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ICT and collaborative co-learning in preschool children who face memory difficulties

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ABSTRACT

Recent development in the role of education in pre-school children includes the use of Information and Communication Technologies (ICTs). ICT nowadays is considered as a tool that can foster the knowledge and the collaborative co-learning for this crucial age and the support of specific areas in kindergarten according to the educational perspective and the areas of needs they serve, is thought important. In this study we present a brief overview of the most representative studies of the last decade (2003–2014), which concentrates on the collaborative co learning and other ICT applications in kindergarten children who face memory difficulties. The effectiveness of ICT in literature, in maths and in children who face learning difficulties is examined. Additionally, the effectiveness of collaborative intervention and diagnostic tools for children with poor working memory in kindergarten children is examined. Concluding, this review, points out certain technological breakthroughs of several researches that focus on the support of children with such deficits.

1. Introduction

Nowadays kindergarten education is thought and considered to be very important in all over the world. As it is believed kindergarten students are very curious to their environment, open to learn and try new activities and thus kindergarten education is thought meaningful to enable them to understand their environment. It is thought also important for kindergarteners to experience and learn by doing and for this reason educating young children is vital for future concept development (Hinostroza, Labbe, & Matamala, 2013). The key role of early childhood education for improving educational outcomes, as well as the collaborative learning, across the educational system has gained international recognition during the last decade, especially among the developing countries (Ananiadou & Claro, 2009). However, in many cases we do not talk only about kindergarten education but also about childhood school as a place where education and collaborative learning are possible and supported by a well-defined pedagogical strategy that includes all the previous caring activities. In childhood school–kindergarten, readiness skills (listening, following directions, etc.) and academics (alphabet skills, colours, numbers, etc.) can be observed. Additionally, cognitive skills, which cover a wide range of mental abilities, including memory and learning strategies can be, also be detected in kindergarten education (Can-Yasar, Inal, Uyanık, & Kandır, 2012).

In the recent years there has been an interesting on educating kindergarten children with the support of Information and Communication Technologies (ICTs) (Drigas & Ioannidou, 2013) and therefore this fact has reinforced the use of technology as a mean of overcoming barriers to their learning enhancing the collaboration among children and school staff (Kucirkova, Messer, Sheehy, & Fernandez Panadero, 2014). However, there is now a general agreement amongst different specialists that ICT can support a child's skills as well as can create a developmental appropriate learning environment depending on the needs they have, the curriculum requirements and the collaboration among the preschool children and the teachers. Their use has been established in primary, secondary and high schools for a number of years now and their profits have been well documented, in many areas (Staarman, 2009).

In addition, many studies have supported the view that ICT can foster the literature, early mathematics, cognitive, emotional–social, motor skills and enhance the creativity and cooperation of kindergarten children as well as can provide children with additional opportunities for rich learning activities that are relevant to their growth characteristics and have positive results in regard to the learning of different topics (Vernadakis, Avgerinos, Tsitskari, & Zachopoulou, 2005). Moreover, attention has focused on an observed engagement factor when students use the devices,

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and how they appear better capable than other technologies such as laptops and desktop computers, to promote learner collaboration. A relative study undertaken by Fisher, Lucas, and Galstyan (2013) compared using iPads and laptops with student pairs, states that students who use iPads reveal significant benefits from using them if learner collaboration is a goal. Also, according to Falloon and Khoo (2014) new devices promise important results that are very encouraging, and underline the potential of collaborative learning environments promising opportunities to raise the quality of students learning.

On the other hand, there is a matter on assessing kindergarten children who need special education with the support of ICT and so the use of new technology as a way to minimize their difficulties and reinforce the cooperation with the school staff and the children is thought a very serious issue (Plowman, Stephen, & McPake, 2010). Existing studies on the introduction of ICTs in pre-school special education argue that can provide children with additional opportunities for rich learning activities that are relevant to their growth characteristics and have positive effects in regard to their learning difficulties (Verenikina, Harris, & Lysaght, 2003). Besides, computing has an indescribable power to influence and connect the population as technological applications promise great expectations for all types of relationships. Additionally, researchers state that preschool children with the support of ICTs can better communicate by enhancing interactive conversations while technological developments affect those children who cannot multitask or face learning difficulties including children with memory problems (Fridin & Yaakobi, 2011).

