

Kindergartens

Teaching Methods, Expectations
and Current Challenges

Henry Switzer
Dwayne Foulke
Editors



Education in a Competitive and Globalizing World

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PREFACE

In this book, the authors discuss the teaching methods, expectations and current challenges in kindergarten education. Topics include designing educational material for early childhood mathematics education; additive bilingualism of immigrant children; evolution of graphomotor parameters in kindergartner's handwriting; multisensory handwriting curriculum enhancing kindergarten skills; family environment as a predictor of behavioral competencies in early elementary years; an exploration of meaning in young children's images and designs; and first aid training in the kindergarten.

Chapter 1 - Recent research results demonstrate that effective mathematics instruction and successful students' learning processes in all grades and especially in kindergarten incorporate tasks that include manipulation of auxiliary means. The fundamental role of auxiliary means in general and of educational materials in particular for mathematics teaching and learning is accepted in theoretical discussions. The use of educational materials is also accepted in today's mathematics classrooms at all educational levels. According to research studies educational materials are useful to the extent, that, they encourage students to think in problem solving ways, they play an important role in the discovery and expression of mathematical relationships, and engage students in mathematical activities and argumentation. They give equal opportunities to all students to develop and understand the concepts, the procedures, and other aspects of mathematics and to set new ideas into practice. They can actually generate and help to explore new mathematical ideas. Designing educational materials to meet specific objectives is common in mathematics education and arises from many factors. In this paper, the authors will highlight these factors and they will present some examples of designed educational materials after taking into consideration the main theories and principles that rule the designing of educational materials. The designed educational materials that will be presented are artifacts, posters, stories with pictures and games for early childhood mathematics.

Chapter 2 - This paper presents a descriptive account of a multidisciplinary project to be introduced with the aim to foster bilingual development (L1 and L2) of immigrant children attending Greek kindergartens. The reason for proposing the introduction of this interdisciplinary project stemmed from the growing number of second-language students in Greek education, given the fact that for the last two decades Greece has been an immigrant receiving country, especially from Albania and the countries of the former Soviet Union. Although the Greek education system, through language policies for primary and secondary schools, has tried to promote English as a foreign language learning from an early age and to

develop a plurilingual competence in the ‘strong’ European languages, it has not managed to deal with the question of immigrant languages effectively. Thus, bilingualism of immigrant children has been overlooked, impeding, as widely believed, the acquisition of the Greek language.

The *proposed project* aims to promote additive bilingualism and establish the children’s bilingual skills through their participation in movement activities in a story-based context, employing stories from the two cultures (Greek-Albanian, Greek-Russian). In such a context, a combination of games will be adopted: Intercultural games, physical activities, role-play games, dancing activities, communicative games, all of which focus on the successful exchange of information and on free expression. It is suggested that the interdisciplinary project is to be carried through the following stages: a) Identification of the children’s needs in the two languages and of their bilingual repertoire; b) Development of ‘a story and game based syllabus’, which will include bilingual (Greek-Albanian and Greek-Russian) courses designed having taken the students’ perceived needs into consideration; c) Implementation of the bilingual modular syllabus (BMS) in a multisensory teaching -visual, auditory, and kinaesthetic- context; d) Evaluation of the effectiveness and feasibility of the interdisciplinary project.

Chapter 3 - The longitudinal study presented in this chapter focuses on the acquisition of writing skills in a group of preschoolers. Eighteen four-to-five year old preschoolers copied six-letter Catalan words (disyllabic and trisyllabic) on a digitiser. The words were presented and copied in capital letters. Data were collected at three different times over two academic years (February; November; and May). The authors compiled eight kinematic and perceptual variables in each of the three sessions, including measures of execution time (both on paper and in air), pressure, fluency, number of strokes, gaze lifts to the stimulus and duration of intervals between letters (ILI). These measures were compared over the three sessions in order to assess the development of handwriting skills.

The results show that motor and perceptual parameters developed positively. However, at the last session there was a decrease in the quality of movement execution (longer duration, less fluency, more segmentation of the stroke), which is interpreted in terms of the impact that linguistic knowledge has on writing execution. The duration of the intervals between letters shows the effect of syllable structure on the programming of the stroke at the different sessions of data collection.

Chapter 4 - Fostering educational development and advancement of students is one of the many roles of teachers in America today. Delivering the necessary academic content at an appropriate developmental level to promote foundational skill achievement in kindergarten is not a simple task. Teachers face multiple challenges including: (1) increased academic demands, (2) developmental appropriateness of instruction, (3) varied college training of teachers, and (4) varied skill development of students prior to kindergarten. Because of changes in education, ability of kindergarten teachers to provide the most effective instruction requires a combination of new skills, creativity, patience, flexibility, and compassion. One skill, handwriting, is a critical foundational skill introduced in kindergarten.

One half-day kindergarten program at a private school recognized the importance of the development of handwriting skills and the challenges of students to produce written language. This school decided to implement a multisensory, developmentally-based handwriting curriculum in order to teach kindergarten students the foundational handwriting skills necessary to foster academic achievement. As the teachers embarked on a journey of

improving the classroom education for their students, data were collected on student performance for comparison with a control group who had not used this multisensory curriculum. This chapter will describe the history surrounding the current kindergarten educational environment, the importance of handwriting skills, the handwriting curriculum used in the study, and the research that substantiates the use of a multisensory handwriting curriculum to build the foundational skills necessary in kindergarten for future academic success. Implications for educators of kindergarten students will be discussed as well as directions for future research.

Chapter 5 - In this paper the authors examined perceptions of family environment of 84 kindergarten ($n = 34$), first- ($n = 18$), and second-grade ($n = 32$) students identified with behavior challenges according to teacher-completed systematic screening tools. First, the authors examined the degree to which these 58 boys and 26 girls varied in their behavior problems and social skills from their teachers' perspectives. Results indicated teachers rated girls with higher levels of problem behaviors than boys, although there were no differences in social skills for boys and girls. Second, the authors examined the degree to which these children's family environments vary for boys and girls in dimensions such as relationship (cohesion, expressiveness, conflict), personal growth (independence, achievement orientation, intellectual-cultural orientation, active-recreational orientation, moral-religious emphasis) and system maintenance (organization and control) as measured by the Family Environment Scale. Results indicated no differences were reported for families in this sample. Finally, the authors examined the relation between family environment and socio-behavioral performance. For boys, the level of Cohesion predicted problem behavior and the level of Cohesion and Intellectual-Cultural Orientation predicted social skills. For girls, there were no significant family characteristics predictive of problem behaviors; however, families with an Active-Recreational Orientation and Intellectual-Cultural Orientation predicted social skills. Educational implications for supporting home-school partnerships for young students upon initial school entry are presented. Limitations and future directions for future inquiry are offered.

Chapter 6 - Handwriting is a complex activity involving perceptivo-motor, cognitive and linguistic skills. Handwriting acquisition is a slow and difficult process which requires several years of formal training for a correct mastering. In this context, the authors argued that there is a crucial interest in proposing new assessment methods to improve handwriting acquisition. Most of the scholar trainings for handwriting only utilize sensory visual and auditory abilities of young children (5-6 years old). Recently, the authors have shown that manual tactile exploration efficiently improves classical trainings in reading, handwriting, and geometry. The present work is a continuation of these studies, and aims at elaborating new trainings for handwriting acquisition. Importantly, the authors hypothesized that proposing exercises which aim at developing proactive motor strategies improve handwriting acquisition. Particularly the authors designed new handwriting exercises based on the use of a tactile tablet. This training included videos in which the writing production of each cursive letter is presented to the child. The authors found that this tactile training significantly improves the writing fluency in French preschoolers. Thus, in the line of the authors' earlier studies, this pilot study tends to show that training exercises using tactile devices can be helpful for the acquisition of handwriting in kindergarten children.

Chapter 7 - The kindergarten years are important in giving children a basic foundation for social and academic skills. Kindergarten teachers are finding that children entering this year

have increasingly challenging behaviors that inhibit their ability to learn and interact with their peers and adults appropriately. Innate personality traits identified during the preschool years can help teachers to intervene and modify instruction in order to help children with challenging behaviors better socialize with their classmates and learn the necessary academic skills during this important year. The following chapter summarizes and reviews research about the M5-35 Preschool Personality Scale which has been used to identify innate personality characteristics in young children, particularly preschoolers. The chapter will focus on several studies that have been conducted in the area of the preschool personality.

Once traits have been identified, teachers can use the information to intervene with children with challenging behaviors in the classroom. Activities and routines can be modified according to personality traits in order to ease challenging behaviors.

Chapter 8 - This chapter describes an integrated art and early literacy project. Students in a teacher training program worked with young learners on visual and verbal responses to a picturebook. A design grid served as a template to encourage children to explore meaning making in compartmentalized spaces. Using a qualitative, interpretative analysis, a subset of drawings was chosen to demonstrate how young children: (1) express thoughts through their choice of design elements and symbols, and (2) apply compositional strategies to construct meaning. The point of interest was not on the performance level the children achieved in their artwork, but rather on how meaning and understanding can be mediated through image-making that encourages the inclusion of patterns and designs.

The results showed young artists demonstrating divergent thinking as they applied shapes, colors, symbols and metaphors for relating similarities between the elements of a visual design and objects in the real world. While each child invented his or her own way of representing ideas and events, the evidence showed that children configured their drawings in a purposeful manner, weaving principles of selection and arrangement into unique graphic designs full of meaning. These children readily combined component parts to create the whole message as they actively constructed understandings of their worlds through their choice of designs and pictorial units.

Chapter 9 - Purpose of the study: An emergency situation can occur at any time, often out of reach of experienced medical personnel. Everybody should be prepared for helping others in acute emergency situations like accidents or acute illnesses. Therefore first aid training should be given to the whole public including children. The aim of the present review is to present existing knowledge on first aid training in the kindergarten from the scientific literature and the author's own experience in the field. Materials and methods: A literature search was conducted in databases for scientific journals (Pubmed/Medline, CINAHL), the Internet and reference lists of books and articles. Relevant scientific articles, recommendations and other publications were reviewed. In addition own experience with first aid training in the kindergarten is presented and discussed. Results and conclusion: There are just a few studies on first aid in the kindergarten and primary school. A Norwegian study on kindergarten children shows that even young children are able to learn and perform basic first aid. Knowledge about first aid training in the kindergarten is lacking and more work needs to be done. Longitudinal follow up studies are needed to learn more about the effect of teaching first aid to children on helping behaviour of the course participants as adults. Nevertheless the actual evidence and own experience allow the conclusion that first aid training in the kindergarten is worth the effort and does not just lead to increased knowledge about first aid but also to more social and empathic behaviour in general.

Chapter 10 - In this paper the thermal comfort and air quality in occupied ventilated kindergarten spaces are evaluated. This review article includes previous results obtained in kindergartens in Mediterranean environment. In the study the natural and forced ventilation, cold environment used in Winter thermal conditions and warm environment used in Summer thermal conditions, are considered. In this paper the numerical and experimental analysis are presented in detail.

In the numerical simulation the building thermal response numerical model, that simulates the kindergarten thermal behaviour and the occupant's thermal response, is presented. In the numerical simulation all building and all internal spaces scheme details are considered.

In the experimental measurements the environmental variables and the subjective responses are used. In the experimental environmental measurements the air temperature, the air relative humidity, the mean radiant temperature, the air velocity and the carbon dioxide are considered. The carbon dioxide, using the tracer gas decreasing concentration, is used to evaluate the air exchange rate, the age of the air or the airflow rate. The adaptive thermal comfort model is developed in a Kindergarten, using subjective and experimental measurements, for cold environment used in Winter thermal conditions and warm environment used in Summer thermal conditions.

Different validations of the numerical model, using numerical values and experimental data, are made. The Summer thermal conditions and Winter thermal conditions, with and without surrounding buildings, are considered in the validation tests.

The numerical and experimental techniques, presented and applied in this paper, are used to increase the thermal comfort level and the air quality level, that the occupants are subjected. For warm environment used in Summer thermal conditions the shading devices and the underground spaces are used, while in the cold environment used in Winter thermal conditions the greenhouse is used.

Chapter 1

DESIGNING EDUCATIONAL MATERIAL FOR EARLY CHILDHOOD MATHEMATICS EDUCATION

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ABSTRACT

Recent research results demonstrate that effective mathematics instruction and successful students' learning processes in all grades and especially in kindergarten incorporate tasks that include manipulation of auxiliary means. The fundamental role of auxiliary means in general and of educational materials in particular for mathematics teaching and learning is accepted in theoretical discussions. The use of educational materials is also accepted in today's mathematics classrooms at all educational levels. According to research studies educational materials are useful to the extent, that, they encourage students to think in problem solving ways, they play an important role in the discovery and expression of mathematical relationships, and engage students in mathematical activities and argumentation. They give equal opportunities to all students to develop and understand the concepts, the procedures, and other aspects of mathematics and to set new ideas into practice. They can actually generate and help to explore new mathematical ideas. Designing educational materials to meet specific objectives is common in mathematics education and arises from many factors. In this paper, we will highlight these factors and we will present some examples of designed educational materials after taking into consideration the main theories and principles that rule the designing of educational materials. The designed educational materials that will be presented are artifacts, posters, stories with pictures and games for early childhood mathematics.

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INTRODUCTION

Children's math related experiences during their early years, influence their later performance in primary school. For this reason they need to be provided with high quality, challenging, and accessible mathematics education by the kindergarten (Clements, 2004). Mathematics teaching/learning process should include tasks that support the development and use of cognitive strategies involving inquiry, exploration, argumentation, construction and modeling of situations (Christiansen and Walter, 1986; Doyle, 1988). Making mathematics active, interesting and worth investigating for young children at school, requires, tasks that include manipulation of auxiliary means (Σκουμπούρδη, 2012). It seems rather difficult to imagine the teaching and learning of kindergarten mathematics without auxiliary means, because they play a very important role for the students' engagement in mathematical activities.

The auxiliary means, which are external representations of mathematical concepts and operations, in their early use in mathematics education, caused two opposing tendencies (Szendrei, 1996). In the first tendency the use of auxiliary means was not easily acceptable, because it was dominated by the view that mathematics is abstract and therefore need to create abstract concepts in the students' minds. The second tendency considered the auxiliary means as necessary to effectively address all the difficulties that students had in the understanding of mathematics and they used them even in cases where it was not necessary. Thus, the intended learning outcome was not coming. These conflicting views made the effective use of auxiliary means for mathematics instruction, more complicated than it was and lead to their removal from the educational process.

