Intervention and Diagnostic Tools in Preschool Education

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Abstract—A representative study of some of the most important intervention, assessment and diagnostic tools of the preschool education is presented. Additionally, a list of some of the most well known intervention and diagnostic tools that are used for the Greek preschoolers by specialist is examined briefly. The importance of their use and the domains that are examined by these tools are investigated thoroughly.

Keywords—assessment tools, Greek kindergarten, intervention tools, preschool education

1 Introduction

Early childhood education in worldwide is increasingly viewed as a vital component of children's educational experiences and a key factor in some children's educational success. Children who follow kindergarten education seem to be prepared to learn at a clear academic advantage and are more likely to complete high school [1] as the preschool years represent a period of important brain plasticity and sensitivity to environments and experiences [2]. Developing skills in the first years of life and education is possible to open the door to better understanding of lifelong learning and informs the implementation of cost effective early interventions [3]. Moreover, early literacy and number knowledge represent rates of how children will fare from kindergarten onward developing also, procedural knowledge. A growing body of research from the fields of education and sociology provide evidence that learning skills can forecast academic attainment while, strong learning skills also promise less crime participation and interpersonal conflict later in life [3].

According to Zakopoulou et al. [4] the National Joint Committee on Learning Disabilities support the view that people with learning disabilities face problems such as speech and language difficulties, reading comprehension, mathematical discourse and more precisely problems with nonverbal skills, phonological awareness, analysis, synthesis, memorization and perception of word sets, acquisition of reading and spelling mechanism, difficulties with their oral speech, and with their behavior. Identification and need for support of a child's learning disability usually takes place after the child enters the second class of the elementary school and at that time, there is a considerable inconsistency between the child's aptitude and academic achievement [5] Nevertheless, according to the National Joint Committee on Learning Disabilities [4] it has been noted that children exposed to high quality learning opportunities before kindergarten, are less likely to experience school failure and are misidentified as having Learning Disabilities in the early grades. Therefore, in order to determine whether a child is at-risk for learning disabilities, screening, evaluation [6] and possibly intervention services should be provided. With the development of digital multimedia resources the early intervention for young children at-risk for learning disabilities can be enhanced as, even young children are exposed and familiarized with technology from their early age [6].

In the light of the above statements, learning tool is the systematically educational-designed toy of pre-school education. So, if we plan to enrich preschool learning by the use of new technologies, we may consider programmable toys. Digital technologies spread into many kindergartens nowadays and there is a widespread belief among educators and parents that children will require technological competencies to succeed in the workplace. In spite of the fact that some kindergarten experts argue that digital technologies are inappropriate choice for young children's play, in general programmable toys appear to be a good choice for children as they are tangible technological devices and children can directly manipulate with them, stimulating problem-solving in real conditions of children's environment [7].

As a result of the above, in this research we will try to describe some tools that are used in kindergarten education in order to screen, diagnose and intervene preschoolers who might face learning disabilities. The tools that are described can be performed traditionally while some of them with the support of the new technologies. Finally, a description of the most important tools that are used in Greek Kindergarten is given briefly.

2 Assessment tools

2.1 Bee-bot

Many scientists argue that robotic toys bring new dimension to role-play activities in kindergarten education while some preschool programs clearly identify reasons for their inclusion despite that some preschool teachers need to revise usual teaching methods in order to use them. However, according to the developers of a preschool robotic intervention tool Bee- Bot, seems to be a helpful device that offers important help to children and teachers to their teaching method [8].

More specifically, this programmable toy Bee-Bot was awarded as the most impressive hardware for kindergarten and lower primary school children on the world educational technology market BETT 2006. It uses Logo-related principle of controlling floor robot and enables the child to program a journey on the square grid. The toy can be introduced in variety of age groups and school subjects from early years to lower primary school children, for development of literacy, numeracy, natural sciences, history, geography, but also citizen or religion education. The range of ideas for using Bee-Bot in numerous creative ways covers the basic and the only functionality of the robot – to plan the journey on the square grid map and to test the solution by executing whole sequence. Bee-Bot doesn't provide more ways how to control it. Related software product focus on Bee-Bot simulates the behavior of the toy on screen while the software serves as an introduction to 2D and 3D computer screen representations similarly to most on-screen control programs. Lastly, the software and the physical toy are fully autonomous.