Specifically, observable behaviours that, probably, show future learning problems in preschool usually, include hyperactivity, impulsivity, cognitive deficits, distractibility, and memory problems (Stevens, 2004). Furthermore, memory is a key ingredient of cognition that plays a basic role in cognitive development. Memory has a number of domains including long term and short-term memory while the short-term memory's main part is working memory and long-term memory consists of a declarative, procedural and perceptual representation system. Close links between memory functions and many aspects of learning and academic achievement in children are well sanctioned. Memory skills of children with special needs have been a domain of great research for professionals over the last years as there are findings that claim that poor memory skills characterize children who fail to progress in different areas of needs. Memory impairments can also have negative consequences on social factors and the sense of personal history besides, this kind of deficits may affect academic performance and can result in low self-esteem. However, it is well known that computerized programs seem to be a promising new approach for collaborative learning as well as for people with cognitive difficulties (Drigas & Dourou, 2013).

Taking the above into consideration, our scoping study drew upon national and international publications as well as the research findings of the most representative studies of the last decade, which concentrate on the use of ICT in the kindergarten in terms of a collaborative learning, in order to support children who face memory problems. This paper will focus on recently conducted studies that introduce software applications programs for diagnosis and intervention purposes of preschoolers who face memory difficulties and need assessment in the areas of literature and math. In addition, intervention tools that support children who have poor working memory as well as children who face learning difficulties accompanied with memory deficits are presented.

2. Diagnostic tools for memory deficits

Early identification and intervention for children with memory problems has been strongly recommended. Professionals in psychological, medical, scientific, and educational fields have stated the importance of the years between birth and five years, for learning. If there is any risk of difficulties, these early years seem even more serious (Blackwell, Cepeda, & Munakata, 2009) as there is a history of research supporting the importance of early identification and intervention. One value of early identification and intervention is that it provides a base for later learning and could thereby raise later academic success experiences for children at risk. In addition, early identification can prevent secondary problems from occurring because it prevents the need for more extensive education services in the future and leads to more inclusive and cooperative programming (Steele, 2004).

According to the above, in a current study, Alloway presented the Automated Working Memory Assessment (AWMA), a standardized computerized tool that can diagnose memory problems. This tool helps teachers and psychologists to assess memory skills with a user-friendly interface. AWMA includes three levels of assessment and is designed for students with suspected-especially-working memory difficulties. General speaking, AWMA is a computer-based assessment that provides three measures each of verbal short-term memory, visuo-spatial short-term memory, verbal working memory, and visuo-spatial working memory (Drigas & Ioannidou, 2013). Specifically, AWMA Short Form (AWMAS) is used for screening learners who are suspected to have memory deficits, but the main area of their difficulties is not known and AWMA Long Form (AWMA-L) which is suitable for confirmation of working memory problems for learners identified as having working memory problems in the classroom (Alloway et al., 2005; Drigas & Ioannidou, 2013).

In a similar research (Nevo & Breznit, 2011) the findings suggest that the ability of working memory skills at 6 years of age, before reading is taught can predict for reading abilities. Specifically, the researchers claim, that among all working memory components, phonological complex memory usually predicts all reading abilities suggesting that a minimal ability of phonological complex memory is necessary for children to gain a normal reading level. In the current study, a battery of 28 tests assessing general and cognitive abilities, were administered to the preschoolers who participated. A total of 11 tasks assessed children's working memory ability. Of these tasks, 9 were taken from the Automated Working Memory Assessment (AWMA) test suite (Alloway et al., 2005), which is suitable for this age, and 2 other tests were developed for the specific study via computer. The AWMA test was originally designed to be administered by computer, with the test items presented on the screen or spoken by the computer to participants in English. However, in the current research only the visuospatial subtests were administered via computer and the examiners in their language administered the verbal subtests orally. All children were tested in a quiet place by two examiners and the results claim that the tests that were revised in similar versions a year later have practical implications for the early identification of reading difficulties as well as for the design of optimal intervention about the memory difficulties.