The theoretical basis of the reintroduction of auxiliary means in mathematics education was set by Comenius (1592-1670) and Pestalozzi (1746-1827) who recognized the necessity and the value of visualization and manipulation for teaching and learning. Fröbel (1782-1852), Montessori (1870-1952), Cuisenaire (1891-1976), Gattegno (1911-1988), Dienes (1916-), as well as other important researchers, mainly educators, invented and used in innovative ways, educational materials for motivating students. They argued that children need many experiences with concrete materials to understand themselves and the world around them. Furthermore, the views of Piaget, Bruner, Dienes, Skemp and Vygotsky have contributed to consider the use of auxiliary means as necessary in the teaching/learning of mathematics. Piaget suggests that very young children do not have the mental maturity to grasp abstract mathematical concepts presented only in words or symbols and need many experiences with concrete materials and drawings to learn. Bruner quoted, that children demonstrate their understanding in three stages of representation: enactive, through the handling of physical objects; iconic, through pictures and images of objects¹ and symbolic, through symbols and formal mathematics. Dienes mentioned that multiple embodiments are necessary to support students' understanding. Skemp, supported the view that early students' experiences and interactions with physical objects create the basis for later learning in a more abstract level. Finally, Vygotsky referred to tools as mediators of acting and thinking, according to socio-cultural construction of knowledge.

¹ Heddens (1986), goes further and divides the transitional iconic level into the semiconcrete level (representation of a real situation, such as pictures of real objects) and the semiabstract level (symbolic representation of real objects or situations, such as number line).

Nowadays, the role of auxiliary means in mathematics education has been reconsidered and occupies a central place both in research and practice. An increasing number of researchers internationally, study the effects of their use in the teaching/learning process of mathematics. According to them, the use of auxiliary means is crucial for high quality mathematics education at all levels (Ahmed, Clark-Jeavons and Oldknow, 2004; Arcavi, 2003). They are useful for effective mathematics instruction as well as for successful students learning (Fuson and Briars, 1990; Thompson, 1992; Varol and Farran, 2006). This is because, auxiliary means are particularly useful in helping the children to move from the concrete to the abstract level. When children are encouraged to use auxiliary means in whichever ways make sense the most to them, they develop their mathematical thinking and improve their performance (Raphael and Wahlstrom, 1989; Suydam, 1986; Watson and De Geest, 2005), they develop confidence and flexibility in their problem solving ability (Carpenter, Fennema, Franke, Levi and Empson, 1999; Jacobs and Kusiak, 2006), they effectively construct their mathematical knowledge (Szendrei, 1996), they handle mathematical concepts and structures from different perspectives, and finally they acquire positive attitudes to mathematics (McCulloch Vinson, 2001; Sowell, 1989). Also, auxiliary means can be particularly efficient in the organization and development of abilities and skills of students with special learning needs (Moyer, 2001), as well as of students from different cultural backgrounds (Davison, 1990). The auxiliary means can also assist students to develop their own internal representations—like imaginary pictures of numerals, which lead them to increase their computational fluency (Becker and Selter, 1996; Moyer, 2001; Russell, 2000).

Though, the use of auxiliary means to support teaching/learning is not taken for granted for all the mathematics teachers. Although the majority express the view that they are helpful in specifying the abstract nature of mathematics (Sáenz-Ludlow, 2006; Straßer, 2009), experienced teachers and teachers of upper grades do not use them often in their teaching (Moyer, 2001). Also there are teachers who support that auxiliary means are not helpful at all in the mathematics teaching/learning process (Szendrei, 1996). For kindergarten and lower grades teachers, the use of auxiliary means to support teaching and learning is obvious (Σκουμπουρδή, 2012).

The opposite trends that were formed for the use of auxiliary means in mathematics education still exist in another form. The first trend, expresses pessimism about their effectiveness. It indicates that oftentimes, in the teaching-learning process, educational materials are chosen and used in a rote manner, with little or no learning of the mathematical concepts by the children, because they are unable to connect their actions with the abstract mathematical ideas. As it was mentioned by Pimm (1995) children may end up just manipulating the materials. The other trend highlights their important role and their involvement in engaging students in meaningful experiences, that promote mathematical understanding and recommends their designed integration at all educational levels, from kindergarten up to secondary school.

There are many types of auxiliary means. Piaget separates those which can teach children mathematics, such as tangram and those from which we expect to learn mathematics to children such as the balance, designed to support addition and subtraction, as well as the multi-base blocks which are designed to support the understanding of the digits place value (Kamii, Lewis and Kirkland, 2001). Other researchers have classified auxiliary means differently. For example, Hart (1993) distinguishes software or computer languages, books and manipulatives. Szendrei (1996) refers to concrete materials as tools of every day life, and

describes them together with artifacts, as common tools. She also refers to games and materials that are specially designed for school use and describes as educational materials. Bartolini Bussi and Boni (2003) refer to concrete materials as items specially designed to serve specific learning objectives, to cultural instruments and artifacts, to technological objects and to software. Ahmed, Clark-Jeavons and Oldknow (2004) as teaching materials, indicate artifacts and tools.

Generalizing the above categories, two groups of auxiliary means can be formed: those that exist regardless of the teaching/learning of mathematics—materials and tools of our everyday lives such as the human body and its members, books and stories, games etc—and those which are specialized in serving teaching/learning goals—materials designed for educational purposes, educational materials, such as Fröbel gifts, Montessori materials, Cuisenaire rods, Gattegno geoboard, Dienes blocks, arithmetic rack, shape blocks, pentominoes, connected cubes, connected shapes, etc., as well as any artifact that is designed to support the mathematical teaching/learning process.

The design of educational materials and the inclusion of materials in mathematical education can allow the monitoring of children's interaction with the material on their way to learning and to the development of their thought. It can also provide the necessary information to identify concepts in the understanding of which the materials help. Therefore, it can be an ameliorative intervention in its design, its development and its manipulation in accordance with the concept approached each time, and with the especially sociocultural characteristics of students.

Designing educational materials to meet specific objectives is common in mathematics education and arises from many factors. In this paper, we will highlight these factors and we will present some examples of designed educational materials after considering the main theories for the educational material designing and principles for designing educational materials.

THEORETICAL FRAMEWORK FOR EDUCATIONAL MATERIAL DESIGNING

The role of educational materials in classical instructional approaches, such as structuralism, is different from their role in the pedagogical approach of constructivism and different from their role in the socio-cultural approaches, as well as in the approach of distributed cognition. The synthesis of all these theories, attributed by the Cobb' interpretive framework sets the role of educational materials nowadays.

Educational materials play a dominant role in structural approaches when depicting in a transparent way both the mathematical structures and the way the mathematical knowledge is organized. Therefore, based on structural approaches, the means used in the teaching/learning of mathematics are specially designed materials, educational materials, which are developed in a top-down process. The mathematical content is analyzed, is simplified and is integrated into the material in order to be transferred to the student. Student's active participation is limited to the discovery of mathematical knowledge which is embedded in the material. The learning process, for structuralism, is achieved through the educational material translation in a particular way. But according to the critique in that approach, the teachers may recognize

the mathematical relationships embedded in the material, from their experience, whereas students may only see the physical characteristics of the material. As a result, the meanings that emerge when the students negotiate their interpretations differ from those planned. This is a highly technocratic viewpoint in which the designers develop the materials from static models which “are derived from formal crystallized expert mathematical knowledge” (Gravemeijer and Stephan, 2002).

The adoption of this top – down approach led to the development of various educational materials. Examples of such materials are those of Fröbel, Montessori, Cuisenaire, Gattegno and Dienes. Teachers, who select these materials when realizing mathematical activities for their students, believe that by engaging students in mathematical activities using these materials will miraculously develop their mathematical knowledge (Gellert, 2004).

However, this approach to design and use of educational materials began to create problems in students’ understanding and performance. The materials involved are thought to be ‘transparent’, in the sense that the students are expected to see the mathematical concept that they represent, which is developmentally more advanced than their current understanding. The most fundamental critique to the classical instructional approach came from the constructivist perspective and the broader socio-cultural theory (Cobb, Yackel and Wood, 1992).

Constructivism does not accept that the mathematical meaning is embedded in materials, because this ignores students’ interpretive ability (Gravemeijer, Lehrer, Van Oers and Verschaffel, 2002). In this approach, the auxiliary means used by students are neither only educational materials specifically designed for teaching/learning, nor can promise the acquisition of knowledge through their unique translation, but they are developed and used in a bottom-up process. This process is taking into consideration the students’ informal knowledge, preferences and experiences. The materials constitute a base, a starting point to begin an activity, where the child, through his/her interaction with this material and his/her multiple interpretations can manufacture new significances and relations, thereby constructing his/her knowledge.

In constructivism, the auxiliary means constitute a negotiation point for teachers and students. The discussion which takes place in the classroom, teacher and students’ interpretations for the actions with the means as well as the different ways they symbolize their actions, are considered to facilitate the construction of mathematical meanings and contribute to the further development of their mathematical ideas in a more abstract level. The teacher guides and supports the teaching/learning process in an indirect way, by choosing activities, by posing concerns for discussion and by informing students for the mathematical conventions.

Both the structuralism and the constructivism did not take into account, from the very beginning, the meaning that actions with the auxiliary means had in the broader social context. By highlighting the importance of the social aspect of learning, the interest of the research community was turned to the socio-cultural approaches that influenced also constructivism giving it social dimension. In socio-cultural approaches, students do not learn mathematics directly from educational materials—even though they may incorporate mathematical relationships, but from the cultural tools that acquire meaning through the social practices. Students would be able to appropriate the cultural tools by participating in social-cultural situations under the guidance of the teacher. The students are not expected to

copy the teacher but to appropriate and internalize cultural tools for use in their own activity (Gravemeijer, et al., 2002).

In the social constructivism, based on cues from the theoretical approaches of Vygotsky, the individual and the society are interconnected and the environment affects the knowledge. The construction of mathematical structures is done by students themselves who are the manufacturers of mathematical knowledge in the social practice of their class. The communication between teacher and students leads to formalization of the materials' interpretation as well as in the joint construction of mathematical knowledge in the community of the classroom.

Distributed cognition negotiates the processes taking place in the classroom as emergent phenomena rather than as already established practices in which students have been introduced. The aspects of the classroom's learning environment, such as the norms, the communication and the ways in which materials, social and symbolic means are used, are formed by the teacher and the students in their progressive interactions.

Nowadays Cobb's (2007) interpretive framework constitutes the main background theory of educational materials designing, development and use. It provides an analytic approach, taking into account the different ways that students think when using tools and symbols, but also how these modes of reasoning evolves over time. The tools and symbols used by students are considered as part of their activity rather than something that exists outside their activity. Students are considered to contribute to the development of classroom practices and norms, which form the social situation for learning mathematics.

PRINCIPLES FOR DESIGNING EDUCATIONAL MATERIALS

Educational materials developed over the last years have shown that they have been created to represent the abstract mathematical concepts with specific and clear way (Moyer, 2001; Moyer and Jones, 2004), to cause better learning outcomes (Burkhardt, 2007), to overcome the limits of the existing materials as well as to combat the misconceptions of students on various mathematical concepts (Szendrei, 1996).

Other factors which indicate the need for designing educational material is the weakness of finding the appropriate means for teaching a specific mathematical concept, the difficulty of children to manipulate existing materials, the need for improvement or modernization and specialization of existing materials, the expectation for further supporting and improving of the teaching/learning process of mathematics, the specialized needs of different educational environments, as well as the specific conditions of each class—the specific goals of each teacher, the specific needs of each student and of class community (Σκουμπουρδή, 2012).

The process of designing and developing educational materials itself can help to foster a variety of abilities and skills, such as critical and creative thinking, observation, investigation, control, decision making, imagination, problem solving abilities, self-esteem, as well as technical and artistic abilities and skills. It also provides opportunities for collaborative learning and communication, learning through exploration and facilitates metacognitive thinking.

The stages for creating educational materials are in general four and include the designing of the material, the construction of the material, the implementation of the material

and the use of the material. Romberg (1992) proposed a series of methodologies for developing new products, which can be used both for designing and developing educational materials. 1. Needs Assessment: In order to be considered as a necessity to design a new material, there should be a need for this material, as well as a documentation that meets both this need the advantages of the new material. 2. Formative Evaluation: The construction standards to be conformed by the new material should be of high quality. The desired results that will be achieved through its use should minimize the undesired effects and provide support services for its use. 3. Summative Evaluation: For the new material to be ready for use, clear should be made in what differs in its use and in its cost from the likes as well as clear should be made if there are enough amount of the new material in order to ensure the continuity of its use.

The characteristics of the cognitive tools that were used by Zbiek, Heid, Blume and Dick (2007) for the development and the evaluation of tools can be taken into consideration for designing educational materials. These are the mathematical fidelity, the cognitive fidelity and the pedagogical fidelity. Mathematical fidelity is the reliability of the artifact to visualize the mathematical properties, contracts and behaviors in order to be understood by the mathematical community. The actions with the materials as well as the behavior which will follow these actions should reflect accurately the expected mathematical characteristics. To the extent in which this is done, it represents the degree of materials' mathematical fidelity. The cognitive fidelity regards the materials' reliability to express students' thoughts and strategies when realizing an activity by using it. Pedagogical fidelity concerns the materials' pedagogical accuracy, the extent in which the learning develops through the material. It is investigated in which extent the material allows students to act mathematically in ways that reflect the nature of the mathematics learning and are consistent with the practice of teaching.

Kilpatrick, Swafford and Findell (2001) use the terms transparency, efficiency, generality, and clarity to describe the characteristics for choosing a representation. These terms can also be taken into consideration in the designing, in the selection or in the evaluation of educational materials. The transparency characterizes the easiness with which the mathematical concept can be seen through the material. The efficiency regards the materials' adequacy to functional use and communication. The generality refers to the range of concepts that can be supported by the material. The clarity has to do with how simple or complex the material is and how easy its use is.

Considering the above, it can be said that the principles for designing educational materials include the assessing of the need for new educational material, the investigation, recording and evaluation of the characteristics of similar existing materials, the functions and limits of their use as well as the particular characteristics of the educational material that is to be designed.

In addition, the knowledge of the contemporary learning theories and the proposed instructional practices, the study of the creation, development and evolution of mathematical concepts and the obstacles encounter as well as the difficulties cause to the teachers and to the students, should also been taken into account as educational materials' design principles. Other factors that should be taken into account when designing educational materials for teaching/learning mathematics is the informal knowledge, the experiences, the specificities and the interests of the students. These design principles are enriched with others more sophisticated, depending on the type of the educational material designed.

The designed educational materials that will be presented in the next session are: artifacts (such as the modabacus), posters (such as the manipulative bulletin board), stories with pictures (such as “The prints”, “The Adventure of policeman Sachini”, “The castle gates”, “My home”, “Nadia’ transformation” and “Phoebus”), as well as board games (such as the "Going up and down", the "Cat and mice", "The tower of triangles", "The city of shapes", the "Cicadas and ants" and the "Seeking the shape”) (Σκουμπουρδή, 2012). These are educational materials that can support the teaching/learning process of early childhood mathematics.

DESIGNED EDUCATIONAL MATERIALS

Artifacts: The Modern Abacus (‘Modabacus’)

The modabacus is an artifact that is suggested to be designed in order to serve as a multi-material for acting out mathematical tasks as well as a material that could hopefully overcome the limits and restrictions of traditional abacuses and counting boards (Skoumpourdi, 2009).

