular context where play/learning takes place, and the tutor's own specific background, the availability of technical support and context are considered as a touchstone factor for learner support. The second dimension refers to the attributes of the particular learner including their learning background, styles and preferences. The third focuses upon the internal representational world – or diegesis- of the game or simulation, namely the mode of presentation, the interactivity and fidelity of the game. The fourth dimension focuses upon the process of learning, reflecting upon practitioners' methods, theories, models and frameworks. The four dimensions could facilitate the practitioner's flow between the different visualizations, addressing more critical and reflective process for embedding games and simulations in teaching practice and thereby providing improved opportunities for the children to work in a team [8].

Hypothesizing, probing and reflecting upon the simulated world within the game relates to higher degrees of engagement and immersion, endorsing continued learning in game-based learning environments. Computer games have helped maintain students' attention for hours, weeks, and even years while scaffolding their learning and vice versa. Through increased concentration, interest, and enjoyment, players are organically driven in this framework to develop their abilities and engagement, which are inextricably linked to learning. These traits are associated with a psychological state known as "flow," which promotes increased immersion and engagement and reflects learning through the game. Serious game –based learning is considered as an effective learner-centered educational approach, arguing that engagement is a critical aspect of learning. Learning challenges that are perceived as interesting and enjoyable keep learners maximally engaged, creating conditions for flow, and heighten interest, concentration, as well as enjoyment [9].

I. SERIOUS GAMES' IMPACT ON VISUOSPATIAL AND PHONOLOGICAL SKILLS

A group of serious games (SGs) called Paths, Fence Letters, and Wizzards were created by O. Gaggi et al. in 2012 in an effort to forecast the likelihood that very young infants may develop dyslexia. The ability to correlate auditory-phonological skills with visual and aural inputs, eye-hand coordination, visual search ability, and rapid recognition of visual and aural inputs are just a few of the specific reading-related skills that the games could be used to train for in youngsters. The youngster is invited to follow some predetermined courses in the first game to get to a goal. These paths are made up of a number of open circles that are oriented in the four directions left, right, up, and down. In the second game, the youngster is taught to concentrate on nearby



stimuli by filling in gaps in a fence with partially dashed edges so that fish swimming inside can't get through. The third game asks the player to identify sounds based on the order in which they were emitted. This is a nice challenge. The researchers established that these SGs can teach phonological abilities and visual-spatial attention just by playing and lower treatment dropout. The produced games make use of visual cue stimuli and distractions and are made to be playable on any device while also being accessible through any browser (portability) and tailored with the specific target users in mind [10, 11]. This turns an irritated patient into an enthusiastic player.

In a related publication, Gaggi et al. (2015) proposed a number of SGs to investigate neurocognitive capabilities associated to pre-readers' future reading ability, measure them, and perhaps train them via games. The concept is that the user will enjoy playing and likely keep playing even if there are hints or other distractions, helping them to accomplish the game's important objectives. They developed the games Paths, Local Visual Search, Hidden Fish, Fence Letter, Global Visual Search, and Wizards, all of which are based on the neurocognitive deficits that Developmental Dyslexic youngsters experience (DD). 'Paths' trains the ability to rapidly discriminate among images by rapidly engaging/disengaging attention in the central (fovea) and peripheral vision. 'Local Visual Search' focuses on the ability to analyze the local characteristics of a figure within a certain time limit. 'Hidden Fish' measures and trains the orienting mechanism of visual spatial attention. 'Fence Letter' trains the child's ability to focus on local stimuli, because the player has to pay attention to the movements of two or more stimuli, ignoring the global structure which is a large letter with partially dashed boundaries. 'Global Visual Search' aims to train global research skills modulating the attentional focus dimensions. 'Wizards' explores the ability to rapidly process auditory stimuli. The games can be used to train rapid auditory skills and the visual-spatial attention, as well as letter-to-speech sound integration to improve children's future reading and predict the risk for DD even in preschool age, being played as an entertaining and engaging activity. The designers have tried to endow their games with a dynamic balance between challenges and player's skills, thus embodying a possible daily treatment with a low probability of dropout. These games can be used to train rapid auditory skills and the visual-spatial attention, as well as letter-to-speech-sound integration [12].