Furthermore, Aristodemou, Taraszow, Laouris, Papadopoulos, and Makris (2008) developed a battery of Internet based applications which collectively operate as a screening test of cognitive abilities capable not only to predict children at risk of learning difficulties but moreover to equip the teacher with a profile of mental abilities relevant for choosing and designing personalized programs. This study evaluated the capability of the new computerized cognitive battery of tests to predict reading performance. Specifically, the MAPS (Mental Attributes Profiling System) battery addressed eight major domains of language independent tests that have been linked to learning difficulties (such as short-term and visual memory, short-term auditory memory, and auditory and visual discrimination). The findings of the research suggest that

this test can diagnose memory problems in children supporting the view that five main domains (lateralization, auditory memory, categorization, sequencing and auditory discrimination) can be strong predictors for later reading problems. The research conclude claiming that MAPS can create a child's profile signifying abilities and problems in learning and can screen memory problems in very young children as well as in children who are bilingual or multilingual offering an assessment in a broad spectrum of cognitive processes.

Last but not least, one of the most widely used software tools is the Cognitive Profiling System (CoPS), a computerized psychometric assessment system that identifies the cognitive strengths and difficulties for kindergarten and primary school children. CoPS is consisted of eight tests in the form of game that takes around 20 min to be administrated while is used across the UK, Scotland and British schools around the world. According to the developers, the students are tested in sequential and associative memory, in auditory and colour discrimination and in phonological awareness offering a picture of the child's level of development in the relevant areas at the time of school entry. Although this tool not primarily intended for diagnostic purposes, it could however, identify children who are weak in various aspects of learning and thus can be used to in decision-making about appropriate teaching and learning approaches for such children (Singleton, 2004).

3. Support children's memory skills in literacy

The rapid growth of Information and Communication Technology has led to an important increase to the use of computers at the pre-school age, especially during the first decade of the 21st century. As a result, there have been designed sites even for infants and a lot of them offer free online games and activities for toddlers and preschoolers (Quinn, Osher, Poirier, Rutherford, & Leone, 2005). The many software programs aimed at young children have persuaded parents and teachers that there is no limit to the computer's educational value as research findings indicate that children who use the computer and are gradually getting better at navigating around, have better self-respect and confidence, develop their cognitive abilities, enhance better cooperation and collaboration with the other children, explicate math skills, fine-motor skills and eye–hand coordination and facilitate learning and development in kids with special abilities (Ντολιοπούλου, 2006).

According to a recently conducted study, it is examined the emerging inquiries and dialogue of five- to six-year-old kindergartners taking place around computers as they are engaged in a mapping project in a technology-rich classroom in the U.S. According to the researchers, the in-depth analysis of young children's conversations in a technology-rich classroom helped their perceptions of the computer-based technology as a learning tool. The findings showed that cumulative talk patterns among the children evolved into exploratory talk while children's ideas, thoughts and questions were intentional, contemplative, and autonomous. Additionally, the results showed that children's speech and dialogue influenced their emergent technological literacy skills as the peer collaboration and teacher input enhanced student development while their literacy and cognitive skills showed improvement (Hyun & Davis, 2005).