The modabacus is a combination of the traditional abacuses, the counting boards, the Al abacus (Cotter, 2000) and the arithmetic rack (Gravemeijer Gravemeijer, Cobb, Bowers and Whitenack, 2000; Treffers, 1987). It is an artefact that consists of ten interconnected rods, two bases, ten bars, 50 white beads and 50 black. The length of each bar is about twice the length that the ten beads occupy, in order to provide comfort and help children to avoid mixing because of unintentional movements (something that often happens with traditional counting boards).

The beads are not spherical but cubic, to prevent the rolling and the disappearance. The rough surface of black beads allows visual impaired children to understand the difference in colour.

The modabacus can be used in various ways depending on the student strategy in relation with the objective of the activity: student can use the beads themselves (Figure 1), or a horizontal compound of specific number of bars to create series of 10, 20 (Figure 2), 30, etc, 100 beads as a chain of cubes. This chain of cubes could be used as a forerunner of the number line.

The beads in the series may be placed by 1, by 2, by 5, by 10 in contrasting colours. The modabacus can be also used as a counting board. It can have one (Figure 3), two (Figure 4), etc ten rows with 10 beads (Figure 5) which can have by 1, by 2, by 5, by 10 contrasting colours. For example, a rod with 10 beads by 5 in contrasting colours can be used for counting and for solving simple problems.

Two rods with beads, one above the other, can be used in activities like double bus (Gravemeijer, et al., 2000). Similarly the use of three, four etc ten rows can serve for more advanced mathematical needs. The alternation of the colours (and the quality of the material) per five both in the chain of cubes form and in the counting board form, supports visualization (tactile) and subitizing the quantity of the beads. Other material which can be developed with the modabacus is the traditional abacus. Putting the bars with beads vertically, two (Figure 6), three (Figure 7), four (Figure 8), etc columns with beads are created. The columns of the modabacus may have beads in one colour or in two contrasting colours unlike the traditional artifact that has beads in the same colour, different per column. The beads can

be removed and repositioned from the columns. In this form it can support the concept of units, tens, hundreds, thousands etc.

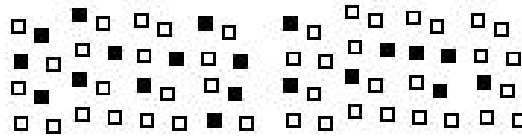


Figure 1.



Figure 2.

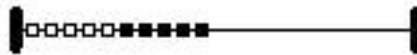


Figure 3.

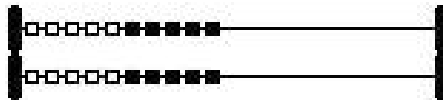


Figure 4.

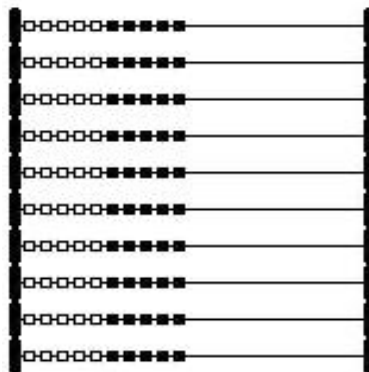


Figure 5.

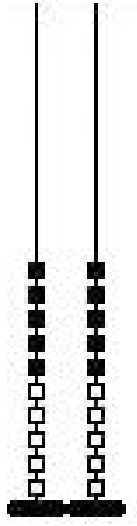


Figure 6.

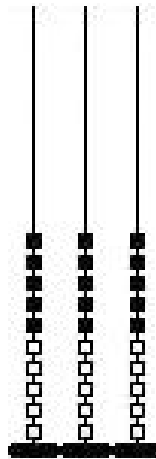


Figure 7.

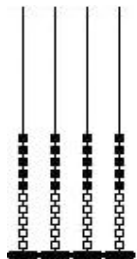


Figure 8.

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Modabacus like traditional abacus, counting boards and arithmetic rack can be used to reach early childhood's mathematics goals. These goals are related to fundamental skills, like counting on from any number, locating numbers and jumping towards numbers which are considered important and necessary for the later learning of operations like addition, subtraction, multiplication and division. It enhances young children's abilities to imagine or visualize a quantity, and to realize that our number system is based on tens.

The way modabacus can be used depends on the user. According to Gellert (2004) neither do all students use materials in ways that their teachers foresee, nor do the teachers employ materials to the full satisfaction of the designers of these materials. Modabacus constitutes an educational multi-material where students choose each time which type of the material they want to construct and use to consider a specific task. From that perspective students are viewed as active learners that can participate increasingly in the mathematical practices and who must reflect on their actions with the modabacus in order to build their meaning (Moyer, 2001). This process could offer students the freedom to describe the different ways in which they perceive things and to develop their mathematical thinking in their own way.

Posters

There are many kinds of posters whose form and structure are formed according to the purpose of their use. There are posters for presentations, posters for teaching/learning purposes posters made by a professional, by a researcher, by a teacher, by a student etc. The designer of the poster 'explains' what he/she wants to say through text or/and images, charts, tables, etc. The ways a poster can be used vary. Its manufacturer can present it, the public can read it or/and interact with it etc. Poster can support the design and implementation of mathematical activities in the kindergarten and in the primary school (Skoumpourdi, 2011). In the case of mathematics teaching, teachers can present mathematical situations and activities in a variety of ways and students can present their reasoning on a topic by a poster. The design principles of a poster are directly linked to its characteristics. These features result from a superficial analysis and a deep analysis (Καλαβάσης, and Σκουμπουρδή, 2001). In the superficial analysis, the elements described concern the external characteristics of the poster and the factors taken into account are:

- The technical characteristics. How it is made: is it handmade, is it designed in the computer, is it two-dimensional or three-dimensional etc.
- The structure. For example if it has the classical structure—title, subtitle, text—if it is flow chart or cognitive map, etc.
- The type of text and representations used. For example, if it has text only, text with pictures, with real objects, with diagrams, no text etc.

In the depth analysis the internal structure of the poster becomes evident and the factors taken into account are:

- The subject. For example, in which scientific area the subject of the poster belongs, what trades etc.

- The context. For example, is the context in which it presents the major concepts from the reality, is it from the historical development of mathematics, is it associated with other cognitive area etc.
- The principal objective.

The Manipulative Bulletin Board

Taking into consideration the above factors, posters as manipulative bulletin boards (MBB) were constructed with the aim of engaging young students in categorization² activities. The manipulative bulletin boards (MBB) are teaching aids that can be valuable for teaching mathematical concepts to young children. These boards can be developed with simple materials in real contexts and stimulate children's interests (Skoumpourdi, 2011a). This kind of auxiliary means could lead children into interesting mathematical avenues and help them learn mathematical concepts by allowing them the time to explore and experiment (Copple, 2004).

Two MBB types were created. The first type included two-dimensional posters with simple drawings or constructions, such as flowers (Figure 9), nets, shelves, and was accompanied by simple paper images as additional material for classification, which were given in a folder.

The second type was three dimensional posters depicting situations of reality with miniatures of real objects, such as the "bedroom" (Figure 10). All posters included pictorial representations (drawings, pictures) or tangible objects instead of text, because were addressed to young children (5-7 years old) who did not know to read. The context of the poster was realistic for the children and was linked with their daily lives or their experiences about butterflies, bouquets, fishing, animals, bedrooms etc..

The additional materials that were given were structured or unstructured. Specifically, in the "butterflies" MBB, in the "bouquets" MBB and in the "fishing" MBB, the butterflies, the flowers and the fish that were given to categorize, were structured—were made in a certain way, based on specific criteria. For example, in "fishing" (Figure 11), the fish were in three sizes and in four colors.

In the "animals" MBB, in the "magic wardrobe" MBB, in the "bedroom" MBB and in the "faces" MBB the materials that were given to categorize were unstructured. For example, in the "magic wardrobe" MBB, pictorial representations of real objects: clothes (pants, shirt, hat and shorts), edible (strawberry, ice cream, caramel, banana, apple, cake, cherry), animals (dog, rabbit, giraffe, cat) and means of transport (car, plane, train and boat) were given (Figure 12). For the "faces" MBB the additional material was hats, mustaches, hair, eyes, nose, lips, glasses, tie and eyelashes (Figure 13).

The same poster allows children to create various categories. For the "animals" MBB the categorization could be based on the number of feet of the animals, on whether or not they have tail, on the place they live, etc. In the "flowers" MBB, the categorization could be based on different colors. In the "fishing" MBB the categorization could be based on the different types, colors and sizes of the fish. In the "magic wardrobe" the categorization on the different

² According to researchers (Clements, 2004; Seo & Ginsburg, 2004) categorization is a mathematical concept developmentally appropriate for young children. Categorization activities help children to practice their observation skills and develop a strong understanding of the words "same" and "different". "Classification also gives children opportunities to reason, solve problems, make decisions, and be in control of their learning" (Gallenstein, 2004: 103).

shelves could be done according to the additional materials' particular characteristics - whether it was clothes, food, animals or transportation.



Figure 9.



Figure 10.



Figure 11.



Figure 12.



Figure 13.

In a research (Skoumpourdi, 2011) it was found that the MBB is an auxiliary means which can involve children in significant mathematical thinking that provokes their curiosity in an authentic way. As children try to classify objects they can form their own categories in their own developmental level by observing and identifying similarities and differences of objects and pictures in the different situations. Through the manipulation of the MBB, students can be actively involved in activities that have meaning for them and that offer them opportunities to use their informal knowledge and their strategies for the classification of objects. The manipulation of these posters by the children can also develop substantial mathematical capabilities, which require from them to communicate, to explain, and to represent their thoughts.

The construction and use of MBB in the teaching/learning process of mathematics, offer teachers the opportunity to create various situations that encourage the active engagement of students in mathematical tasks. It also adds to the teachers' learning by giving them information about children's informal knowledge and their adopted strategies for the categorization process when they realized activities in small groups. Moving from small group work to tasks performed individually enables teachers to assess the developmental level of individual students in categorization tasks.

Stories with Pictures

Stories with pictures and picture books are increasingly recognized by educators as valuable contexts and effective tools for the teaching/learning of mathematics (Anderson, Anderson and Shapiro, 2004; Casey, Erkut, Ceder and Mercer Young, 2008; Elia, van den Heuvel-Panhuizen and Georgiou, 2010; van den Heuvel- Panhuizen and van den Boogaard, 2008). It is widely believed that children, especially those of a very young age, need books and stories with pictures, as they understand them more easily than books with just words. They need the visual information to lead them to the understanding of the text. Children can more easily interpret a story with pictorial illustrations (House and Rule, 2005).

To improve the ability to understand and retain mathematical knowledge, it is useful to embed the mathematics in a story context and to develop mathematical concepts through sequenced mathematics problems connected to the storyline (Casey et al., 2008). Stories have power because they communicate information in a memorable form and they shape the

listener's feelings about the information being communicated (Egan, 1989). They also create vivid and powerful images in the listener's mind (Haven, 2000). Furthermore, they may attract students' interest, reduce anxiety, create a comfortable and supportive atmosphere in the classroom and build rapport between the educator and the students (Zazkis and Liljedahl, 2009). According to Casey (2004), when storytelling characters are used to pose mathematical problems they evoke the children's imagination and create excitement. In this way children's energy is directed toward mathematical learning.

Books and stories motivate students and connect mathematics to emotions (van den Heuvel- Panhuizen and van den Boogaard, 2008). They are considered of great significance for children's development (Anderson et al., 2004). Griffiths and Clyne (1991) indicate that "building on the mathematics which is implicit or explicit in a book ... can assist children in developing concepts, solving problems and making connections" (p. 10). Other researchers mention the role of children's literature in providing a model, in illustrating a concept, in posing a problem and in stimulating an investigation. They also mention that the incorporation of literature into mathematics curriculum improves children's mathematical achievement, increases their interest in mathematics and influences the frequency in which they use mathematical vocabulary during free play (Jennings, Jennings, Richey and Dixon-Kraus, 1992). When read storybooks in the classroom and play with math material children do better in classification tasks, in number combination tasks and in geometric shape tasks (Hong, 1996). The use of children's books could be a useful tool for making mathematics meaningful to young children, for promoting mathematical discussion as well as for communicating mathematical ideas. Picture books supply children with experiences, and informal knowledge, which usually embodies mathematical objects and structures (Ginsburg and Seo, 1999). This informal knowledge is developed in a more formal way as children meet the mathematical concepts in the teaching sessions.

There are theoretical perspectives that support the use of picture books and storytelling at teaching/learning mathematics. In the constructivist approach of learning, picture books can offer an environment for children to actively construct mathematical knowledge (Phillips, 1995). Within social perspective of constructivism, which is based on the socio-cultural theory of learning of Vygotsky, children's knowledge is obtained as a result of social interaction. In the notion of contextualized learning, knowledge is situated and learning is inspired by the activity, the context and the culture. Finally, learning by interaction (van den Heuvel- Panhuizen and van den Boogaard, 2008), set the important role pre-formal learning can have in young children's understanding of mathematical concepts in context. Contexts and the related informal knowledge can be used in mathematics classrooms as a starting point for learning formal mathematics.

According to Shih and Giorgis (2004) there are three types of literature which integrate mathematical concepts into a story: (a) In the first type the basis of the story is mathematics, (b) In the second type the story is understandable only if mathematics is understood, and (c) In the third type mathematical discourse may emerge naturally. Zazkis and Liljedahl (2009) distinguish stories, by the kind of engagement with mathematical content, the story brings about. They mention stories that set a frame or a background, stories that accompany, stories that intertwine, stories that introduce, stories that explain, stories that ask a question and stories that tell a joke.

The way the story is told determines students' involvement in storytelling as well as how they established meaning. According to Zazkis and Liljedahl (2009) the way the story is

presented influences the power of plot of the story and its potential contribution to the listener. Students can become involved in the story by answering a question, making a suggestion, imagining what the hero thinks or does, suggesting a solution for a presented problem or explaining the hero's thoughts. Though it is important for kindergarten teachers to follow a number of guidelines for using picture books that have been written for didactical purposes because they may not always be as effective as expected in evoking mathematics-related thinking. (Elia et al. 2010; van den Heuvel-Panhuizen and van den Boogaard, 2008).

The storytelling session can be closed in several ways such as, designing an activity and connecting it back to the initial story and by inviting students to write the conclusion or the extension of the story, to introduce a different but related story or to write the next chapter (Zazkis and Liljedahl, 2009). Another way of closing could be to materialize some aspects of the story using manipulatives (Skoumpourdi and Mpakopoulou, 2011) as well as to facilitate the child to imagine the story and play it or dramatize it, in order to actively engage in the story, supporting its mathematical reasoning directly or indirectly in creative ways (van den Boogaard and van den Heuvel-Panhuizen, 2007).