Moreover, the toy has a shape of a yellow bee with black stripes and children can control the toy by pushing a few colorful buttons giving a sequence of simple instructions for motion or rotation entering up to 40 instructions in one programmed sequence. Four orange buttons serve for a backward/forward motion and rotation to the left/right while the central button is a green GO button. There are also two blue buttons for erasing memory (CLEAR) and short break in executing commands (PAUSE) in the toy controlling part.

The results of the study and the observations of the researchers while using this toy in kindergarten children showed that children enjoyed playing with it despite the fact that the toy itself doesn't mean fun and meaningful play to them all the time. More specifically, the discussion 'Learning about technologies' and the activity 'First steps with Bee-Bot', in which the developers introduced control elements of the toy to children, were interesting for them only for very short time. On the contrary, children played essential role on the activities of the 'Alarm clock alive' and 'Birthday party' when they had to chose the way how the story would develop and set up own goals, challenges for a movement of a toy. Some children clearly demonstrated deep comprehension to principles of Bee-Bot's control besides others was cautious and their self-confidence didn't increase during whole series of activities with the programmable toy. Finally, the variability of the tasks for Bee-Bot is constrained because of its simple interface without possibility to change some parameters of its behavior [9].

2.2 The Working Memory Rating Scale

Working memory is the system that underlies the capacity to store and manipulate information for brief periods of time. According to leading models of working memory[10], it can be distinguished from short-term memory as it involves both storage and processing of information, while short-term memory systems are specialized purely for the temporary storage of material within particular informational domains. Individual differences in working memory capacity have important consequences for children's ability to acquire knowledge and new skills. In the classroom, children frequently have to rely on working memory to perform a range of activities. Poor working memory leads to failures in simple tasks such as remembering classroom instructions [11] to more complex activities involving storage and processing of information and keeping track of progress in difficult tasks [12].

The aim of the development of the Working Memory Rating Scale (WMRS), an observer-based rating scale, was to observe the potential of the behavioral difficulties of children with poor working memory. The findings of the study indicated that the good internal reliability and adequate psychometric properties helped teachers to use it as a screening tool. Specifically, higher (more problematic) teacher ratings on the WMRS were associated with lower memory scores on direct assessments of working memory skills. The use of the WMRS allows educators to draw on their expertise in the classroom for early detection of children with working memory failures [13].

Furthermore, the Working Memory Rating Scale [14] consists of 20 descriptions of problem behaviors, and was developed to help teachers to identify children at risk of the learning difficulties associated with working memory deficits. Main characteristiques of this tool are that it can be rapidly administered and simple to score while does not require any training in psychometric assessment prior to use. Furthermore, it can play a helpful role in familiarizing teaching staff with classroom situations in which working memory failures frequently arise. Advice concerning ways of minimizing the impact of working memory failures in the classroom is available both in the manual and in a variety of publications [15]. The current study provides information on the internal consistency of the WMRS, and on its value in identifying children with very low scores on two direct assessments of working memory, the Automated Working Memory Assessment [16] and the Working Memory Index in the WISC-IV [17]. The AWMA was included as this is the only standardized tool for non-expert assessors to screen their students for significant working memory problems. The WISC-IV Working Memory Index tests were also included as they provide an assessment of verbal working memory skills widely used by clinicians and psychologists. The inclusion of both the AWMA and the WISC-IV Working Memory Index allows for the direct comparison of behavior ratings with cognitive assessments of working memory skills.

Additionally, the Working Memory Rating Scale consists of behaviors that are characteristic of children with working memory deficits such as ‘The child raised his hand but when called upon, he had forgotten his response’; ‘She lost her place in a task with multiple steps’; and ‘The child had difficulty remaining on task’. Teachers are asked to rate how typical each behavior is, using a four-point scale ranging from (0) not typical at all to (1) occasionally to (2) fairly typical to (3) very typical. Also, all 12 tests from the Automated Working Memory Assessment [16] were administered and two verbal working memory measures from the AWMA, listening recall and backward digit recall, were administered to the low and average WM groups.

Finally, according to the developers it is worth noting that the purpose of the WMRS is to be used as a clinical assessment that confirms working memory impairments and enables teachers to conduct a more systematic means of screening for potential working memory. Lastly, this study seems to represent a first step in establishing the reliability of this tool while future research may focus on the validity of the WMRS, as well as teacher effects, would help to strengthen the efficacy of the WMRS in identifying potential working memory that merits detailed assessment [16].