Moreover, an existing study, (Rambli, Matcha, & Sulaiman, 2013) describes the design and evaluation of an Augmented Reality based book for teaching the alphabet to preschool children supporting also their memory skills. According to the developers this intervention tool offers a rich media-learning environment to the children because is used together with camera and computer and children can view the huge virtual alphabet in a fun and interactive manner using the pattern markers as an interaction tool. Additionally, the research showed that fun learning might increase the ability to memorize and understand the learning concept besides the brief interviews with the teacher who participated suggested that this program seems to grab the attention and memory skills of the children. According to the developers, teaching young children could be difficult due to the focus of young children is different from elderly since they could only focus on something for short period of time. However, introducing animation, virtual objects, sound and video teaching can generate excitement, engagement, collaboration and enjoyment during the learning process and can foster children's memory skills in literature. The study conclude stating that the unique interface of combining real and virtual objects do acts as a natural attention grabber as well as an engaging and fun learning tool for this age group.

It is well known that kindergarten children generally are engaged in literacy-related activities at home and in school. As a result, most children develop some understanding of letter–sound relationships before formal reading instruction starts in first grade, despite the fact that not all children benefit equally from natural stimuli in their environments, as a result of their poor regulatory skills (inhibition, memory, flexibility) (Miguez, Santos, & Anido, 2009). Children with poor regulatory skills are less proficient in planning, organizing, and applying rules, are easily distracted and impulsive, and have problems dealing with changing tasks (Kegel, van der Kooy-Hofland, & Bus, 2009). According to the above view, Kegel et al. (2009), designed an intervention activity that improves the early phoneme skills in order to assess preschoolers with poor regulatory skills. The Internet program Living Letters, that was used at practicing phoneme skills uses the spelling of a familiar word like the child's name to draw attention to phonemes in spoken words, is available for teachers and is presented with an attractive animation that explain the upcoming games and offers fun and enjoyment. The results of their investigation showed that children scoring in the normal range on regulatory skills did benefit from Living Letters. In addition, the program can also be used as a diagnostic tool to detect poor regulatory skills as a barrier to learning and is thought a valuable teaching aid. Nevertheless, the research states that children with poor regulatory skills did not benefit from the computer intervention, probably due to their failure to ignore distracters and to choose an adequate problem-solving strategy (Van der Kooy-Hofland, Bus, & Roskos, 2012).

Last but not least, Fridin (2014) claims that the storytelling robot successfully promotes children's emotional involvement in the learning process emphasizing that kindergartners show benefits from playing educational games with the robot in the areas of literacy and cognitive skills. More specifically, the author supports, that Kindergarten Social Assistive Robotics (KindSAR) is a novel technology that offers kindergarten staff an innovative tool for achieving educational aims through social interaction promoting communication and great enjoyment between the children helping also them to develop their vocabulary, their attention, perception and memory.

4. Support children's memory skills in maths

It is well known that early years are the important years to develop children concepts and also critical and creative scientific thought (Saracho & Spodek, 2009). A kindergarten child needs the opportunity to apply its skills in a variety of learning environments, and is strongly recommended that the digital learning media can contribute to the learning of mathematical skills. Many aspects of early informal learning of mathematical concepts, such as numbers, arithmetic problem solving, and spatial syllogism along with general geometrical knowledge, are developed during

the kindergarten age (Zaranis, Kalogiannakis, & Papadakis, 2013). Research has supported the view that new technology can help young children learn mathematics and there are several studies that can improve this theory (Clements & Sarama, 2007). However, memory skills are important predictors of children's success in school (Alloway et al., 2005) especially in the domain of mathematics, which is one of the most important subjects in school. Maths learning is related to early math performance or children's early numeracy, as the most important components of early numeracy are counting and quantity knowledge (Toll & Van Luit, 2013).

One of the mathematical areas investigated recently in preschool education is also, the notion of probability (Magyart, 2010). Research has shown that children at the age of five to six may understand the randomness, as they recognize the likelihood of events (Batanero, Godino, & Roa, 2004) they make causal inferences (Kalas, 2013) and they can make use of basic probability notions (Janka, 2008). A current conducted study investigated whether preschoolers respond to the mathematical notion of most probable using their memory skills and the cognitive skills in a probabilistic game designed on the computer. This random-game, named "Shoes and Squares", let children to get involved and express the most probable outcome among different conditions with structural changes in the composition of the sample space. Children were tested on whether the gradual alterations in the analogies and distribution of the items in every condition affect their predictions (Nikiforidou & Pange, 2010). The developers claim that, preschoolers were personally engaged and seemed to interact as they made estimations and seemed to get affected by the constructional changes among the sample space. They also state that children's cognitive skills improved and that such finding offer educational implications taking into account not only the teaching and constructing of probabilities in kindergarten but also the role and use of technological means in the classroom.