A well-chosen picture book or story with pictures can cause the mathematical reasoning of students in a natural way. Sometimes though, it is hard to find the right book or story that supports the mathematical education of young children, which combines good literature with original mathematical situations and which assists the emergence of mathematical reflection through the story and not against it (Jacobs and Rak, 1997). In these cases, there is a need for designing stories. The stories that are designed by the teacher and/or the students of a class may have greater value and gain special meaning for this class when approaching mathematics (Σκουμπουρδή, 2008).

There are particular design principles for stories with pictures for mathematics which arise from the main features of the picture books—such as the illustrations, the text and the way they are presented, the content and the context of the story line etc—from the characteristics of the mathematical concept included, from the age and interests of the readers.

A picture book can be a book that has many pictures and little or no text, so images "tell" the story (Marantz and Marantz, 2005). Authors and illustrators have the responsibility to convey the spirit of the story, even if they have not the freedom to express it. The illustrations must be in accordance with the students' preferences and abilities. The educators believe that illustrators need to know what details to include in the illustration, in order the story to be recognizable, understandable and entertaining for the children. The illustrations, according to picture books' critics (Marantz, 1992), should be selected/designed in a way that offers something more than just reinforcing the text. They must add items to the story, introduce new dimensions, and perhaps even "say" an additional story. But specific pictorial representations impede or facilitate the teaching/learning process. For example, images with objects to be measured are more difficult for children (Griffiths, 2007) than the manipulation of real objects, because the objects in the image can not be moved by the child. But such images can challenge the child to find a way to remember the objects that has already count.

Illustrations addressed to nursery school and primary school students should be simple and realistic. House and Rule (2005) reported the types of illustrations that prove to be most engaging for preschool children. They mentioned several topics, characteristics and abilities. Some of the preschooler's criteria for pictures book illustration were familiarity, action, color, feeling and imagination. Children often refer to the similarity of the picture with their own

family. They mention characteristics that they like, because they belong to their own habits. They usually describe as pretty the images containing action, such as running, dancing, hunting, hiking, climbing etc. The bright colors (red, pink, blue, yellow), the designs like plaid and polka dots, the clothes (pajamas, blouses, skirts) and the accessories (jewelry, hats, shoes, makeup) are some of the things that excite young children. They observe and interpret the feelings of a person or animal depicted. They prefer clothes and accessories even for the animals presented in their natural environment, indicating that they would like to wear nice dresses and shoes to those animals. If there is something unknown in the illustration it causes questions and queries to children and leads them to interpret it in their own way using their imagination. Young children do not like images with unusual features such as red eye, ugly characteristics in humans and animals as well as animal habits that are not real. Also they do not like images evoking fear like animals that show their teeth, images and expressions that indicate biting, sharp black nails, and anything related with blood or with feelings of pain and misery.

The pages of a modern picture book can be specifically configured to open at some places, form pop-ups or use other techniques that enrich the illustration. They may also integrate other materials such as fabric, giving the child the opportunity to touch it or to handle it in some other way, cultivating its senses.

Egan (1992) supports the idea that connecting teaching with students' everyday experience helps in engaging students in learning subject matter. Children benefit from stories that contain predictable data. Predictability is displayed through stories related to familiar topics and through known stories, but also through stories that contain familiar concepts and expressions, like days of the week or numbers, and repeated events. These elements help children to understand the sequence of the events of the story and allow them to participate actively in the narrative. Contexts that rotate around one character and contexts that are related with television programs appropriate for their age are also of interest. Egan also suggests that for more imaginative engagement of students we can use situations more distant and different from their everyday experience. Through imaginary situations, children develop their reasoning, as they have the potential of mental and emotional engagement, something often missing in school activities. The imaginary situations create to students' queries that usually have more than one correct answer.

The storyline may contain (Monhardt and Monhardt, 2006) questions or problems with an open end or with a particular end, with change in a perspective, as well as with explanation, repetition, surprise, funny, and situations that cause the development of various skills (observing, communicating, classifying, measurement, prediction). Also, the story itself can give the end, the solution and the settle. The integration of mathematical elements in the storyline requires the knowledge of the scientific concepts and the students' informal knowledge on such matters (van den Boogaard, and van den Heuvel-Panhuizen, 2007; Ramsey, 2007). The mathematical reflection should be derived from the plot of the story and the effort to understand it and should not have the form of typical mathematical classroom activities. From the plot of the story and from the heroes' actions, situations for mathematical discussion are created. The above features form the design principles of the stories with pictures. A carefully designed story involves mathematical concepts and procedures with scientific precision, addressed to the age of children for whom it was designed, includes explicit images and easily recognizable objects in close relationship with the text and its context is linked to the children's interests in the actual or in the imaginary world. It allows

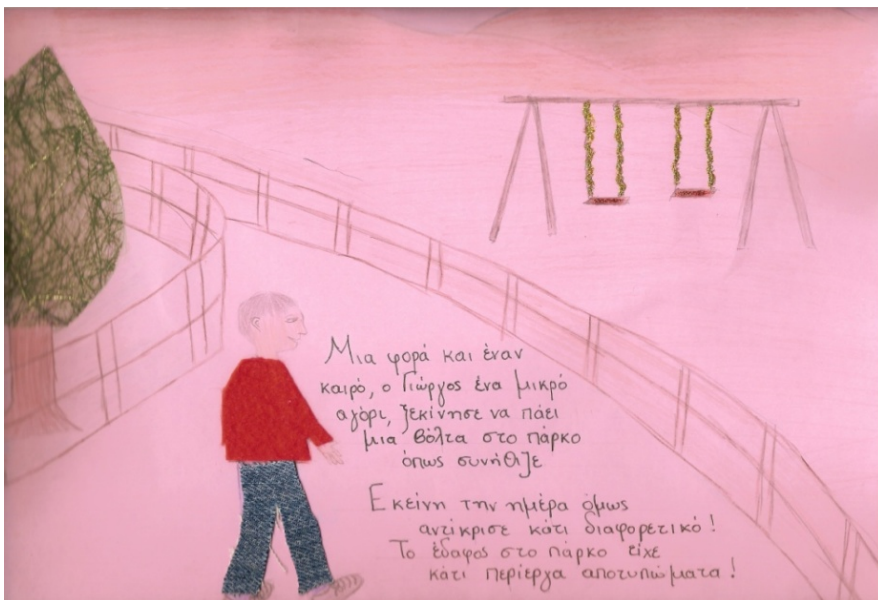
the evolutionary interpretation and understanding from simple to complicated engaging children in mathematics in a natural way (Σκουμπουρδή, 2008). Indicative examples of designed stories with pictures are the following: “The prints”, “The Adventure of policeman Sachini”, “The castle gates”, “My home”, “Nadia’ transformation” and “Phoebus”.

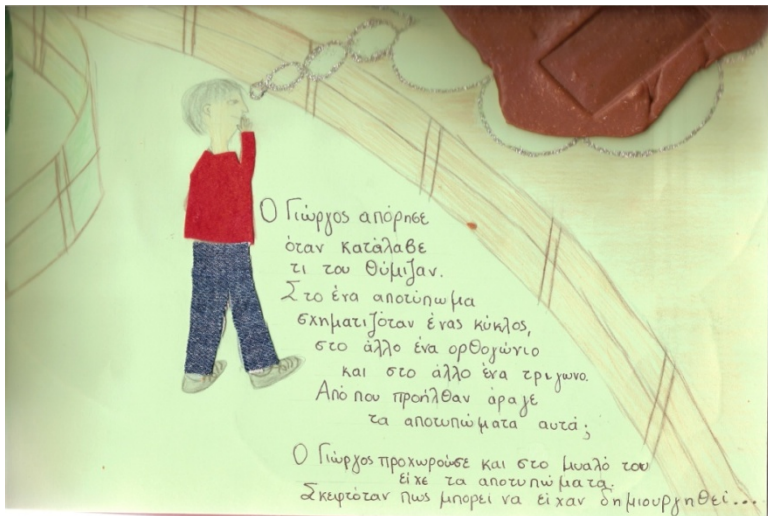
The Prints

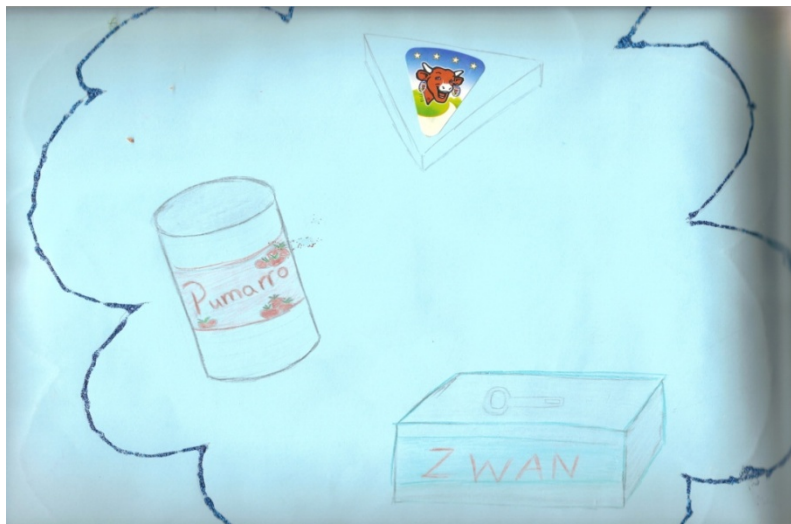
‘The Prints’ is a picture book, for helping kindergarten children recognize the origin of the plane figures presented (Skoumpourdi and Μπακοπούλου, 2011). Through the picture book which presents plane figures as prints of real life objects, we assumed that children could link to plane figures and solid shapes³. The story is connected to children’s everyday experience by using pictures of familiar items. Though, much of this story is unrelated to their real lives and experiences. Children are unlikely to ever find themselves in the situation presented in the story. The pictures are either in accordance with the text or tell the story themselves. The plot of the story of the designed picture book is about a person, George, who saw some strange prints while taking his daily walk in the park. The story is written in such a way that the kindergarten children can see that the mathematics involved have meaning. The storyline includes several examples of objects that can be the creators of these prints trying to accomplish the author’s purpose which is the connection of plane figures with solid real life objects. These prints—plane figures—intend to engage the children’s imagination and to make them curious as to how these prints were made. The “Prints” can serve as an auxiliary means⁴ for helping kindergarten children build their pre-formal knowledge of geometric shapes. This pre-formal knowledge could be the starting point for mathematical understanding which then could be supported by the teacher through teaching as well as through informal and formal conversations. Through storytelling students engage in the mathematics that emerges out of the story. They can have the opportunity to study geometric concepts that go beyond identification of simple geometric shapes. The identification of the print of a solid shape can become more accessible and more engaging to children. Children can recognize the basic plane figures and their source connecting them with the prints of solid real life objects.

³ Young children’s concepts of geometric shapes begin forming in the prekindergarten years and stabilize as early as at the age of 6 but these concepts are not necessarily accurate (Gagatsis & Patronis, 1990).

⁴ Auxiliary means used for ‘teaching’ geometric shapes, in some cases, are inappropriate or introduce children only to idealized examples. For instance, in most kindergarten classes students explore plane figures using a variety of materials including tangrams and geoboards and for exploring solid shapes they usually use pattern blocks. But can plane figures be explored by tangrams or similar manipulatives? These materials cannot represent plane figures because they can be handled and can be stacked. Plane figures cannot have any thickness. The above mentioned misuse minimizes and contradicts the development of geometric constructs and their relationships in young children.





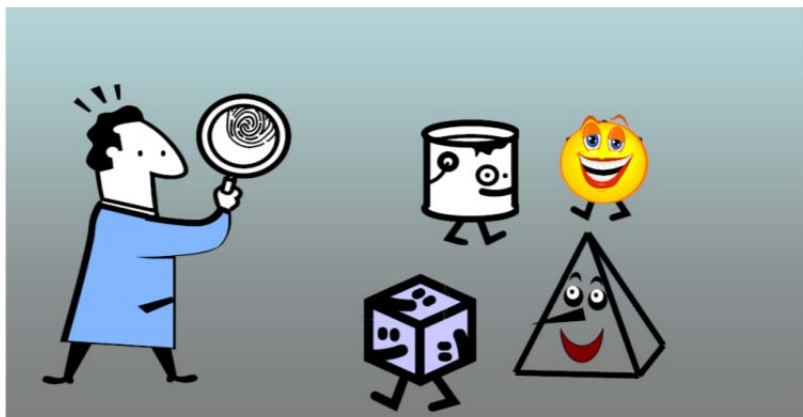




The Adventure of Policeman Sachini

The story shows the search of geometrical shapes by policeman Sachini. This story, through the various forms of solid shapes presentation in different situations, can help children to understand the characteristics of solid geometric shapes as well as their place and their role in our everyday life, but also their relationship with the plane geometric shapes (Σκουμπουρδή, 2008).

Although the story and characters are fantastic, the plot takes place in everyday situations and the hero is real and familiar to children, from children's television shows with similar themes. Each character of the story has the name and shape of a solid. These solids that are sought by the policeman are sometimes presented as geometric shapes, sometimes as real objects in everyday life situations and sometimes their prints appear. Thus the cube, the sphere, the cylinder, the pyramid, the square, the rectangle, the circle and the triangle are searched, identified and named in order the plot to be understood and the story to be continued.

