22 Drafting the individualized education plan for students with ADHD: Can ICT assist with inattentive learning?

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22.1 Abstract

Nowadays, the number of children identified as having specific learning difficulties is rising. This fact highlights the possibility of having children with these difficulties in every class (Macintyre, 2003). Specific learning difficulties (SPLD) is an umbrella term used for Dyslexia, Attention Deficit Hyperactivity Disorder (ADHD), Developmental Dyscalculia (DD), Dyspraxia and Specific Language Impairment and appears approximately at the 7-10% of the population. These children have difficulties in learning and are diagnosed according to the discrepancy criterion (Reid, 2009; Bishop, 2004) which indicates a discrepancy between good intelligent and pure academic performance.
Primary intervention for children with SPLD is crucial and for that reason significant effort has been made to develop educational tools with the use of ICT, suitable for children with special educational needs as children can benefit from the use of new technology. Examples of the use of ICT and a currently running research are presented.

Keywords: SPLD, ADHD, Developmental Dyscalculia, ICT

22.2 Introduction

22.2.1 Symptoms of Developmental Dyscalculia

The most significant symptom of DD is the mathematical anxiety; often these children suffer from stress when they deal with maths and usually they create negative emotions and perceptions about them (Shalev, 2004). Karagiannakis et al. (2014) grouped the symptoms into four categories:

a) Visio-spatial difficulties (in which belong children that have difficulties with mathematical symbols or understanding geometric shapes).
b) Retrieval difficulties (when children struggle to retrieve arithmetic facts, such as multiplication table).
c) Difficulties in estimating quantities and comparing and linking numerical contributions with quantity and numeracy, and
d) Difficulties in math reasoning (when children struggle to find which strategy is more appropriate in order to solve a mathematical problem).

Children may improve the acquisition of mathematical concepts and abilities such as calculation with appropriate teaching (Shalev, 2004; Rosselli et al. 2006). Students with DD often relate maths, numbers or even words related to maths, with negative feelings and anxiety. Rubinsten and Tannock (2010) in their research concluded that DD is strongly related

to math anxiety and fear; they also noticed that the felling of fear grow when there was time pressure.

22.2.2 Use of ICT in education for Developmental Dyscalculia

ICT and technology is integral in school programs nowadays and also it has been found that it helps children with Specific Learning Difficulties (SPLD).

According to Drigas and Ioannidou (2013) ICT can assist with teaching and learning. Computer games applied to pedagogical approaches can significantly help children that face difficulties at maths (de Castro et al., 2014; Coştu et al., 2009; Griffin, 2004). There is a variety of technological types that can help pupils with SPLD and especially those with DD, and divided into the following categories: mobile applications, computer games, assistive technology, software and virtual environments; all these, however, need support and the appropriate guidance from teachers.

Applications – software

According to Nagavalli and Fidelis (2015) there is a variety of applications that help children with DD and one of the mentioned ones in the research is “The Number Race” which can help the children to develop visual-spatial connection to numbers. Pupils through such applications can see and understand the relation of symbols to physical space and can also adjust to pupils’ level.

“Number Race” helps young children understand the basic number concepts and the older ones to conquer the sense of numbers and to be able to count, add, abstract and divide (www.thenumberrace.com, 2018). Wilson et al. (2006) also tested this specific application and concluded that children made significant progress in numerical cognition.

Another application is the “LongDivision” for iPods that help pupils solve long-division problems. While, at the same time, it animates all the steps that need to be done for the solution (division, multiplication, deduction) (Nagavalli and Fidelis, 2015).

Furthermore, Ariffin, Halim and Abd (2017) investigated the results of the mobile application “Calculic Kids” which is addressed to pupils with DD, in Malaysia. The researchers concluded that such applications could help and ease children with mathematical difficulties in order to learn mathematics efficiently and deeply understand the basic numerical system (decimal).

“TouchMath” is addressed to children of all ages beginning from pre-kindergarden years. It is based in multisensory math teaching and aims to deep comprehension of number facts, so that children do not guess but find the right answer and the way to solve a problem (www.touchmath.com, 2018). At the same time it helps children to form a size-quantity relationship while being asked to find, touch or draw numbers (Nagavalli and Fidelis, 2015).

Computer games

Research that dealt with an educational program based on computer games and tested on 7-year-old DD children, concluded that there was improvement of mathematics and numerical capacities of the students after their avocation with the programme in which pupils asked to execute arithmetic operations. In the same research the teachers’ perception about the usage of computers in teaching kids with DD was positive (Mohd Syah et al., 2016).

Another research concerning educational computer games investigated the attitudes of pupils towards this type of teaching and learning is in line with the above; children stated that they found it interesting, fun and very helpful and most of them agreed that this kind of technology should be used all the time in maths. The research also proved that there was reduction of mathematical anxiety and that children form a more positive attitude towards maths (Coştu, Aydin and Filiz, 2009).

Moreover, an example of such computer programmes is the “Number Shark” that consists of 45 computer games that try to improve step by step the mathematical skills of pupils, especially those with DD, and their comprehension and perception of the four basic mathematical operations, the number system and the sequencing percentages (Nagavalli and Fidelis, 2015).