Also, another research focuses on the experimental study of a specific learning activity (adaptation of a more general model known as "Monster Exchange") that puts emphasis on the use of the Internet as a communication tool and developmentally appropriate for preschool age (Fessakis, Sofroniou, & Mavroudi, 2011) that promotes the collaboration and the cooperation. Taking the above into consideration, the developers designed and tested the "Shapes planet" a learning activity that constitutes an adaptation of a general paradigm known as Monster Exchange. Its learning content includes activities that enhance familiarization with ICT skills, various Internet services, reinforce of memory skills and geometry. According to the research findings, the application of the activity may be assumed successful as the activity gives the children educational opportunities related to naming and building shapes, use of colours and the concept of number, within an original and attractive communicative framework, which asks the use of the Internet and the training of the memory skills. The study finally argues, that the activity that can be applied in classroom settings, is effective in terms of learning and appealing to students and lastly has the potential to emphasize the collaborative learning supporting the cognitive aspects of learning (Fessakis et al., 2011).

Additionally, Kroesbergen, van't Noordende, and Kolkman (2014) examined whether working memory can be effectively trained in kindergarten children and what kind of results may show to their numerical and communicative skills. The outcomes of their study displayed that the children who occupied with the computerized games that required from them to memorize, to process, and to activate information had very good effects in their working memory skills. These results are related to a previous research, which indicated that various working memory functions could be improved through training in older and in preschool children (Swanson & Kim, 2007). More specifically, this study proved the advantages of working memory training on children's early numeracy skills and two different working memory-training programs were implemented (a domain-general and a domain-specific one). The finding of the study claimed that the children in both experimental conditions improved more in counting skills and quantity in comparison to children in the no-intervention control group. Despite the fact that former studies with older children (Holmes, 2009) had shown generalization effects on problem solving or in math, this study is the first one that has found generalization effects of working memory training on early numeracy in young children. In conclusion, the researchers claim that the advantage of this type of intervention is that it can easily be implemented in the regular kindergarten class, because it can be given in groups and does not require additional materials while the cooperation among the children is enhanced satisfactorily (Hornung et al., 2014).

Finally, in recent years, with the design of smart applications and programmes several researchers have proposed the use of many devices such as tablets and mobiles in order to develop an appropriate learning environment for the pre-schoolers (Zaranis et al., 2013). Particularly in the subject of mathematics, Goodwin (2010) conducted a research and the results showed that the impact of interactive multimedia on kindergarten students, who have difficulties in representations of fractions, is significant. Specifically, the study states that the use of instructive and constructive application tools (such as Kidpix, Kidispiration and Create A Story) can aid children's performance in a collaborative learning environment. After the intervention, the kindergarteners seemed to be skilled at using symbol notation and at recognising quarters whereas some of them depicted mathematical concepts. Additionally, the researcher claimed that the immediacy of the feedback provided by the multimedia tools allowed for a quicker pace of learning while the results showed that the kindergarteners also improved their memory skills.