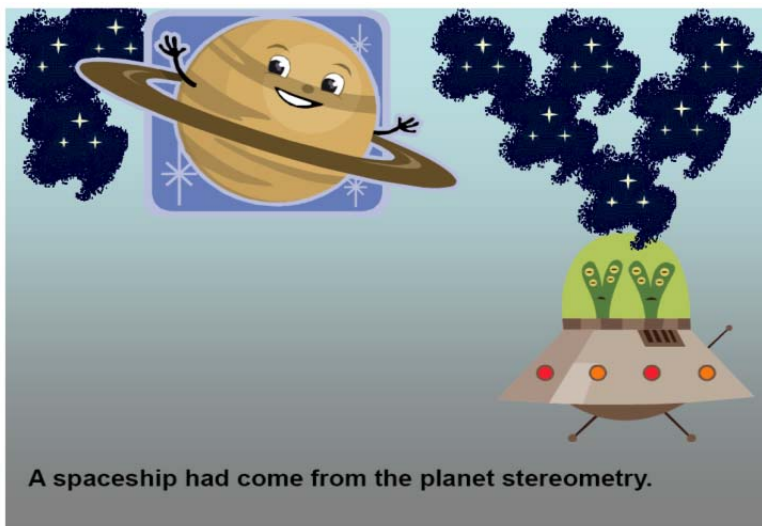




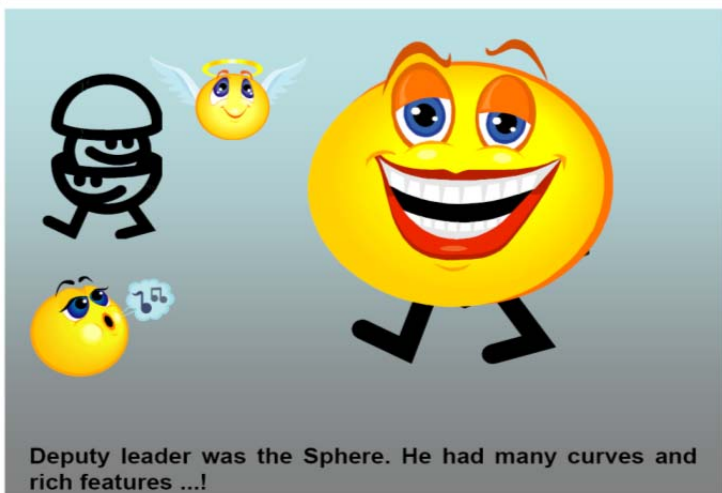
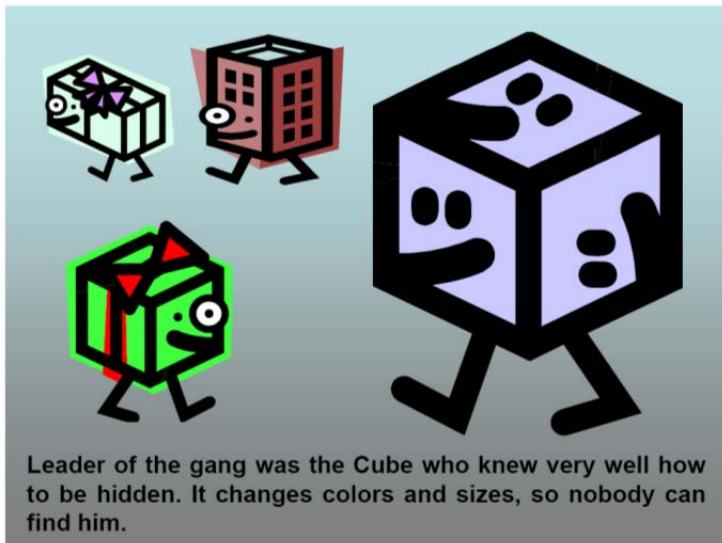
On Monday, the policeman went to face once again the outlaws.

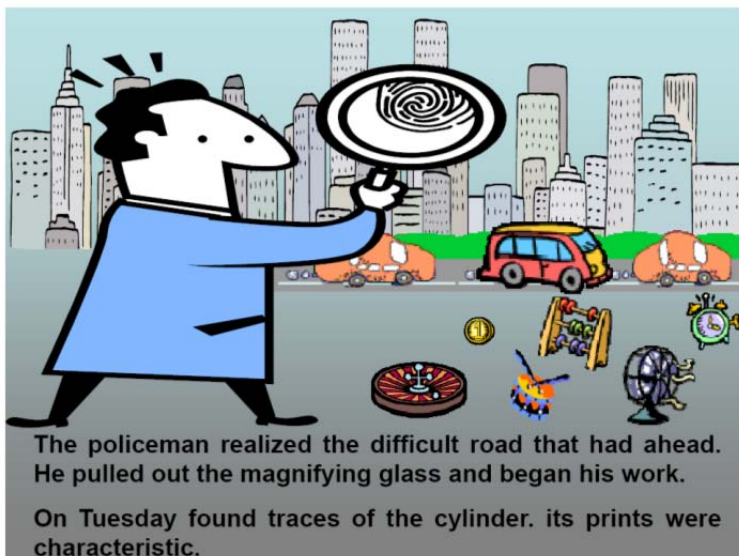
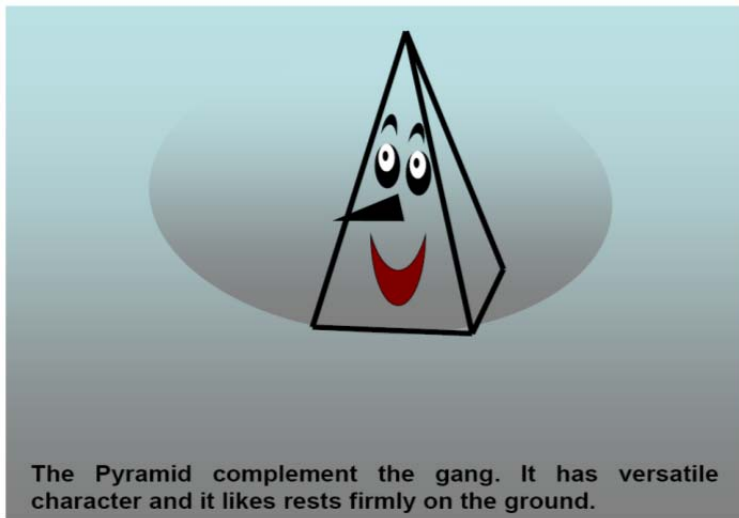
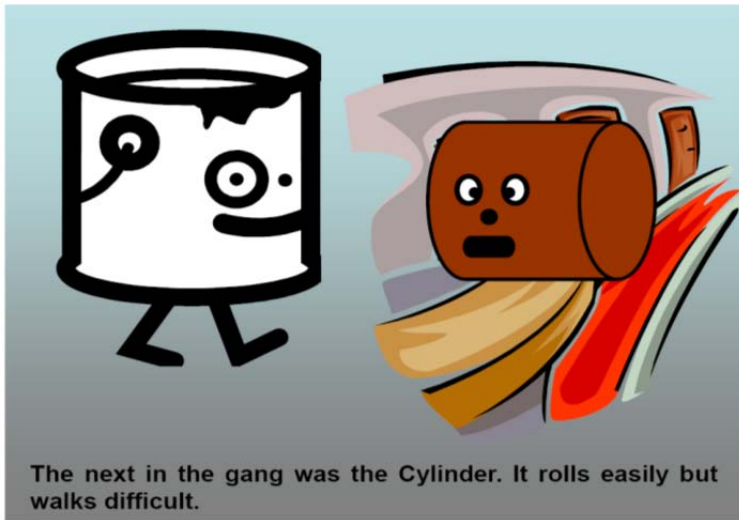


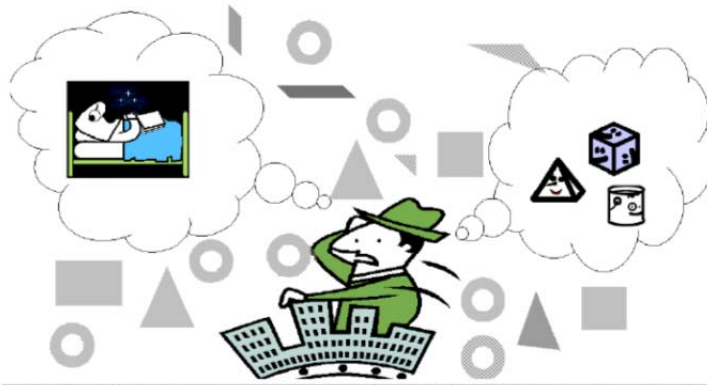
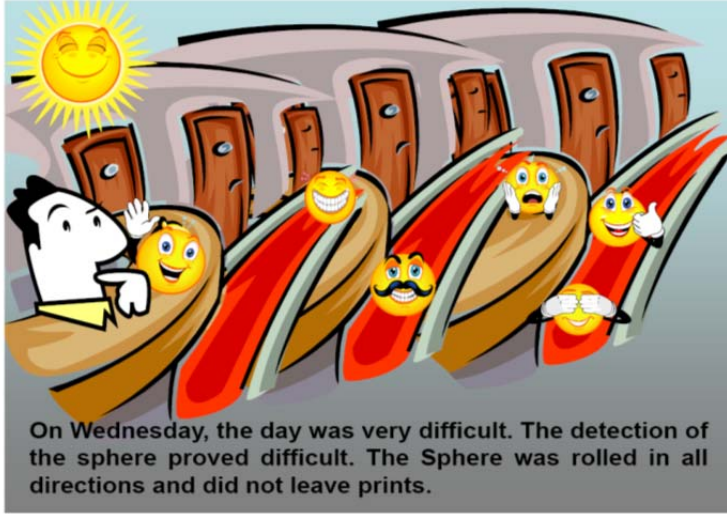
His assistant informed him by telephone for the space objects attack.



A spaceship had come from the planet stereometry.





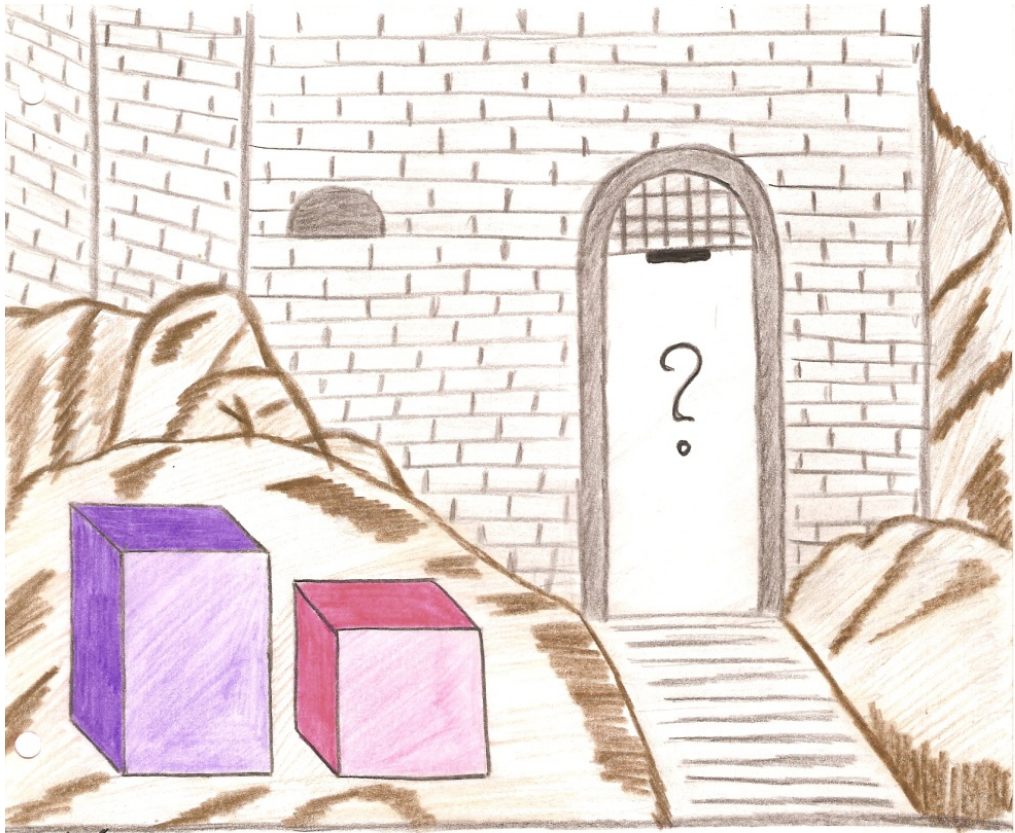




The Castle Gates

The story causes a variety of considerations about the way the shapes should be placed so they can pass the gates and enter the interior of the castle. Through the story, the images, and the manipulation of the solids which have the same colors and the same sizes as in the images-the concepts of the square, the rectangle and their interrelationship with the cube and the rectangular parallelepiped are achieved.





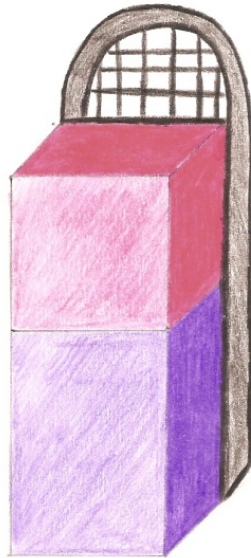
Μια φορά σου ήταν παιδί, σε ένα ήσυχο χωριό, ζούσε ένας από τους καλύτερους ερευνητές, ο κ. Μωβ, που ήταν ορθογώνιος παραλληλεπίπεδος. Ένα ήσυχο πρωί, όταν έμαθε τα άσχημα νέα, ότι τέσσερις φίλοι εμπλωβίστησαν μέσα στο κάστρο με τις παράφρενες πύλες, έπεσε να ζητήσει τη βοήθεια ενός άλλου καλού ερευνητή, του κ. Μωβ, του κυβού. Ο κ. Ροζ' δέχτηκε με χαρά να του βοηθήσει και αμέσως ξεκίνησαν για το κάστρο.

- Η πύλη είναι κλειστή. Πως θα μπούμε μέσα

- Ήλπιω ένα σουμπί γράφι. Πες αν το πατάσουμε να ανοίξει η πύλη;

- Ας δοκιμάσουμε. Μόνο που φανεί από τους δύο μας δεν φτάνει.

- Ή, πες να χάρουμε;

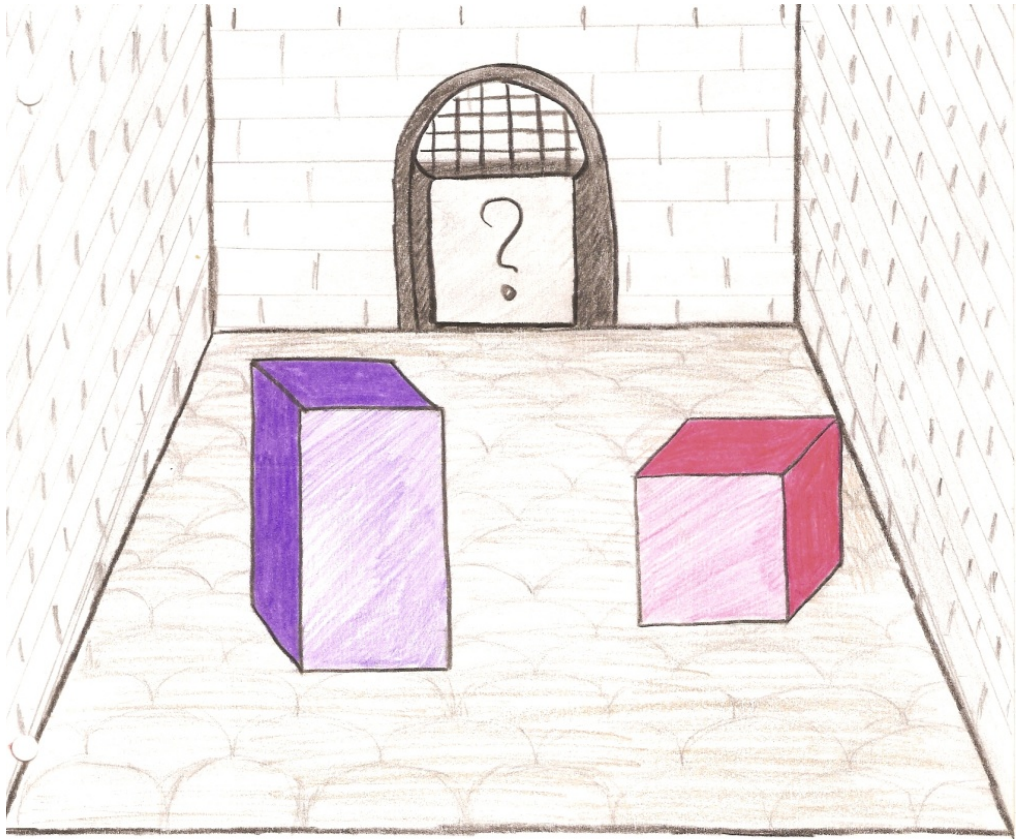


- Νομίζω ότι αν ανέβει εγώ μου, φτάνουμε να σταtingουμε το κουμπι.