22.2.3 Virtual environment and digital games

De Castro et al., (2014), studied the effect of virtual environment in mathematical skills of children 7 to 10 years old. The results showed improvement in mathematical skills of DD students and that this kind of environment worked as motivation and encourage these children to participate and try more. Tests showed improvement after the experiment in contrast to children that had not had computer based reinforcement. Students in this research also mentioned that this type of teaching was a more interesting and fun than the traditional one.
Furthermore, according to Laurillard (2016) digital games can also help in improvement of mathematical difficulties. Digital games are efficient in achieving independent learning; something quite important for DD students that usually need more time and active engagement in order to comprehend the subject and the sense of the teaching.
All the above cannot replace the teaching of mathematics but they can help children with mathematical difficulties to deeply understand the meaning of numbers and encourage them to try and getting over these difficulties while at the same time they can have fun(Mantzana and Nikolopoulos, 2017).

22.2.4 Individualized learning plan/ intervention program

Educators should take into account the needs and weaknesses of each child and the possibility of the co-occurrence of SPLD (co-occurrence of dyscalculia and ADHD) for this reason an individualized plan is necessary. Educators should take into consideration the anxiety that these children present when they have to do with maths, as it is a factor that can exist either as a symptom or as a cause of the impairment (Shalev, 2004).
Consequently, teachers have to help students to minimise their stress. According to Wadlington and Wadlington (2008) the positive reinforcement is significant. The use of computer games such as the “NumberShark” can reduce students’ stress and form positive attitudes towards maths.
Students participating in research stated that they found the “NumberShark” fun, interesting and helpful (Coştu, Aydin and Filiz, 2009). Using this game in teaching students with DD helps them to see the relation between numerical facts.
It is essential for the teachers to break down the lessons into smaller parts and move on progressively and step by step and present the teaching material well organized (Plemmenou and Nikolopoulos, 2017; Wadlington and Wadlington, 2008; Sharma, 2003; Kay and Yeo, 2003). Moreover they should be given small volume of homework and the assignments or the mathematical problems should be broken into smaller parts, in order to be easier for the pupils to process and store in their memory, efficiently mathematical facts (Wadlington and Wadlington, 2008). It is significantly helpful to receive feedback for each part (Laurillard, 2016). The student could be encouraged with computer games such as “AdaptedMind Math”, as students can start from the simplest operation and progressively continue to more complicated when at the same time they have immediate feedback.
However, when DD coexist with dyslexia educators should work on vocabulary, especially maths vocabulary. That means that teachers should focus on the explanation of words and symbols of maths using examples from children's everyday life. For example, they could create with the children their own mathematical dictionary and slowly, but progressively, add new words to it, which will have first been worked in classroom. Also children could use these words into their own examples in sentences, for teachers to know what they have learned (Wadlington and Wadlington, 2008). Teachers could use “MathisFun”, an online math dictionary where virtual representation objects progressively turned into symbolic representation e. g. 3 - 1 = 2. It might be helpful if children write their own problems, or the teachers give them problems that are directly related to their daily life (Plemmenou and Nikolopoulos, 2017; Wadlington and Wadlington, 2008; Payne and Turner, 1999). However, in children that present mostly memory and retrieval difficulties teachers need to first work with the sense of the material that pupils have to memorize. In order to do so, breaking the material into chunks is one of the solutions. By this way children could see the relation between numerical facts, to understand, for example, that 8*2=2*8. It has been proved that children with mathematical and retrieval

problems were helped by putting the facts into music or give them rhythm (Edelson and Johnson, 2003). Finally, it has been proved that these children were helped also by systematic repetitions (Sharma, 2003) and by explaining out loud the steps they took to solve a mathematical problem (Witzel et al, 2001).

22.2.5 The case of ADHD

Symptoms

According to the American Academy of Paediatrics guidelines (2000) the main symptoms of Attention – Deficit Hyperactivity Disorder (ADHD) are inattentiveness, impulsivity and hyperactivity. ADHD is also generally typified by lack of continuing task involvement and disorganized or poorly modulated behavior. A person can be predominantly inattentive (often referred as ADD), predominantly hyperactive – impulsive, or a combination of these two. Typically, ADHD symptoms are first exhibited in early childhood and continue to be present throughout adolescence and adulthood (Weiss & Hechtman, 1993). In order to make a diagnosis, Diagnostic and Statistical Manual of Mental Disorders – IV (DSM – IV) is widely used as long as there is not any objective standardized test or any identified aetiology for ADHD. Studies indicate that children diagnosed with ADHD also display comorbid psychiatric conditions such as childhood anxiety, conduct disorder, mood disorders etc. Comorbid conditions must be observed and evaluated as they could "influence severity, daily functioning, treatment and prognosis and thus complicate the diagnosis, treatment and prognosis of ADHD (Connor, 2003, Waxmonsky, 2003).

ADHD cannot be considered as a disease nor a neurobehavioral condition but a collection of core symptoms (inattention, impulsivity and over – activity) that comorbid with other mental health conditions. An initial evaluation that would include an interview with the parents, the use of standardized rating scales, school information and teachers' remarks, a psychiatric assessment and a complete physical examination is best recommended (Greenhill et al., 2002).