5. Support children with learning difficulties and memory problems

According to the National Joint Committee on Learning Disabilities, early indicators for learning disabilities usually include difficulties in speech and language development, in cognitive and social skills, in motor coordination, prerequisites to academic achievement and other areas relevant to meeting educational goals. These indicators may present with problems in self-regulation, attention and social interaction. In precise, research has supported that children at young ages show advanced cognitive capacities through computer-based activities as, they develop their memory, their attention, their literacy abilities, their mathematical thinking, the development of their concentration and motivation to learn and complete tasks, their problem solving capacities and consequently their school achievement (Pickering & Gathercole, 2004). Additionally, multimedia technology can provide children with special needs the appropriate reinforcement in order to achieve the better result for them as it offers the opportunity of presenting information in both verbal and pictorial forms, enabling students with learning disabilities for a deeper understanding of more meaningful connections between visual and verbal arrangements while the collaborative co-learning is supported (Lee & O' Rourke, 2006). Similarly, social conventions and interpersonal skills – such as turn taking is a part of the learning objectives as Plowman and Stephen (2003) state. According to them, children sometimes work together, help each other to interpret error messages or discuss which option to select, but they stressed that the issue of guided interaction is thought significant in order to enhance a well designed learning environment especially for the children who

face learning difficulties. Moreover, a study demonstrates the powerful role of collaborative dialogue between learners and teachers to help scaffold knowledge of how to function in a technology-rich learning environment while the active encouragement of collaboration when using ICT has benefits for the helper as well as the helped. Research also states that computer learning activities can elicit high levels of interest on the learning task and that young children report high levels of enjoyment and engagement especially them who struggle with learning difficulties (Plowman & Stephen, 2003).

In the light of the above statement, the aim of a recent study was to explore characteristics of 5- to 6-year-old kindergartners and peer dynamics who faced emotional problems during a seven-week learning experience in a computer-based technology-rich classroom in the USA (Hyun & Davis, 2005). The classroom teacher, based on her perception of their friendships, placed the children in pairs. Measures of each child's computer proficiency were obtained at the beginning and conclusion of the experience, using a 20-item instrument called the individualized computer proficiency checklist (ICPC), developed for this study. Overall, after this learning experience the children showed improvement to their social skills as their conversations displayed self-confidence, multiple perspective-taking and cognitive skills, and reflective self-assessment. Paired children who differed in computer proficiencies but shared similar interests worked very well, exemplifying Vygotsky's dialectical constructivist perspective on peer teaching and learning characteristics. According to the results of this study, the pairs demonstrating limited computer proficiency frequently engaged in serial turn taking and non-purposeful clicking on the computer screen. The study concludes saying that computer-based instructional technology can be used simultaneously as individual slate, peer-shared slate, and communal slate in a constructive classroom to maximize meaningful learning processes. The author states, that moving further into the twenty-first century new technology may well become a powerful learning tool and resource with which teachers may support collaborative learning in the classroom supporting also children who need special education (Hyun & Davis, 2005).

Furthermore, another study presented a software tool that was designed to support the student at-risk for learning disabilities that might face and memory difficulties and can be used by the students under the teacher's, special educator's or speech pathologist's supervision (Toki, Pange, & Mikropoulos, 2012). According to the researchers, the teacher selects and incorporates suitable activities in a digital environment that can be used in the preschool setting or at the first school age to enhance phonology activities. The young students at-risk of learning disorders, that are entering the world of knowledge, can interact with the computer ensuring undiminished interest on the learning activities. Through an interdisciplinary and experiential approach the aim is to enhance phonological awareness and communication skills and accomplish the best learning outcomes. The software activities are not just a transaction of traditional exercises presented on the computer but benefit from the advantages of technology like moving images, animations, sound and interactivity that create an amusing, playful and effective learning environment according to relevant studies (Toki, Drosos, & Simitzi, 2012). This study therefore, can be considered that contributes to the development of special educational software for students in the first school age that are at-risk of learning disabilities. It has been created according to educational standards incorporating the modern technological developments in order to function as a learning tool.