Franceschini, Sandro, et al. (2015), introduced an idea about the use of action video game (AVG) training for students with DD to establish possible early prevention programs and improve attention and perception to acquire better reading skills. The aim of their review shows the way for possible early prevention programs that could benefit students with attention and perception deficit dysfunctions to improve reading abilities. AVG training could battle DD even before the diagnosis, whereas children can develop visual, auditory and cross-sensory, perceptual and attentional abilities, resulting in more efficient speech-sound and letter-to-speech-sound learning regardless the DD subtypes and the deepness of the language. Results measured by the word text reading showed that children had an improvement in basic phonological decoding and in lexical recognition [13].

Franceschini, Sandro, et al., 2013 showed that spatial and temporal deficits of children with dyslexia could be remedied even after 12 hours of AVG training, resulting in improvements, more than or equal to highly demanding traditional reading treatments. The findings show that visual spatial and cross modal temporal attention are causally related to dyslexia. Children with dyslexia who received AVG treatment improved much more than would be predicted for a child after one year of spontaneous reading growth in both focused and distributed spatial attention. As general reading skills improved alongside video game training, reading speed rose without sacrificing accuracy and without the need for any direct phonological or orthographic instruction offering a novel, quick and enjoyable dyslexia treatment. The results demonstrate a clear, causal link between attentional functioning and reading remediation investigating the specific role of the 'action' stream in reading acquisition that could drastically reduce the incidence of reading disorders [14].

Kast, Monika, et al., 2011, designed a computer-based spelling training program to investigate the learning curves of dyslexic children compared with non dyslexic ones. Their spelling training software investigated the spelling behavior of children recoding words into multisensory representations comprising visual and auditory codes. The computer-based German spelling program examined in this study relies on meaningful visual and auditory stimuli to support the spelling learning process, using colors and shapes that reflect information about individual letters. Their study's findings, among other things, showed how dyslexic children's spelling abilities were positively impacted and how their memory of the connection between graphemes and phonemes helped them become better spellers. The word problems in the spelling game included doubling of letters, silent letters, diphthongs, visually similar graphemes, and phonemes with similar sounds. Both children with and without dyslexia experienced an improvement in their understanding of the phonological structure thanks to the influence of memory and attention skills learned in the structured environment of the learning program. They also experienced a significant drop in the number of spelling mistakes they made and were able to generalize

ideas and adopt rules based on their language. The multi-modal training induced a significant decrease in spelling errors in both children with and without dyslexia and exhibited the same learning progress [15].

Ludovico, Luca Andrea, et al. 2015, created an action video game oriented to promote phonological and visuospatial attention training in dyslexic subjects aged between 7 and 9. They designed a game where the player improves his own ability to relate graphemes to phonemes, and also develops the speed of reading while choosing syllables to reconstruct words at the same time. The player had to guess increasingly difficult words in accordance with the number of syllables, the word and syllable length, the syllable complexity, and the symbol layout on the board. Additionally, the students had to select the right letters among alternative syllables very similar to the right ones. Since the Italian school syllabus promotes the development of fast reading, the impact of their approach is positive and promising [16].

In a computer-based approach Rello, Luz, et al., 2014, provided evidence that error-based exercises presented in a game for iPad help children with dyslexia improve their spelling skills. They presented a tablet game named DysEggxia to train and improve the spelling skills of Spanish early-writers with dyslexia through playful and targeted exercises. The exercises are based on the linguistic analysis of errors written by children with dyslexia. Their approach presents the child a misspelled word as an exercise to solve, based on the six types of errors found in texts written by children with dyslexia: add a letter (insertion), remove a letter (omission), change a letter (substitution), put the letters in order (transposition), split into words (word boundary errors) and choose the correct word ending (morphology). Also, they applied the linguistic patterns extracted from the errors to the most frequent words, selected distractors for each exercise word and implemented five difficulty levels considering the difficulties of people with dyslexia. After four weeks of playing DysEggxia, children with dyslexia improved their spelling skills, making significantly less writing errors compared to the control group that did word games with correct words [17].