2.3 Get Ready to Read! Screening Tool (GRTR)

In recent years, there has been an increasing emphasis placed on early childhood education as one piece of a system of education designed to increase academic outcomes for children. Increasingly, many schools are adopting preschool learning standards that address critical components of the precursors to later formal academic skills, such as reading and mathematics. Use of screening tools that can identify children who are at risk of later reading difficulties because of below- average development of emergent literacy skills is one way to reduce the likelihood that children will later receive a learning-disabled classification or experience significant academic difficulties. Identification and deployment of effective pre- school interventions to promote the development of the relevant skills that increase the probability of success in school is also required. However, before successful interventions can be used with children who are at risk, educators must be able to identify accurately those children who indeed have below-average skills in critical domains. Brief, but accurate, screening tools are an excellent way for educators to obtain a snapshot of children's emergent literacy skills [18]. Although there are several available measures of emergent literacy skills, very few of these measures are as simple and quick to administer as the Get Ready to Read (GRTR) according to their developers [19].

The GRTR (the revised edition) is a 25-item test that measures print knowledge and phonological awareness. Teachers can administer this screening tool easily, and each usually takes less than 10 min to complete[19].For each item, the child is shown a page with four pictures. The test administrator reads the question at the top of each page aloud, and the child answers by pointing to one of the four pictures. At the end of the GRTR- R correct answers are summed into a single score encompassing both print knowledge and phonological awareness. Internal consistency reliability for the GRTR-R in the normative sample was 88 [20]. Whitehurst [21] validated the GRTR on a sample of 342 preschool children and determined that the concurrent validity of the GRTR with a diagnostic measure of emergent literacy skills was high. Specifically, there have been four studies examining the psychometric and predictive characteristics of this tool, which is administered just before the beginning of the preschool year.

According to the results of this study showed that the use of the GRTR-R gives accurate classification of children into at-risk or not-at-risk groups with regard to their overall emergent literacy skills. In terms of classification accuracy for overall early literacy skills and in regard of specific domain of emergent literacy skills the GRTR-R did about as well as established screening tools that are used with kindergarten and early elementary school age children [22]. Additionally, the findings of this study demonstrate that screening measures can be used to effectively screen preschool children who may be in need of more in-depth assessment or to identify preschool children who are most in need of additional or more intensive exposure to instructional activities to promote the development of early literacy skills. However, the results of this study also demonstrate that the use of this tool does not extend to the identification of specific weaknesses or strengths in specific emergent literacy domains [19].

3 Intervention and diagnostic tools in Greek kindergarten education

3.1 Pass Reading Enhancement Program (PREP)

During the last years, a great number of studies have been conducted to understand how children learn to read. The focus of these studies has been on the cognitive and linguistic abilities that are important for the development of reading skills. One of the reasons for this focus is that information about these processes can explain the locus of difficulties that students might confront in learning to read [23]

Guided by this premise, the PASS Reading Enhancement Program (PREP) was designed to improve selected aspects of children's information processing scoping to increase their word reading and decoding abilities [24]. PREP is an alternative way to direct training of strategies for the remediation of cognitive skills supporting reading skills and is based on the notion that transfer of principles can be facilitated through inductive, rather than deductive, inference. Also, the PASS Reading Enhancement Program (PREP) this remedial program, recognizes and uses all these assertions of the Vygotskian theory and is based on the PASS (Planning, Attention, Simultaneous and Successive processing) theory of intelligence that was proposed by Das and his colleagues after almost 30 years of theoretical and empirical work [25]. .Remedial training of this kind tries to ensure transfer of learned principles and produce strategies for novel situations with high rates of success. Additionally, PREP attains to the development of reading skills through the development of the 'proximal' cognitive processes which are mostly linguistic skills and directly linked to reading, through the support of the 'distal' cognitive processes - which support cognitive processes [26].