However, it is common knowledge that special needs require special attention and as a result early education lays the grounds for future development. According to Galecka (2012), Young Digital Planet started to create applications that were designed to help children restore their curiosity and keep learning engaging, motivating and challenging. Young Digital Planet supports the view that early prevention is very important; edu-Sensus is an intervention tool that is based on intuition, designed for speech therapists and combined with the educational needs communicated by the market. According to the developers, this software has been in use in Poland for almost 10 years now and has proven to be an irreplaceable tool for early education and special needs prevention. Specifically, eduSensus is a family of products addressing all developmental needs and one of the advantages is that it has been created together with therapists, teachers, parents and children. Moreover, eduSensus Team covers a wide range of topics in the use of ICT tools in supporting the development of children who face specific difficulties including children who are at risk of dyslexia and face other problems such as memory and attention deficits, and developmental disorders. Lastly, the designers of the eduSensus claim that this platform introduces children into the ICT world develop young learners' vocabulary and communicative skills with digital programs, offering also effective and engaging stimulation of retarded children's development and support children who face learning difficulties at the kindergarten as it offers a collaborative learning environment.

6. Support working memory in preschool children

Nowadays, hundreds of experts in the areas of medicine and psychology are encouraging working memory training. They have brought an important approach into practices and schools around the world and are helping people of all ages succeed in areas of their lives that are characterized by poor working memory (Shipstead, Hicks, & Engle, 2012). Working memory is thought central to concentration, problem solving, and impulse control, is closely correlated to fluid intelligence and is a strong indicator of academic and professional success. On the other hand, deficits in working memory is the cause of many problems related to attention and is often linked to Attention Deficit Hyperactivity Disorder, and other learning disabilities (Engel de Abreu, Conway, & Gathercole, 2010). As a result, recent years have seen a rise in the popularity of computerized working memory (WM) training programs to kindergarten children, because these interventions give promises of increased IQ, creativity, better communication, grades and reductions in day-to-day lapses of attention. However, the effectiveness of the collaborative teaming process in increasing the educational progress and social participation of the preschoolers, especially, those who face memory problems, depends on the quality and fidelity of the support items that are offered by the educational team (DeCaro, Thomas, & Beilock, 2008). Thus, in this sensitive field of the assessment of the kindergarteners that face difficulties the role of the computing for collaborative and resulted learning is thought significant.

Certain tools for working memory training have been developed and one of the most well-known intervention tools is Cogmed. This program has been used at schools to assist students' performance and is available as clinical practice for treatment of ADHD. Their developers claim that Cogmed program may improve a child's working memory capacity as well as can help children to pay attention and concentrate on a subject for more time than they were used to. According to them, there are three types of Cogmed training programs that are referred to preschoolers and older children and include several visuo-spatial and verbal memory tasks. These activities have been embedded in videogames, each of which is performed for around 40 min a day, 5 days a week, for 5 weeks. More specifically, Cogmed JM and Cogmed RM are mainly designed for preschoolers and older children. Especially, ''Asteroids'' which is a visuo-spatial task, presents a field of several free-floating

asteroids and "Input Module" which is a verbal task in which a sequence of auditory digits is played, are some of the most representative examples of the activities that Cogmed program offers. In spite of the fact that some initial studies indicate that Cogmed is a successful intervention tool, there are some concerns about its validity and its results and so more research must be done. (Shipstead et al., 2012).

Furthermore, according to St Clair-Thompson (2007) one way of providing memory strategy training is to involve computer-based teaching and practice of memory strategies. The aim of a recent study was to explore a method of improving working memory, using memory strategy training (St Clair-Thompson et al., 2010). According to this survey, preschoolers and older children were tested on related subjects that are based on the multiple component model of working memory. At first, a group of children completed tasks of following instructions and mental arithmetic in the classroom, and standardized tests of reading, arithmetic and mathematics were conducted. Moreover, half of the children then used Memory Booster, a computer game that teaches children how to find memory strategies for the time of two months. Memory Booster (Leedale, Singleton, & Thomas, 2004), which is an enjoyable adventure game for children, help them to improve their cognitive and communicative skills while according to several studies results in significant improvements on measures of working memory (St Clair-Thompson et al., 2010). All the children were then retested on the memory and ability measures and the standardized tests were administered five months later. Finally, the outcomes of the research showed that working memory strategy training had significant improvements in tasks that had to do with the phonological loop and the central executive components of working memory, additionally with the activities that were related with the following instructions and mental arithmetic in the classroom. However, there were not noticed improvements on standardized tests of reading and mathematics, (St Clair-Thompson et al., 2010).