Van den Audenaeren, Lieven, et al., 2013, developed DYSLX, a game-based application in order to design the optimal tool for preschoolers either to predict variables for dyslexia that can be measured or to predict whether a preschooler (5yrs) shows high risks for developing dyslexia. Also, it was designed to measure and score the tests automatically in school psychology services and clinical diagnostic and rehabilitation centers. Therefore, no qualified personnel are needed to administer the assessment, increasing the utilization potential in all diagnostic centers to detect children with high risks of developing dyslexia. Preschoolers preferred the touch input and the intuitiveness of the physical interaction with their hands and fingers, over the mouse input. Hence, this contributes to achieving some kind of 'Sense-Pleasure'. Another element in the study was that children linked character creation to a relaxed, easy playing style, implying that preschoolers are not always looking for a 'challenging' gameplay, but having the opportunity for self-expression and an aesthetic sense. Lastly, the action-reaction effects that some games implement are usually enjoyed by preschoolers, because they are perceived as humorous or satisfy curiosity. The core of the design is three mini-games, namely a high-speed chase, a line-up, and the search for lost objects each incorporating one specific measurement related to the onset of dyslexia [18].

Another study demonstrates that playing action videogames, which are unrelated to phonological or orthographic instruction, significantly enhances dyslexic children's reading abilities. The usage of a particular typeface called DFONT, whose blank character's width is nearly three times wider than its equivalent in Arial, is important to the study's researchers, who claim that it helps dyslexics read by making it easier for them to recognize letters and words. In order to increase user engagement, self-esteem, performance, and motivation, they also added specific difficulty and skill levels to the game, taking into account details like the quantity and kind of letters on the board, word length, and symbol placement inside words and on the board. The game is, in the evaluation of teachers, suitable for age between 6 and 7 years, and with regard to the overall evaluation of the prototype teachers showed a reasonable interest in the game and its possible educational application, particularly interested about possible improvements that can be implemented within the game [19].

II. SERIOUS GAMES' IMPACT ON ATTENTION AND ADHD DISORDERS

The results of the studies Drigas et al, 2014 explored in their paper showed how new technology such as software with a game format can support people and students with ADHD to improve the academic performance and increase their attention. Another study demonstrates that playing action videogames, which are unrelated to phonological or orthographic instruction, significantly enhances dyslexic children's reading abilities. The usage of a particular typeface called DFONT, whose blank character's width is nearly three times wider than its equivalent in Arial, is important to the study's researchers, who claim that it helps dyslexics read by making it easier for them to recognize letters and words. In order to increase user engagement, self-esteem, performance, and motivation, they also added specific difficulty and skill levels to the game, taking into account details like the quantity and kind of letters on the board, word length, and symbol placement inside words and on the board. Computer-based applications, mobile devices, and social media tools, presented in



this study, give the possibility parents, teachers and specialists to employ ICT strategies to apply diagnosis and intervention process [20].

The results of using computer games in the treatment of ADHD are promising, highlighting the significance of motivational factors and the efficacy of cognitive training through the use of multiple sensory modalities and the immediate feedback of a gaming format. It is asserted that computerization and gaming training help children with ADHD keep their focus and attention while restraining their impulsive and inappropriate behaviors. Although it is unclear which game aspect is more effective, the effect of game elements on the motivation and performance of children with ADHD on a WM task seems to be essential. The results, however, are encouraging when it comes to the responses provided by the parents of ADHD children on a standardized behavior questionnaire, which revealed less impulsive behaviors while completing a task based on a computer game. Additionally, the quantity of impulsive errors and the level of attention were comparable to that of controls. Although it is shown that including game features per se does not improve performance, these findings imply that using computers and gaming helps children's impulse control and attention. As a result, the average amount of time that ADHD kids were not using the mouse during training decreased and they finished a lot more trials when they trained in a game environment. Also, the results of executive functions deficits treatment of ADHD children with regard to their performance and motivation are promising compared with children in the standard computerized training condition [21].