Σαι αφού ο κ. Ρόζ ανέβηκε πάνω στον κ. Μωβ, έφθαγα το κουμπι, το σταting και άνοιξα την πόρτα.

- Δεν ήταν και τόσο δύσκολο καλά, είτε ο κ. Μωβ, και συνέχισα να περιηγηθεί και να εφευρεθεί το γάστρο μέχρι να βρουν τους τέσσερις φίλους.

19

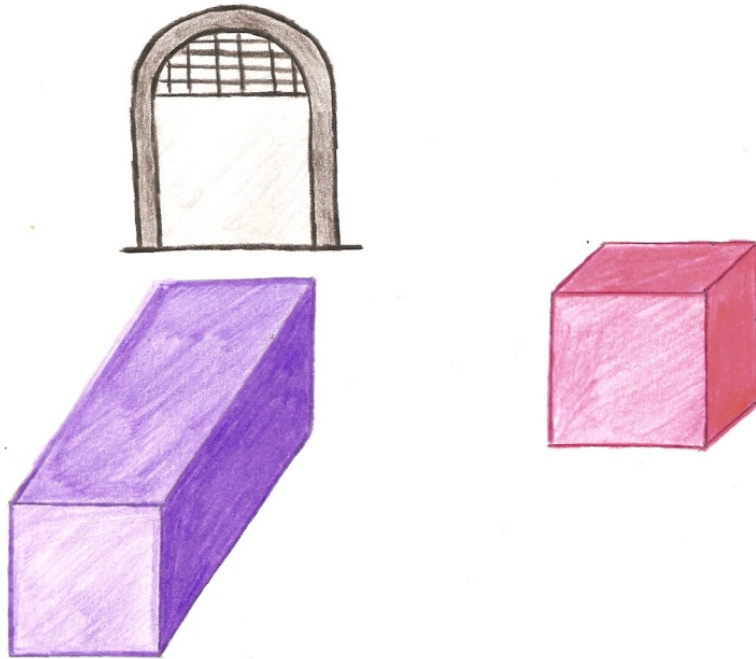


Αφού περπατήσαγα για αρκετή ώρα, βρέθηκα σε ένα δωμάτιο του γυμνασίου που ήταν ελεύθερο άδειο. Στο μόνο που υπήρχε εκεί ήταν μια μύζη.

- Ζητάει/φε, ο μόνος τρόπος να προχωρήσουμε είναι να περάσουμε αυτήν την μύζη, είτε ο κ. Μωβ.

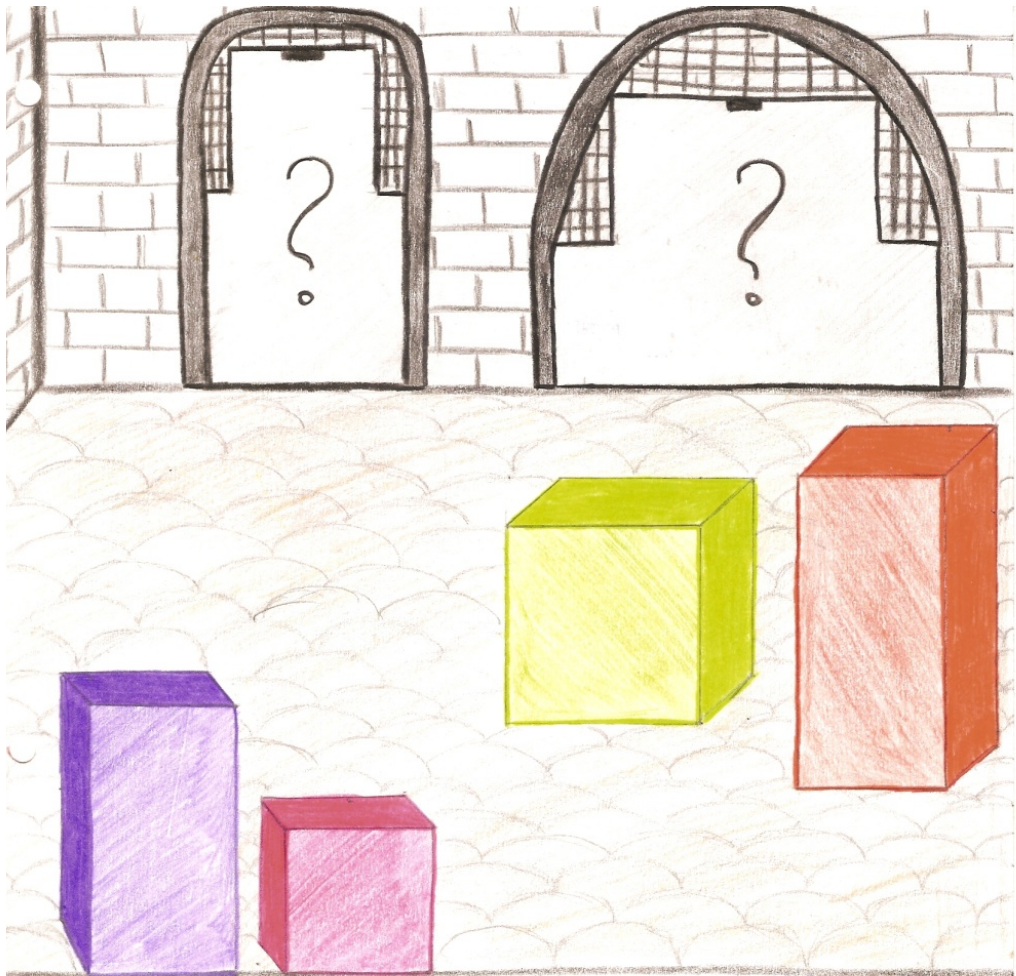
- Εγώ χωράω να περάσω, επειδή όλες οι πλευρές μου είναι ίσες και τετραγωνές όπως το σχήμα της μύζης, είτε ο κ. Ροζ.

- Σε παρακαλώ βοήθησε με. Ήδες ένα τρόπο να μπει και εγώ μέσα.



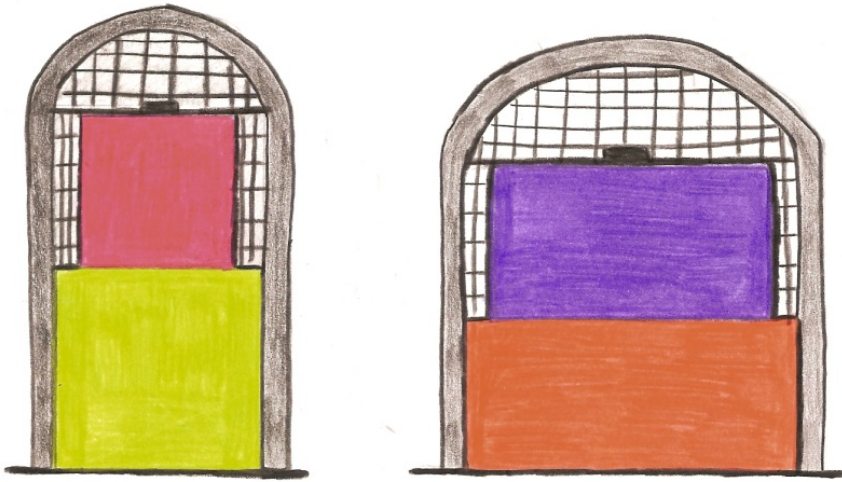
- Νομίζω ότι έχω μια ιδέα. Αφού δεν χωράς να μπεις
 ορθός, δοκίμασε να μπεις ξαπλωτός.
 - Και πως θα περπατάω, ρώτησε ο κ. Μωβ
 Δεν θα περπατάω.... Θα περπατάω!

Και έτσι οι δυο γαζοί εξερεύνησαν συλλογικά τα αποτελέσματα των
 εξερεύνηση τους.

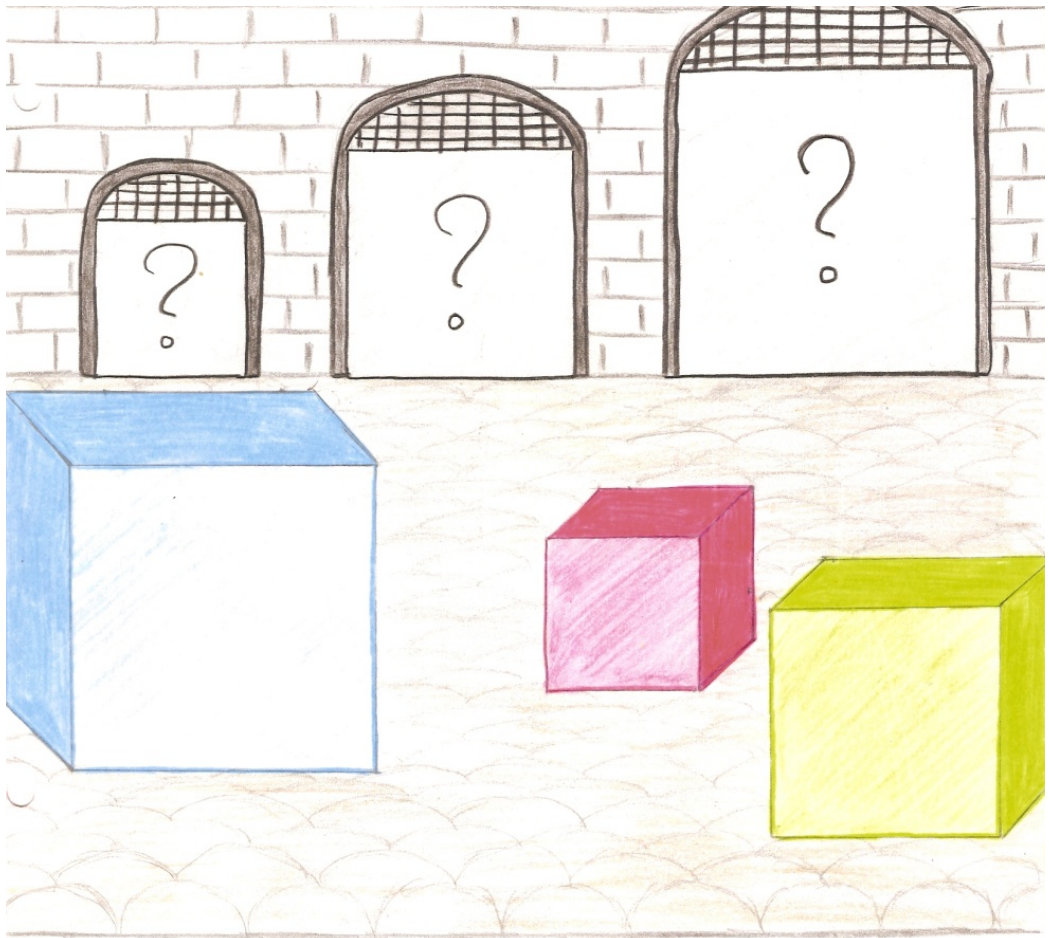


Η πιύνη τους οδηγησε σε ένα κοιτούριο δωμάτιο όπου με μεγάλη
 τους χαρά είδαν τον δύο από τον ζέσθερις αγροούμερα.
 - Σεία γας. Ηρδαμε να γας βοηθήσουμε, είτε ο κ. ροφ.
 - Σεία γας. Είμαι ο κ. Πράσινος, ο κύβος και από εδώ ο κ. Πορτοκαλίς,
 ο Ορθογώνιος Παραλληλεπίπεδος. Θα μας βοηθήσετε να βρούμε τον
 φίλο μας;
 - Θα γας βοηθήσουμε. Γι' αυτό είμαρτε εδώ άλλωστε.
 Έχετε καμία ιδέα πως θα στεράσουμε τον πιύνη;



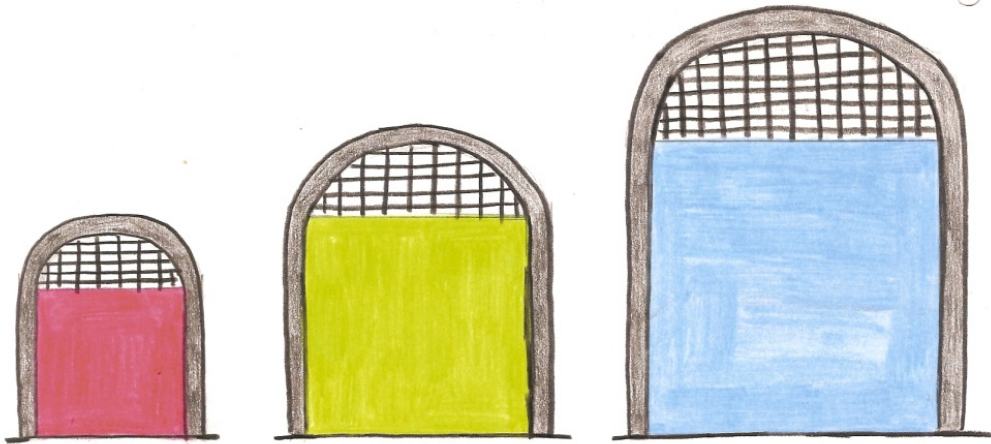


Ὁ Μοιτῶ οἰεῖ ἔχω μιὰ ἰδέα! Ὅπως λέγετε πρέπει νὰ βουρξαλοῦμε
 γιὰ νὰ φτάνοῦμε νὰ πατήνοῦμε τὰ κοιλινὰ τῶν παιδιῶν. Προτείνω λοιπὸν
 ἐμεῖς κ. Ροῦ καὶ ἐμεῖς κ. Τροῦγιε νὰ εἶτε κύβοι καὶ ἔχετε ὄφες ἐν
 πλευρῆς εἰς τετραγώνους νὰ σταθῆ μαζὶ καὶ ἐμεῖς κ. Τροῦκορὰ νὰ
 γινῶμε τετραγώνια. Ζέβαια μὰλλον θὰ πρέπει νὰ σταθῶνοῦμε.
 Καὶ ἐπεὶ ἐπιθυμῶντας ὁ εἶδος τῶν αἰσθητικῶν νὰ σταθῶνται
 καὶ αὐτὸς ἐν τῶν.