Moreover, despite the fact that not many studies have explored the role of ICT in working memory and inhibition, in kindergarten children, Thorell et al. (2008) report the role of a computerized training of visuo-spatial working memory and inhibition. The findings of their study suggest that children who trained on working memory improved significantly on trained tasks and children who trained on inhibition showed a significant improvement over time on two out of three trained task paradigms compared to the control group.

Last but not least, multiple assessments of both verbal short-term and working memory are provided in a working memory test battery standardized for children that was designed recently (Alloway, Gathercole, Willis, & Adams, 2012). The Working Memory Test Battery for Children – WMTBC (Gathercole, Alloway, & Pickering, 2006) includes four measures of verbal short-term memory (digit recall, word recall, non-word recall, and word list matching recall) while all these measures involve verbal presentation of memory items, while the first three require immediate spoken recall. The WMTB-C also includes three measures of verbal working memory (listening recall, counting recall, and backwards digit recall), scores on which are used to give a mixed working memory score. This test is particularly appropriate for use with children with memory deficits and gives an overall profile of their cognitive skills.

7. Conclusion

During this review paper an attempt was made to present the significant role that ICTs play in dealing with memory deficits in preschool education in terms of the collaborative co-learning. The scope of this study was to present if and how new technology can support kindergarteners who face memory problems in the two most important domains of the preschool age; literature and maths with the support of a collaborative educational environment. Furthermore, intervention and diagnostic tools that enhance learning in children who have poor working memory and learning difficulties were described. The findings of the studies we examined, which are the most representative studies over the last decade, showed that kindergarteners can benefit of the use of new technology and can gain many advantages and profits using the appropriate educational tools that offer the use of ICT in a supportive, collaborative and regularly organised daily schedule. The use of ICT has also played a major part in shaping the knowledge and skills of school staff, therapists and special educators while their collaborative effort with the assistance of the parents and the build of common goals seem to be the key role of an inclusive and co-learning education. Additionally, diagnostic tools seemed to provide the specialists with the possibility to employ different ICT strategies which might lead to an easier understanding of children's learning differences while ICT intervention tools support activities of kindergarteners' life. Taking the above into consideration we argue that there is the general consensus that ICTs, including the role of the social networks, do play a significant role in both ensuring and enhancing learning skills of kindergarten children who face memory problems in a supportive and collaborative learning environment. Besides, it is strongly accepted that the social net-working websites and online communities which are available and very popular towards the preschoolers give children the opportunity to explore a virtual world, use their imagination and share their opinions with other children around the world. The virtual worlds that often include games as well as the ability to chat with other children helps children to make online friends but also to multitask assessing their learning and cognitive style (Hourcade, 2008). However, there are also several fields that require further research such as investigations into the reliability and validity of the diagnostic ICT tools, adaptations of diagnostic and intervention tools to the various needs of children and therapists and development of more ICT programs for the support of the kindergarteners. According to this short overview, it is obvious that there is need for such research while we did not have a satisfactory number of findings for this crucial age and the enhancement of a collaborative environment asks for more investigation and effort from the educational team. Moreover, we consider that the sensitive field of the pre-school education and the special education in terms of the co-learning calls for more research in order to have positive outcomes for the school community including children, parents and teachers. Also, in contrast to other research on collaboration and communication, there is very little scholarly research in the field of social network in preschool age and thus there is need to investigate how this area can influence a child's life and how children understand this virtual world (Hourcade, 2008). Concluding, we hope that the results of the current study are encouraging and give the opportunity for further studies in the above areas ensuring that ICTs, collaborative learning and social networks are not only the basic tools for an effective learning but the basic platform for enhancing a scaffolding learning.

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