A set of eight PREP tasks is usually selected for the remedial training. Each task has a "global" process training form and a content-related "bridging" form, both with three levels of difficulty. Passage from one level to the next is potential upon at least an 80 percent success rate in that level. More specifically, Window sequencing is used focusing on successive processing and the student's task is to reproduce a series of chips that vary in color and shape in the same order in which they are presented by the instructor. The chips are presented one at a time, left to right, through a '2x2' inches window. Each chip appears in the window for approximately one second. The series ranges in length from three to six chips. Four series of each length are presented per session, for a total of 12 items. Also, Connecting letters in which the student is required to follow a line to find which letter on the left side of a page is connected to which letter on the right side of a page is concluded. Each stimulus card contains five letters on each side and the student is presented with each card individually, required to write (or say) all of the connections. After the initial trial, the instructor directs the student's attention to any errors so that corrections can be made. There are three levels of difficulty. The other task is the Joining shapes whose purpose is to join a series of geometric shapes in response to a series of verbal instructions and a set of rules provided by the instructor. The shapes - triangles, squares, and hexagons - are presented in rows on a sheet of paper. Each row of triangles, squares, or hexagons is always separated by a row of circles. Within each session, six items with varying numbers of rows are presented. The first two items contain one row of triangles and one row of squares, with a row of circles in-between. The third and fourth items contain one row of triangles, one row of squares, and one row of hexagons, with rows of circles in-between. The fifth and sixth items contain a row of hexagons, a row of triangles, a row of squares, and another row of hexagons, with rows of circles in-between. These items are presented on two different stimulus cards and there are three levels of difficulty. Furthermore, another task Matrices requires from the student to memorize a sequence of randomly chosen letters displayed within a five-cell matrix. The matrix is designed as a cross: there is one central cell, with one cell on each of its four sides. Each cell of the matrix contains one number (Matrix Numbers) or one letter (Matrix Letters). The student is shown the complete matrix containing one number or letter in each of the five cells and is then asked to write (or say) the sequence in order, as the instructor points at each cell of a blank matrix. If the student has difficulty reproducing the sequence, he is shown the matrix numbers or letters in five stages, with only one number or letter being revealed at a time. After progressing through the sequence, the student is again asked to recall the sequence. In next task Related memory set, student has to match the front half of an animal with its appropriate back half. The animal pictures are line drawings on '3x3' inches cards. Three fronts are presented in a column on the left side of a page and one back is presented on a card placed on the right side of the page. The student is required to point to the front that matches the back. After making this prediction, he/she then places the front and back together to determine whether the response was correct. The student is then allowed to alter his/her prediction as necessary. There are three levels of difficulty. The Transportation matrices were also used and the student was required to reproduce a series of transportation pictures in the correct order. The pictures are presented in a single-line matrix strip divided into sections (cells). The entire strip is shown, and then each individual picture in the strip is shown from the student's left to right on a horizontal line. There are three levels of difficulty. Lastly Tracking and Shape design are used as tasks in this tool. Tracking asks from the student to line a drawing map of a "village" and illustrate a path from a starting point to either a numbered house or a lettered tree. The tracking cards outline the roads and street intersections of the village map. The student's task is to survey each card and the village maps, and then locate the number of the house or the letter of the tree on the map. Besides, Shape design asks to study a design that is presented for ten seconds and to reproduce the design with the colored shapes provided. The shapes include circles, rectangles, squares, and triangles in three colors (red, blue, and yellow) and two sizes. The stimulus cards consist of designs composed of these shapes. The designs range from a simple combination of three shapes, differing only in color, to a complex combination of six shapes differing along dimensions of color, shape, and size. The task is divided into three difficulty levels with six items in each [26]

Overall, according to the developers of this program it is encouraging to notice the positive effects of PREP training program upon at-risk readers between the ages of 5 and 6, when early literacy skills rapidly progress. PREP attempts to remediate both proximal and distal cognitive processes and thus, it is broader in its approach of remediation of phonological and/or reading difficulties. Beneficial effects of this program in relation to reading skills with older populations had already been established in previous studies [27]. Moreover, this tool confirms that deficient phonological processing in children at-risk for developing reading problems implicates processing deficits beyond the phonological module but also that short-term memory deficits, evident from early on, likewise appear to be specific also to tasks, which do not require phonological coding.

3.2 Athina Test (Diagnosis of Learning Difficulties)

This test can be administrated to children 5-9 years old and was build to be used by teachers in preschool and in first classes of elementary school or other specialist that deal with such matters. Athena Test gives a detail picture of the present situation of child in vital sectors of growth and points specific areas that are deficient and require particular teaching or therapy intervention. Its development was based on two other tests, the Illinois Test of Psycholinguistic Abilities and Aston Index, which are comprehensive, tried, and tested batteries of assessments for screening and diagnosing language difficulties. It is constituted by 14 tasks in a form of developmental psychometrics scales: (a) intellectual ability (linguistic proportions, copying shapes, vocabulary), (b) memory of sequences (numbers, common sequences, pictures, forms), (c) completion of representations (sentence completion, word completion), (d) writing-phonological awareness (discrimination of graphemes, discrimination of sounds, composition of sounds), (e) neuropsychological maturity (visual co-ordination, perception of "right-left", dominant hemisphere). It is performed traditionally and it takes from 20 minutes to one and a half hour to be administrated according to child's age [28].