Bavelier, D., et al. 2012, used brain imaging to test changes in the mechanisms that control attention allocation and its efficiency in action game players. They first reviewed the aspects of attention that had been shown to be modified in VGPs investigating how such changes in behavior may be instantiated at their neural level comparing to individuals who do not play such games. They carried out a study that revealed more fronto-parietal activity when attentional demands grew in non-players (NVGPs), but players hardly activated this network at the same time, probably because they filter irrelevant information more effectively. As a result of their gaming activity, video game players (VGPs) have superior selective attention throughout space and can allocate attention to multiple items for several seconds with less effort. Parietal activations bilaterally seen in the inferior parietal cortex and the superior parietal cortex extending medially to the cuneus/precuneus are the main processes involved in the attentional enhancements reported in NVGPs as opposed to VGPs. Attentional load, such as static or moving random-dot displays, emerged in the field of a visual search paradigm processed in VGPs and NVGPs. When performing the task, VGPs outperformed NVGPs in terms of search rates. Additionally, compared to NVGPs, VGPs were less activated by irrelevant motion. The fact that VGPs show less activation suggests that they have evolved a strong distractor suppression mechanism, which has helped them achieve excellent attentional abilities. Comparing the neural networks underlying attentional processing in VGPs and NVGPs under different attentional loads in these two groups a visual search paradigm was used. It showed that VGPs develop more efficient attentional processes as a result of their gaming activity and an automatization of the resource allocation process [22].

The role of cognitive control in visual selective attention illustrates the importance of considering the level and type of load involved to prevent distractor interference. It is vital to remain focused on a task especially when increased perceptual load regarding the different-identity items need to be perceived or visual information-processing tasks are involved (e.g. the number of items that can be subitized). Effects of video game playing in VGPs confirm a superior performance on attentional capacity due to plasticity [23].

The usage of Microsoft Kinect motion-based touchless games for ADHD kids is a current trend in gaming that is in line with these impacts. In their study, Retalis, Symeon, et al. emphasized that this kind of user interaction enhances the motor planning and execution skills of ADHD students as well as their hand-eye coordination, concentration, and memory much more naturally and appropriately than the typical input devices for games, such as the mouse, joystick, and keyboard. The affordances of the Kinect sensor were used to validate the Kinems learning games, which are based on conventional, widely acknowledged therapy procedures, in a real therapeutic environment. All children showed strong interest and motivation while ADHD population consists of children who are very easily distracted, discouraged or just bored. The pilot study's quantitative and qualitative results demonstrated improvement in the children with ADHD's cognition, concentration, impulsivity, sustained visual attention, and overall ability to create a pleasant atmosphere [24].

Bul, Kim CM, et al. 2015, developed an online serious game called "Plan-It Commander" specifically assigned to a population of ADHD students, from 8 to 12 years of age. ADHD children tend to have fewer problems with concentration and engagement when playing digital games concerning domains of daily life situations that are known to be problematic for them. As a result, they encouraged behavioral learning and the adoption of strategies with a futuristic and adventurous character made up of two components: a) the mission game and b) a closed social group for interaction. The mission and learning goals' growing complexity and performance demands increased skills for carrying out daily tasks including time management, planning and organizing, establishing friends, and other "real world" behaviors. The game was made up of three minigames:



"Labyrinth," which teaches players how to manage their time and estimate how much time is needed; "Explorobot," which teaches players how to plan ahead and divide a large assignment into smaller tasks; and "Space Travel Trainer," which teaches players how to support one another on a team. Components such as monitoring their abilities, regulating their emotions, and practicing as many times as needed in order to reach mastery were built into the game to practice skills that could be generalized in their daily life. The usability findings of developing and implementing the specific serious game indicated positive acceptance of this game intervention where children with ADHD and their parents would recommend the game to other parents of children with ADHD. Moreover it could be an example for developing serious games for similar target groups and outcomes [25]

III. SERIOUS GAMES' IMPACT ON STUDENTS WITH AUTISM SPECTRUM DISORDERS

The effectiveness of a video modeling (VM) intervention on children with autism spectrum disorder (ASD) was demonstrated by decreased inappropriate behavior and generalization of the effective play skills and social engagement with their peers to a novel game context. The outcomes of teaching games to young children with ASD revealed improved participation in the games and enhanced social interaction with their play partners, both of which occurred naturally and unprompted by adults. In order to increase their interest and drive their engagement even alongside their usually developing peers, the intervention was performed by adding the unique interests and strengths of children with ASD [68] into the game. The target behaviors of the participants, the treatment fidelity and social validity throughout the study were assessed and showed that this VM intervention was an efficient strategy for offering repeated practice of targeted skills, while maintaining the children's interest. The effects were maintained during the follow-up and at the same time students' learned skills were generalized to an untrained game indicating that the intervention was meaningful, feasible, and effective [26].