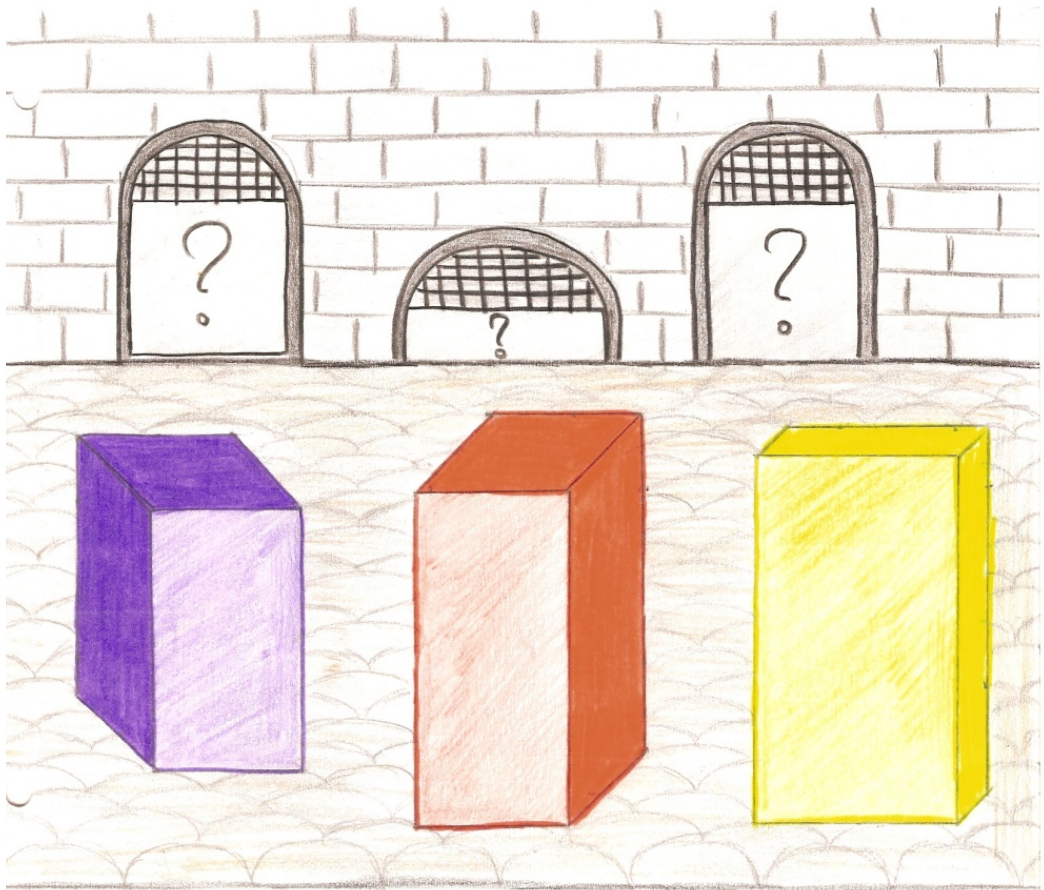


Το Σευγάρωμα των κύβων που αποβούλευσαν την μια έξοδο, οδηγούνταν σε ένα δωμάτιο, όπου για καλή τους τύχη βρήκαν και και του τρίτου της παρέας, τον κ. Λορέντο, έναν μεγάλο κύβο.
 - Και τώρα πάλι η ίδια αμοιβαία πως θα περάσουμε ως γίγες για να βρούμε επιστέφως την έξοδο, είτε ο κ. Ροζ.

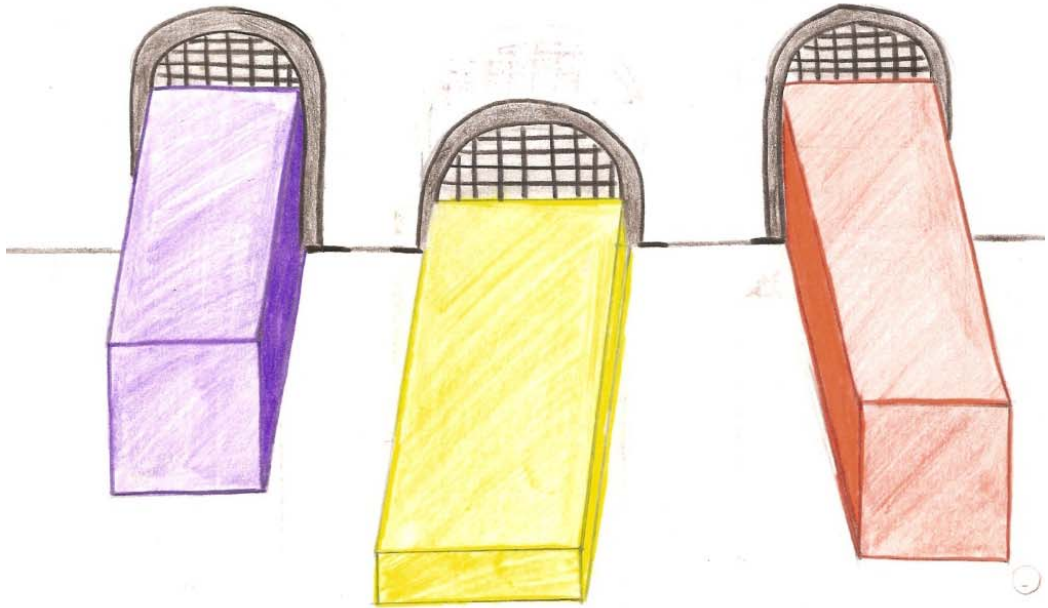
C



- Νομίζω ότι τα πράγματα τώρα δεν είναι και τόσο δύσκολα.
 Όπως βλέπετε υπάρχει μια γύνη για τον καιέρα μας που του
 σουριάζει χάνσι.
 Την ίδια στιγμή που οι κ. Κυβοί έβριγυαν γύνη στο πρόβλημα
 τους, στο δικαίω δωμάτιο οι κ. Ορδοχώνιοι Παρυσήνεστρεδοί
 έβριγυαν και τον σέρουαίο της παγέας.



- Ήπιεζας σε βρήκαμε! Παιδευτήκαμε ποζι χι' αωσò εζηρβουμε
γα είναι η τελευταία μας δοκιμασία.
- Τα πράγματα βέβαια δεν φαίνεται γα είναι τόσο εύκολα.
Πρέπει γα βρούμε έναν τρόπο γα περάσει ο κωδίκας μας
από τα εωσσι ποζι.



Μετά από πολύ ώρα γνώστη ο κ. Μάβ και ο Δημήτρης.
 - Εμείς έχουμε αναπτύξει τέτοια δουλειά, γι' αυτό πάλι
 θα πρέπει να ξεκινήσουμε.
 - Πάλι θα μιλούμε, είτε ο κ. Γεωργιάδης
 - κ. Κίριε, νομίζω ότι το μιλούμε είναι και για εσάς ο μόνος
 τρόπος διαφυγής.

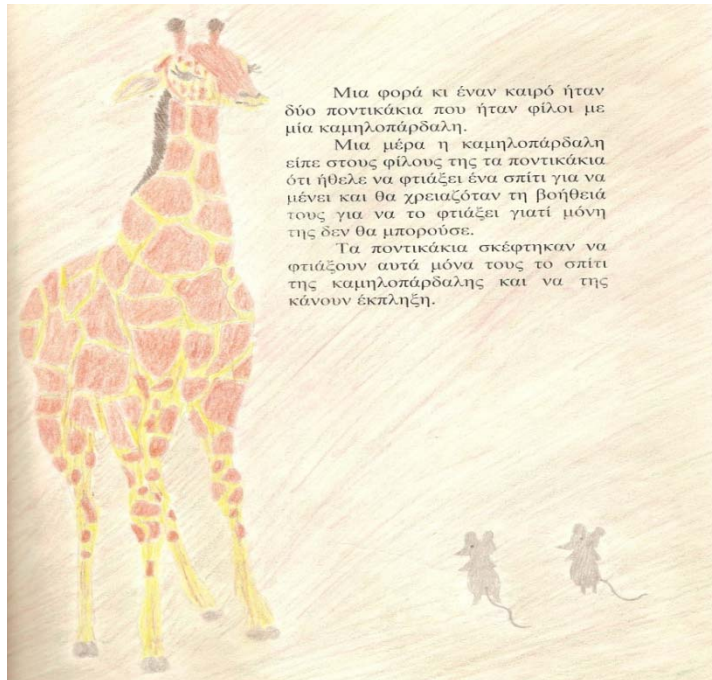
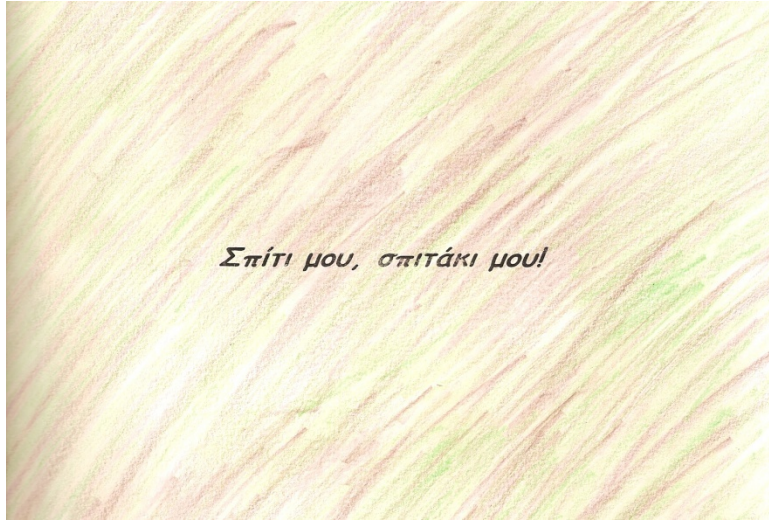


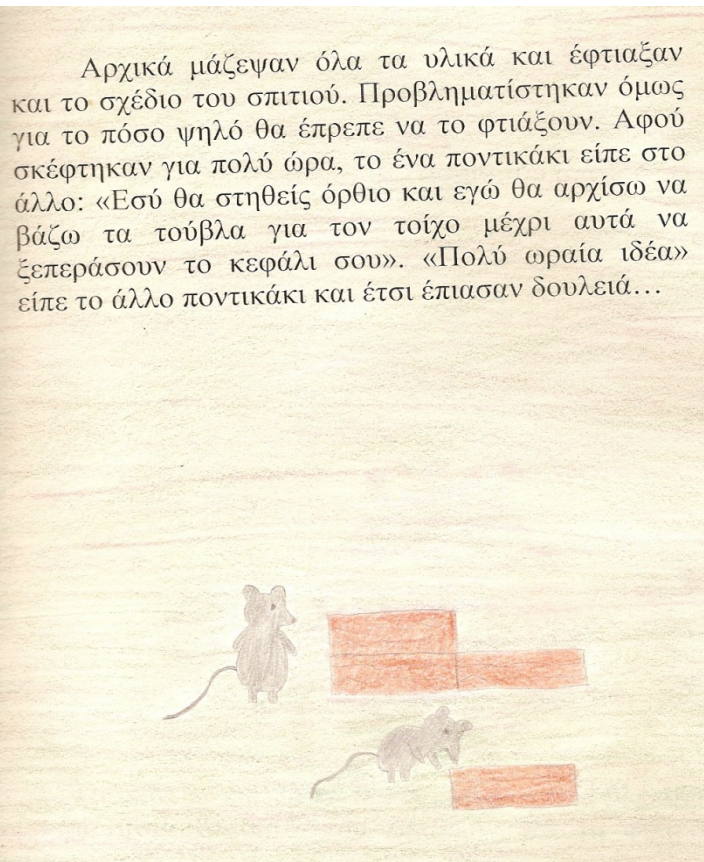
«Επει η περιπέτεια των αεθάρων φίλων
 είχε καλό τέλος και παίρνεται τον
 δρόμο του ηρωισμού τραγουδούσαν όλοι μαζί
 «Κόβοι και παραλλήλες πεδοί είμασθε όλοι εθείς
 για στην εστράδα δει μας μοιάζει καρείς»

Τέλος

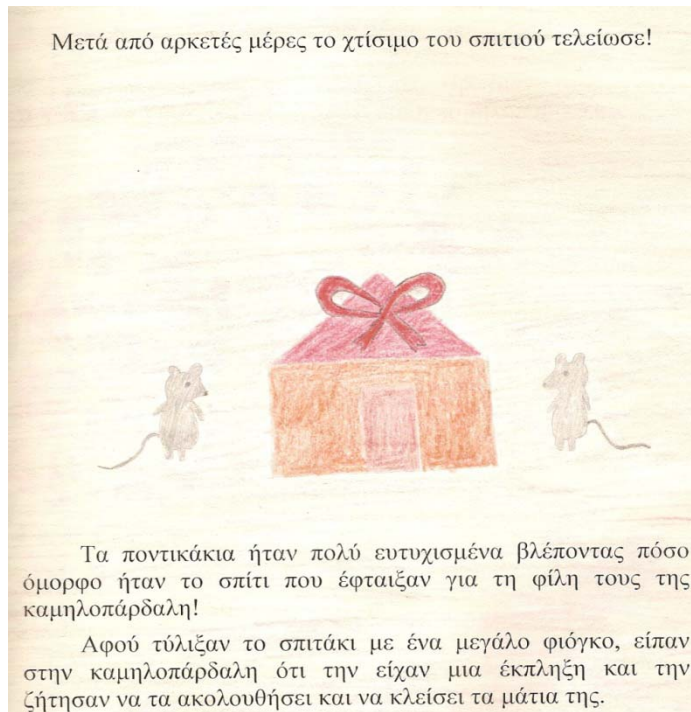
My Home

The story, through friendship and diversity, helps to understand the relevancy of sizes. The little mice, the giraffe' friends, are decided to make her a surprise and build a house for her. They built her house but eventually it became too small' ideal for mice, but not for the giraffe. How high should the house be constructed in order to be appropriate for the giraffe? The children are wondering why the house built by the mice does not fit the giraffe and they suggest ways to improve the construction.





Μετά από αρκετές μέρες το χτίσιμο του σπιτιού τελείωσε!



Τα ποντικάκια ήταν πολύ ευτυχισμένα βλέποντας πόσο όμορφο ήταν το σπίτι που έφτιαξαν για τη φίλη τους της καμηλοπάρδαλη!