3.3 Test of early identification of dyslexia

This test tries to indicate the factors most probably included in an early detection of special developmental dyslexia at the preschool age. It offers the possibility of identifying a child's various difficulties or particularities if any, despite the fact that it does not classify the type or the form of difficulty. The test is divided in two sections the description of a subject's general intellectual development and the description of specific skills of development such as psycho-mobility, visual perception, laterality, pre-writing ability, and phonological awareness. This test is also performed traditionally [29].

3.4 Alpha test

Alpha test is a screening test for school readiness [30]. It is a very short screening test that takes almost 10 minutes for its performance while it is for children 5-6 years. This test examines the learning and emotional readiness of a child for elementary school, so as to prevent school failure and serious social and mental disturbances. It is not an intelligence test however assesses school readiness for the elementary school, child's behavior due the process and investigates if the child faces attention and hyperactivity difficulties. The evaluation is computer-based.

3.5 Phonological screening Test of Dyslexic Behavior (FO.T.A.DY.S. 5-6)

This is a test for children 5-6 years old [31] that concern the identification of preschool children, which seem to show dyslexic behavior. It includes eight psychometrics tasks: repetition of pseudowords, phonemic synthesis, phonemic composition, recognition of rhyme, elimination of initial part of word, rapid naming of nouns, colors, comparison of pseudowords, and syllabic/phonemic segmentation and is performed traditionally.

3.6 MetaPhon Test

This tool aims for the evaluation of metaphonological abilities of preschool and first school age children for the detection of difficulties in the written language aiming to prevent learning difficulties in children 3.1-6.6 years old. More specifically, it interprets children's' achievements via a diagnostic diagram of phonological awareness, a developmental profile of phonological awareness, and via developmental milestones. This test is also performed traditionally [32].

4 Digital multimedia resources that support early intervention for Greek young children at-risk for learning disabilities

Children at risk of learning disabilities may face difficulties in handling speech language, phonological processing and decoding of written text. The digital activities focus on phonological awareness issues in a multimedia interactive and playful environment that keeps student's interest and adjusts to his/her needs and abilities in order to achieve the desired learning outcomes. Through an interdisciplinary and experimental digital knowledge approach another goal is to enhance students' creativity and communication [33].

Taking the above into consideration, an intervention tool was designed in order to support the kindergarten children, which are at-risk for learning disabilities. It forms a tool that can be used by the children under the teacher's, special educator or speech pathologist's supervision as they select and incorporates suitable activities in a digital environment for the preschool setting or for the first school age in order 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. Furthermore, the activities that are presented in this tool help the children to learn how the phoneme is pronounced, how to write a letter, find the "hidden" target letter among many other letters, numbers and symbols (visual discrimination), match the letter to its phoneme (auditory discrimination), choose the word that begins with the letter that is required, put in the correct order the syllables for the formation of a word and put the words in the correct order to form a syntactically and semantically correct sentence [34].

According to the developers the aim of the activity 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 [35]. 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 and has been created according to educational standards incorporating the modern technological developments. Besides, the option of accommodating the supportive material online and thus Internet publication can provide time and space independence.

5 Conclusions

Technology is almost everywhere and its widespread adoption in various applications influences almost every aspect of modern life and especially the field of education. Amongst them, the role of the ICT (Information and Communication Technologies) in education is obvious. Today children seem to be more involved in the learning process, because they have the advantage of the technology from their early years while ICT can make teaching and learning more effective, efficient and entertaining. The results of our research seem to agree with this view. Moreover, children who are at risk of showing learning difficulties later in their life seem to need the technology more in order to screen, diagnose and assess their difficulties. The early identification of learning disorders or delays is a crucial first step for offering them an appropriate intervention avoiding also possible developmental and socio-emotional problems. In this study we tried to describe some tools that are used traditionally and with the support of new technology in order to investigate the difficulties that may face some preschoolers. The tools that were presented are used worldwide while explored tools and games that are used by the Greek teachers and special educators in kindergarten. Concluding, we have to mention that in the field of language learning and assessment, computerized applications are limited, particularly for the Greek kindergarten. Most diagnosticians use qualitative means of assessment based on their personal experience [36] while screening tests that are used are performed traditionally and not with the support of new technologies. Taking this in consideration, we would like to underline the importance and the need of the development of new screening and diagnostic tools supported by technology that assess kindergarten children and can be preformed by the teacher in order to draw the appropriate intervention.

6 References

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