In a work conducted within the Learning, Design and Technology program at Stanford University, a game suite that combines the steps of an evidence-based therapy with common game design techniques and the feedback of 30 ASD children was designed. It is suggested that an effective design of a therapeutic video game for young elementary school students with ASD could act as a mechanism to close the gap between the prescribed amount of behavioral therapy and the amount they actually receive. For this reason, the researchers created a collection of games (Go Go Games) based on the principles of Pivotal Response Treatment (PRT), one of the most well-researched treatments for autism that also results in unintended enhancements in "collateral" areas. The educational objective of Go Go Games is to teach a skill known as 'multiple cue responding', whose gradually increasing demands and tailored reward structures are central to achieving the goals of PRT. Managing player's stress and gradually increasing demands on a child's multiple cue responding underlie a specific technique known as "conditional discrimination" through which the PRT practitioner deliberately structures the natural environment such that a child must notice multiple cues simultaneously [27]. Cankaya, S. and Kuzu, A., 2010, proposed a project for investigating how ASD children interact with computer games, developing them according to pre-designed standards. Also, they intended to use a design based research methodology to investigate their characteristics (concerning pragmatic, grounded, interactive, integrative and contextual aspects) as well as to set out both the criteria of educational computer game development and their effectiveness. Their purpose was to determine the standards of educational computer games for ASD children, to develop educational computer games according to the standards, and to determine their effectiveness [28].

Researchers created four games for teaching abilities that are thought to be fundamental to strengthening ASD students' matching, pointing out (based on visual and auditory stimuli), sorting, and labeling skills as part of a pilot project for a learning framework for children with autism (LeFCA). Find the same, Which shape does not belong, Select the shape heard, and What is the shape called were the games that corresponded to the aforementioned skills. The created software was user friendly for kids with Autism and systematically and developmentally appropriate sequenced for learning. LeFCA learning framework should be implemented through four modes of learning, namely matching, pointing out/ selecting, sorting/categorizing, and production responding. Their main goal was to teach ASD children basic shapes: square, circle, triangle, rectangle, rhombus, star, heart, hexagon, and semicircle helping them to build early cognitive abilities, generalize learned and school readiness skills using basic interaction with a teacher without any needed training. Preliminary results showed that participants have generalized game play skills and were able to use them in a different environment, on the computer. This framework has been designed to build up ASD children's early cognitive abilities and school readiness skills using basic interaction with a teacher. Finally, it promotes e-Learning, knowledge transfer, basic computer literacy skills and supports the development of a participative, knowledge-based information society [29].



Aresti-Bartolome, N. and Garcia-Zapirain, B., 2015, developed a game system designed for people with ASD, which could help in cognitive rehabilitation of the affected areas of ASD, assess communication skills and interaction between children with ASD and the therapists objectively. By selecting a variety of parameters and variables in the interaction between the child and the session leader, the game has been created to meet the demands of each user and establish indicators like visual contact and interaction duration. Additionally, the system evaluates its efficacy by permitting cognitive behavior between participants with ASD and neurotypical participants who served as the control group. This allows children with ASD to gradually strengthen their areas of weakness while living independently. Defining and selecting the environment in which to play the games is vital for children with ASD because they find it difficult to react to changes that have not been notified to them in advance. The results obtained from this study confirmed that the system could help in cognitive rehabilitation and the working interaction area affected by ASD [30].