According to Pavlidis and Giannouli (2013), there is a significant comorbidity of ADHD and special learning difficulties, especially with dyslexia. The correlation between the inattentive type of symptoms of ADHD and dyslexia is stronger than the hyperactive – impulsive ones. The hyperactive – impulsive symptoms are often associated with behavioral problems. In general, students with ADHD and dyslexia display slower naming speed, processing speed, working memory deficits, inhibition deficits and face more difficulties in "estimating the duration of a task". Furthermore, they appear to be forgetful, they are easily distracted and disorganized and because of them they are missing social cues, they get into fights or frequently involved to accidents due to the hyperactivity.

22.2.6 Individualized learning plan/ intervention program

The U.S Department of Education (2008) suggested that the teacher chooses among different educational practices that are "associated with academic instruction, behavioral interventions, and classroom accommodations that are appropriate to meet the child`s needs."

Improving academic performance

The first step towards forming an individualized educational program is effective academic instruction. Students with ADHD are in need of a carefully structured academic lesson linked to previous knowledge and with new distinct skills to be achieved. Ainsworth (2006) says that constructing a representation rather than just interpreting one, can lead to a deeper understanding of the situations. The use of audiovisual materials is essential. Greenwood et al. (1991) describe peer tutoring as the instructional strategy where in two students collaborate in an academic activity, with one student providing assistance, instruction and feedback to the other. Task modification also enables students with ADHD to reach higher levels of academic performance (DuPaul et al., 1998).

22.2.7 The use of ICT in education for ADHD

Significant efforts have been made in order to develop educational tools that offer the use of ICT, suitable for children with special educational needs. There is a growing literature which indicates that students with ADHD can benefit from the use of new technology. Drigas and Tourimpampa (2014) point out the fact that ICT enhance systematically the investigation on mental disorders field, as they are hot topics in children's lives and present more accurate and valid measurements.

Computers generally enhance students' learning ability as they provide learning at the individual's pace, they promote constructivist learning with instant reinforcements and feedbacks. Moreover, the presentation of information visually, auditory and kinaesthetically appears to be stimulating and motivating, especially for students with attention problems and/or hyperactivity – impulsivity. When students with ADHD symptoms work on computer, they spent longer time practicing and completed a twofold amount of exercises than they would if paper – and – pencil tasks were used (Solomonidou et al., 2004).

Ford et al. (1993) concluded that students were more attentive when using gaming software linked to the curriculum, especially when reply time was unlimited.

Furthermore, computerized cognitive – training programs proved to be effective tools for the management of ADHD symptoms, aiming to increase attention and reduce impulsivity. (Navaro et al., 2001)

Solomonidou et al. (2004) stated that when students dominated the use of computer, paid more attention and were less energizing. In addition, when they had to actively engage with the software program, students with ADHD behave similarly as students without ADHD. The above mentioned researchers emphasized on the fact that students with ADHD symptoms react typically under certain circumstances of using computer and multimedia: they prefer watching videos and pictures, listening to short narration items, reading short texts and above all working individually, unless they work collaboratively in highly interactive constructivist – type software.

As stated by Raggi and Chronis (2006), Computer Assisted Instruction (CAI), with specific instructional objectives such as apportionment of content, multisensory provision and immediate feedback improved students' attention and working attitude. Schrieber and Scheifert (2009) examined the use of handheld computers/PDAs by students with learning difficulties and ADHD. They confirmed their premise that the devices helped students with their organizational and memory related difficulties enabling them to concentrate on their tasks and improve their self – esteem. The use of a computer assistive software intervention, that Hecker et al. (2002) proposed, improved reading speed and simultaneous attention while enhancing positive attitudes towards school settings in students with attention disorders. Ota and DuPaul (2002) also promoted the use of game formats as an additional resource in order to amplify the teaching of the curriculum, especially in mathematics. Shalev et al. (2007) worked on creating a computerized progressive attentional training (CPAT) program which improved attention levels in children with ADHD. The intervention program proved to help in reducing behavioral disarrangements.

22.2.8 The example of Atentiv

Atentiv uses a child's "cognitive signature" of EEG brainwave activity to measure attention, every second. Children play the specialized video game on a computer or mobile device. The game illustrates a desired action or behavior to achieve a stated goal. The child instantly modifies his/her actions to set a path toward the goal. The AV headset amplifies and sends electrical brain activity to the tablet via Bluetooth. When the player is focused, the avatar moves forward. When the player is not focused, then the avatar stops moving. (Atentiv.com, 2018)

Three pilot studies examining "Atentiv" have been completed and more than 50 children (aged 6 to 12) participated. Children received 8 to 10 hours of training per week for 8 to 10 weeks and ADHD symptoms improved by approximately 30% to 50% in 80% of the subjects as rated by parents and clinicians. Behavioral improvements were sustained for three to four months

following training, which was as long as the researchers followed the children. (Hamadicharef et al., 2009, Lee et al., 2013 and McDermott et al., 2016).

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