A playable training toolkit for ASD children is demonstrated as a novel approach to train them via computer. Although ICT itself is just a tool, it should provide the channel to connect children with ASD and the environment outside. In their proposed work, Tseng, R., Y., and Do, E., Y., L., 2010, designed a novel prototype computer game based on the film "Alice in Wonderland" by Walt Disney, called by the acronym FEW (Facial Expression Wonderland). The purpose of FEW is to capture attention and compel ASD kids to play the game since they have major social communication difficulties and cognitive dysfunction. Additionally, it is made to teach kids how to recognize facial expressions, enhancing their flexibility, independence, and problem-solving abilities. The game has three separate training levels that start with the fundamental skills for recognizing facial expressions. The participants are asked to identify the SAME and discern the DIFFERENT facial expressions while listening to spoken instructions. In the second level, students are asked to check out photographs of foods that they regularly eat and then express their preferences for those foods with a corresponding facial expression. Food is used as a reward to encourage and get children participants involved. The final level of the ASD curriculum requires kids to identify changes in facial expressions and spot how the tale affects a character's expression. ASD children who can recognize facial expressions gradually learn how to reflect the mental state of others (Theory of Mind). The pilot game design makes it easier for kids with ASD to live their lives and gives them a way to interact with the outside world. Researchers have found that everyone who interacts with children with ASD, including parents, carers, teachers, and others, agrees that computers may significantly change these kids' lives since ICT can actually make real life complete for them [31].

IV. SERIOUS GAMES' IMPACT ON STUDENTS' MEMORY

M. Ninaus et al. (2015), examined effects of adding specifically implemented game elements to a conventional working memory training task on performance and flow perception. They implemented three game elements—a progress bar, a level indication, and a themed setting—to evaluate their effects in comparison to a standard version of the job. Participants who interacted with the game's aspects scored noticeably better on the working memory training assignment than those in the control group, according to the study. As a consequence, both the GAME and NOGAME groups' results demonstrated that the game aspects improved users' training effectiveness and performance. Additionally, users who completed the gamified memory task tended to train their working memory close to its maximum capacity, whereas users in the control group tended to train their working memory below its capacity. Additionally, the quantity and the precision of the feedback elements were higher in the GAME version than in the NOGAME version. It can be reasoned that the game elements could better allocate working memory resources of the GAME group through the active and real-time update of the inferential statistical analyses [32].

Prins, P. J. et al. (2011), showed the facilitating role of computer games on children's impulse control and attention. They added gaming components to a typical computerized WM training to boost the children's motivation (more training time), performance (fewer errors), and working memory (WM) (better scores). In the WM training game for basic visuospatial abilities, players had to duplicate patterns of squares in a 44 grid that were randomly lit up. In the game condition, more sequences were executed every training session than in the control condition. In the game training condition, the Working Memory training results demonstrated a considerably expanded memory span from the pre- to post-test. Additionally, the results demonstrated that the children who practiced the WM task using the game version did so with greater desire, with fewer incorrect trials, and at a higher level than the control group. Therefore, gaming seems to be critical to a child with ADHD to maintain concentration and attention and withhold impulsive behaviors and inappropriate behaviors [33].

Drigas, and Kokkalia (2015), conducted a review paper where they presented a list of diagnostic and intervention tools in the form of games that are used to support preschool and older children who face memory and attention problems with user-friendly interfaces. Also, they presented significant tools and e-tools that are used by teachers, specialists and parents in order to diagnose and assess memory and attention problems in



Kindergarten children. However, they state that there are several fields that require further research regarding the reliability, validity and adaptation of these tools to the various needs of children and therapists [34].

V. SERIOUS GAMES' IMPACT ON STUDENTS WITH MENTAL DISORDERS

For a target audience of people with intellectual disabilities and accompanying sensory impairments classified as having "poor spatial skills," games-based learning and related technologies can have a positive impact. In 2013, Brown, David, et al. presented the Recall project, which resulted in the creation of a web-based route planning tool that includes a number of humorous narratives made to encourage users with intellectual disabilities to practice independent travel. Route Mate, the project's main route learning tool, is a location-based application that allows users to independently plan and execute their routes to work and communities using their mobile devices in one of three modes: Plan, Use, or Challenge. The last mode provides a range of playful activities, designed and developed during the Plan Mode, to teach and reinforce the concept of maps and route learning and promotes the connection between map-based representations and their corresponding real world locations. Some of the characteristics of the application that identified as of high priority and important by the people with cognitive/physical disabilities and their carers or trainers, were the following: full and detailed user manual, alerts user when approaching a dangerous situation, allow real time monitoring, remote tracking of user, game based learning approach, interactions with the application should be mistake tolerant. RouteMate's functionality has proven to be a successful methodological approach as it raised issues that one can function as a normal adult and either change towards academic goals or even apply for a job improving oneself independence and self-preservation. A qualitative evaluation of the Recall project showed that the use of the Route Mate system engages participants with Intellectual Disabilities and additional sensory impairments in independent travel training, developing navigational skills and increasing measures of self-determination, motivation and memory. Additionally, the reliability of the application seemed to play an important role as the technical problems started to be resolved and the participant's stress levels decreased whilst their confidence increased [35], [36], [37].

In the framework of another project called Epinoisi, digital games-based (DGB) educational material for special education teachers supporting students with Mild Intellectual Disability (MID) was developed. The project focuses on the outcomes of using such content to enhance the inclusion and motivation of these students in the educational process. Students with Intellectual Disability (ID) are often described as 'slow learners' whose need for special education, adapted to their needs and capacities, is essential. The Epinoisi project has adopted a DGB learning approach to the development of digital games-based educational material from scratch, for students with MID. Educational content relevant to language and mathematics skills, interpersonal relations, communication and other aspects of everyday life, either real or digital, based on free on-line entertainment game applications were used as a virtual drill-and-practice role/playing in order to facilitate their socialization. Also, a multi-episode adventure tale application, the Magic Potion, developed from scratch to provide modular game-based material for basic literacy, numeracy and social skills, as well as an amusing game play experience taking away the feelings of stress and failure. It comprises of narrative scenes and some 20 micro-games in total. Serious games are a highly effective learning tool for both general and special education because they motivate students and boost their self-confidence. They also support a framework of equality and acceptance of diversity. With regard to kids with intellectual and other disabilities, the game's plot is created to avoid tread-milling and make failure and success even funnier than failure [38], [39].

In contrast to all prior initiatives, researchers created a framework for the Spe-Ler project that proposed a serious gaming strategy, decoupling the game from the didactic content that seemed excessively moralizing for the target audience of young people. The didactic content appears between the game's two stages, providing the player with a "dilemma" to consider the material being presented. The content is provided during short interruptions using short movies followed by a question. All participants had a positive attitude against the movies and were very attentive when the didactical content appeared. Measuring the user's joy it was found that the participants enjoyed playing the games, because the key point is that the games are played for fun without any didactical content. Under the specific programming framework each one of the 6 arcade games that were imported in the environment was compatible with the Spe-Ler concept. Adding only a few lines of code makes it easy for non ICT people to create personalized gaming sessions, useful in other domains of very young children, as well [40].

In order to help youngsters with educable mental disabilities enhance their psychomotor skills and hand-eye coordination, Karal, H., et al. (2010) designed an instructional computer game and examined its usefulness. While being followed by another study participant, the user moves to try to follow items on the computer screen with his eyes and catch them with gestures. The user's movement is detected by a webcam, which helps the coordination of hand-eye fine-motor abilities (specialist teacher and physiotherapist). The instructive computer game attracted the children's attention and piqued their curiosity, according to observational results



and the researchers' records. In addition, its multimedia features increased users' motivation and supported their psychomotor abilities. Thus, it can be concluded that the game is suitable for special education in terms of design and interaction [41].

Another game-based learning strategy uses classic building blocks along with mobile service features to explore brand-new instructional scenarios made available by the mobile application. The educational games were created using 3DU Blocks under an Open Source license, which promotes combining and sharing physical and digital interactions between kids and adults. The following four games use toy blocks to help players produce simple melodies (Musical Game), pay for products (Shopping Game), form words (Spelling Game), and assist a monkey in grabbing bananas. These new self-learning experiences are based on the idea of 3DU Blocks (Programming Game). The learning experiences meet three principles: real-time feedback, visual and haptic skills complemented with sounds and scaffolded set of challenges of increasing difficulty. The development of applications such as 3DU Blocks that mix physical and digital objects in new gaming and learning experiences engage learners with difficulties in processing abstract content and enhance haptic and proprioceptive skills. The main aim is to improve the potential of each learner as long as the new gaming experience is self-correcting, promotes multi-sensory interactions, and its challenges are grouped by difficulty in a structured environment which is in line with the principles of Montessori education [42].

VI. CONCLUSIONS

One of the foremost quality features of digital games is their capacity to include a rich variety of auditory, tactile, visual and intellectual stimuli that triggers students' motivation to focus on the task and increase learners' familiarity with thematic concepts. Playing can have an emotional impact on players, increasing their self-esteem and enabling them to engage in social activities, having a calming effect on participants and helping them remember facts more vividly. Therefore, it is essential to link game concepts to real life, explaining key actions in the digital game that mirror real life concepts: What is the main topic of the game? What did you learn from the game? What is the goal of the game? What do you need to do to be successful in this game? What would happen if...? In this regard digital games provide an additional way to motivate children to understand topics through play that they might otherwise find too complicated [1].

Research shows that games provide a variety of basic psychological needs including autonomy, competence and relatedness that result in some reward or fulfill some basic need related to reinforcement. Games, in fact, teach children complex task and abilities and result in the way players see the world and process information that enhance learning. A proper level of difficulty keeps individuals right at the edge of their ability, providing several user-controlled difficulty settings. Action video games promote a model of how to teach children complex and difficult tasks and abilities, representing a form of play that can be harnessed for serious good, namely improvements in a wide variety of perceptual, attentional and cognitive abilities. Action video game training enhances aspects of vision such as contrast sensitivity or the ability to detect small incremental changes in shades of gray. Video gaming also improves visual selective attention which is the process of choosing which stimulus should be filtered. Other key components are the abilities: to focus on objects across time, to attend to distinct objects, sustained attention, impulsiveness, vigilance, cognitive flexibility and executive functioning including task switching and working memory. Real-World uses of Video Game training include individual with amblyopia, strabismus, and cataracts and demonstrate the positive effect that video game play can have on improving vision. Games use a number of techniques known to promote efficient and transferable learning creating a great number of positive outcomes, for a variety of practical purposes [43].

It is proposed that video games are both invariably positive and necessarily remedial for young people with SENs to nurture skills and knowledge in the games environment and in other contexts as well, such as the classroom, daily activities and peers relations. There isn't a lot of study on how people with learning disabilities or other disabilities utilize video games. Video games present a variety of challenges for children with Special Education Needs (SENs) depending on the nature of their impairment, but there are many other factors that make them highly engaging and beneficial for learning and developing abilities. From a psychological perspective, the potential of games to support and extend cognitive development have led them to exploit the medium both in assessment and intervention. Thus, video games can improve communication, satisfy the needs of kids with physical, sensory, and visual impairments, and help kids with ADHD with their memory function. They can also improve spatial skills. Though challenging and engaging, video games run the risk of becoming less accessible to people with special needs due to advancements in game technologies and content. However, the appeal of games outweighs the difficulties, and it is also suggested that there are games that can be played at various levels of difficulty, allowing people with SENs to interact with this new technology in the same way as people with Typical Development. Learning may be made entertaining and successful by playing good games with the potential to motivate and improve skills. Discovery via errors is an important factor of learning in helping children to acquire challenging skills. Hence, failure in a game context compared to traditional



educational activities is more readily tolerated, not necessarily threatening to the ego, but just a drive to repeat and try again. Moreover, video game play is in a sense a natural exercise in Working Memory (WM) performance which is an essential capacity when playing many video games and entails keeping things in mind while performing complex cognitive tasks [44].

The ability of games to engage and inspire for non-entertainment objectives has grown over the past ten years, which has enhanced the learning process. The setting for the new paradigm of learning in education is examined by De Freitas, S., and Liarokapis, F. (2011), who take serious games and gamification into consideration as essential concepts in the ensuing years. According to them, personalized modeling will place more of an emphasis on social interaction learning than teacher-centered and solitary study within the framework of avatar-driven scaffolded techniques. Additionally, by combining multimodal interfaces and placing pedagogy at the forefront, they established the core conceptual framework for serious game design [7]. They did this by bringing together many lines of research in educational research, computer science, and neuropsychology.

Overall, it may be said, the interrelatedness of digital technologies in education domain is very dynamic and successful, facilitates and improves the educational approach via Mobiles [49-62], various ICTs applications [63-99], AI & STEM [100-111], and games [112-121]. Additionally, the combination of ICTs with theories and models of metacognition, mindfulness, meditation and emotional intelligence cultivation [122-164] as well as with environmental factors and nutrition [45-48], accelerates and improves more over the educational practices and results.

VII. REFERENCES

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