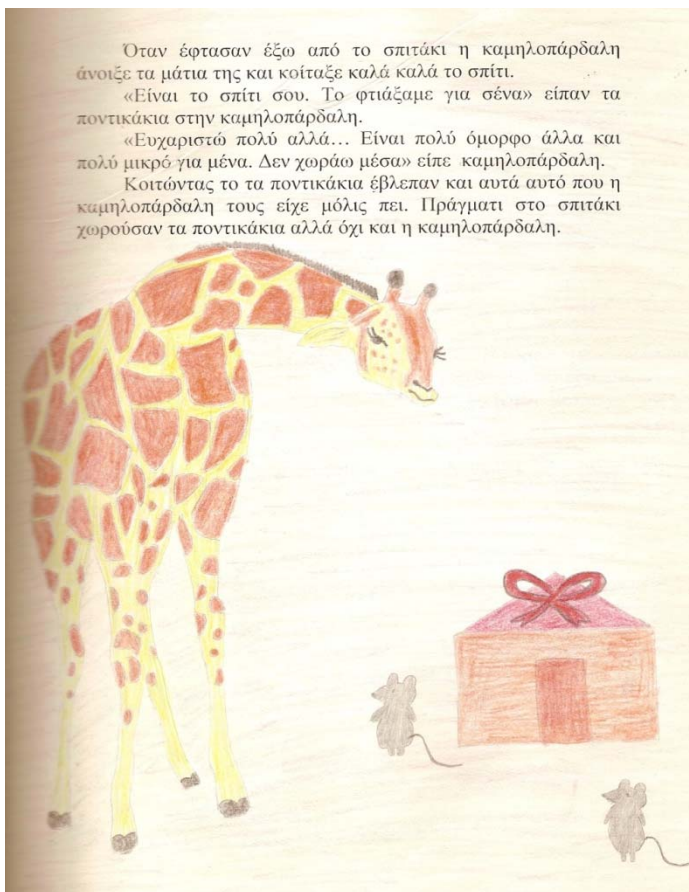
Αφού τύλιξαν το σπιτάκι με ένα μεγάλο φιόγκο, είπαν στην καμηλοπάρδαλη ότι την είχαν μια έκπληξη και την ζήτησαν να τα ακολουθήσει και να κλείσει τα μάτια της.

Όταν έφτασαν έξω από το σπιτάκι η καμηλοπάρδαλη άνοιξε τα μάτια της και κοίταξε καλά καλά το σπίτι.

«Είναι το σπίτι σου. Το φτιάξαμε για σένα» είπαν τα ποντικάκια στην καμηλοπάρδαλη.

«Ευχαριστώ πολύ αλλά... Είναι πολύ όμορφο άλλα και πολύ μικρό για μένα. Δεν χωράω μέσα» είπε καμηλοπάρδαλη.

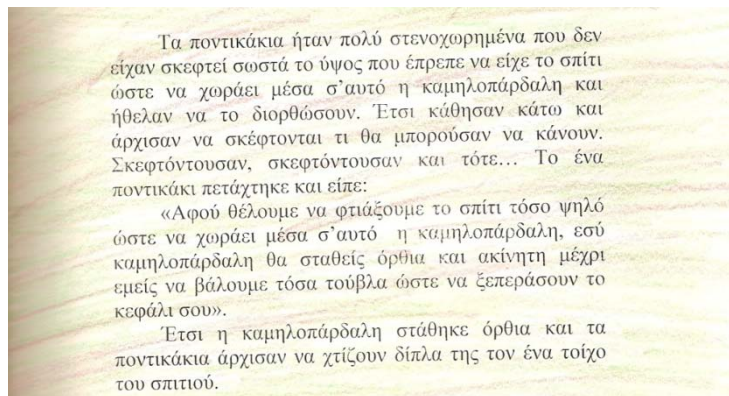
Κοιτώντας το τα ποντικάκια έβλεπαν και αυτά αυτό που η καμηλοπάρδαλη τους είχε μόλις πει. Πράγματι στο σπιτάκι χωρούσαν τα ποντικάκια αλλά όχι και η καμηλοπάρδαλη.



Τα ποντικάκια ήταν πολύ στενοχωρημένα που δεν είχαν σκεφτεί σωστά το ύψος που έπρεπε να είχε το σπίτι ώστε να χωράει μέσα σ' αυτό η καμηλοπάρδαλη και ήθελαν να το διορθώσουν. Έτσι κάθισαν κάτω και άρχισαν να σκέφτονται τι θα μπορούσαν να κάνουν. Σκεφτόντουσαν, σκεφτόντουσαν και τότε... Το ένα ποντικάκι πετάχτηκε και είπε:

«Αφού θέλουμε να φτιάξουμε το σπίτι τόσο ψηλό ώστε να χωράει μέσα σ' αυτό η καμηλοπάρδαλη, εσύ καμηλοπάρδαλη θα σταθείς όρθια και ακίνητη μέχρι εμείς να βάλουμε τόσα τούβλα ώστε να ξεπεράσουν το κεφάλι σου».

Έτσι η καμηλοπάρδαλη στάθηκε όρθια και τα ποντικάκια άρχισαν να χτίζουν δίπλα της τον ένα τοίχο του σπιτιού.





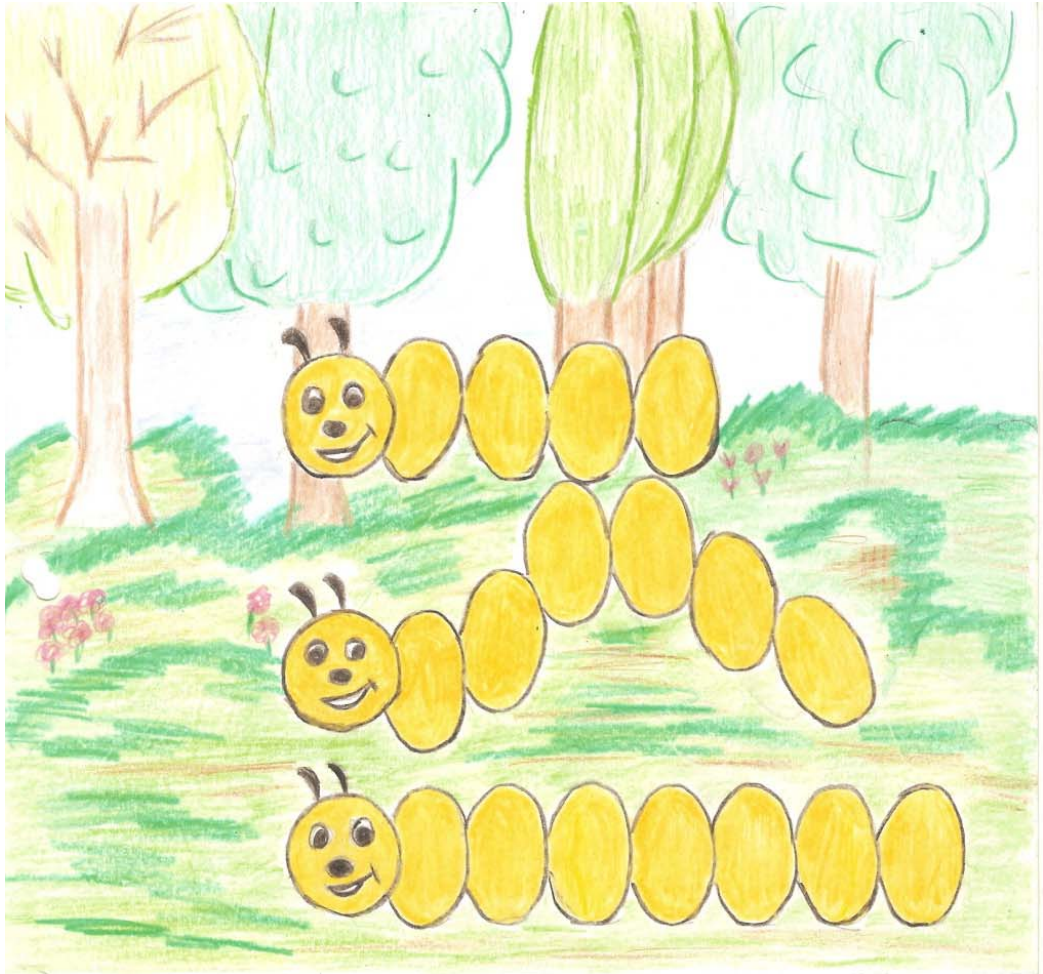
Λίγες μέρες μετά το σπιτάκι της καμηλοπάρδαλης ήταν έτοιμο. Η καμηλοπάρδαλη ήταν πολύ χαρούμενη που θα είχε από εδώ και πέρα το δικό της σπίτι και τα ποντικάκια χοροπηδούσαν από τη χαρά τους που μπόρεσαν και έφτιαξαν για τη φίλη τους την καμηλοπάρδαλη ένα σπίτι για να μένει.
Κι έζησαν αυτοί καλά κι εμείς καλύτερα!



Nadia' Transformation

The story presents the agony of the caterpillar Nadia to grow up and transform into a butterfly. For this to be accomplished, the fairy butterfly causes her to pass some trials: To choose the shortest path, to calculate the woods that are needed to build a bridge, to calculate how many sheets are needed to create a mountain trail and to choose the shorter pathway between three paths. Children in their effort to help Nadia with the trials make indirect measurements, estimations and counting with the use of various auxiliary means.





Μια φορά και έναν καιρό, βίενα καταπράσινο δάσος, ζούσε η Νάντια, η κόρη. Η Νάντια ήταν πολύ όμορφη, έξυπνη και πολύ κοινωνική. Της άρεσε να ανεβαίνει πάνω στα δέντρα και να τα μυρίζει, να λιλιέται στον ήλιο και όταν ήτα κουρασμένη, τρώει από τα φρούτα των δέντρων και ξεκουράζεται στη βλάση. Τis μέρες της, της περνούσε παίζοντας με τις δύο καλύτερες φίλες της, τη Νίσα και τη Μαρίσα, οι οποίες την αγαπούσαν πολύ, αφού και οι τρεις τους γεννήθηκαν την ίδια ημέρα. Από τη ημέρα που γεννήθηκαν οι τρεις μικρές κόρες είχαν αχώριστες φίλες και υποσχέθηκαν να βοηθήσουν πάντα η μία την άλλη.

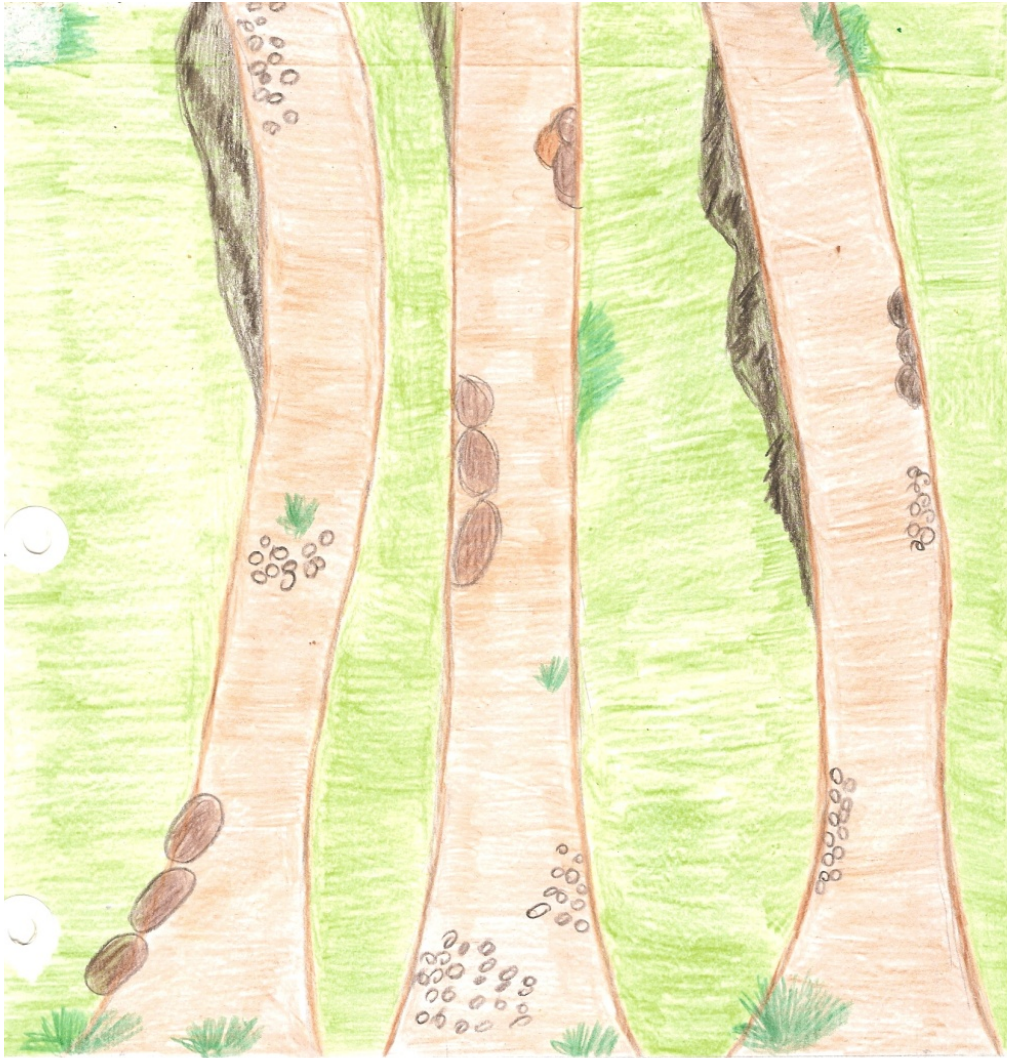
Όμως ενώ περνούσε ο καιρός και η Νίσα με τη Μαρίσα μεγάλωναν, όσο πλησίαζε η ώρα να μεταμορφωθούν σε πεταλούδες, η Νάντια παρέμεινε μικρή. Αντίθετα από τις δύο καλύτερες φίλες της εκείνη δε μεγάλωνε καθόλου, παρέμεινε τόσο μικρή όσο ήταν τη ημέρα που γεννήθηκε.



Και παρόλο που οι δύο καλύτερες φίλες δεν την κοροΐδευαν ποτέ, η Νάντια βλέποντας ότι εκείνη δε μεγάλωνε, φοβόταν ότι δε θα μεταμορφωθεί ποτέ σε πεταλούδα, κάθε μέρα στεναχωριόταν όλο και πιο πολύ. Έτσι, η Νίτζα και η Μαρίζα αποφάσισαν να την βοηθήσουν. Αφού σκέφτηκαν για αρκετή ώρα, φώναξαν την νεράιδα των πεταλούδων.

- << Γλυκιά μου Νάντια, οι δύο φίλες σου που σε αγαπάν μου είναι το πρόβλημα σου και μπροστά να σε βοηθήσω. Μπορείς να μεγάλωσεις... με λίγη μαγική βοήθεια βέβαια! Θα έρθεις να με βρεις στο σπίτι μου που βρίσκεται πάνω σε ένα ψηλό δέντρο, πίσω από το μεγάλο βουνό. Εκεί έχω το μαγικό φίλτρο που χρειάζεσαι για να γίνεις μεγάλη. Θα μπορούσα να σε πάρω αγκαλιά και να πετάξω με μαζί ως εκεί, αλλά πρέπει να προσπαθήσεις μόνη σου για να πετύχεις το στόχο σου.>>

- << Δε ηεράτσει... β' ευχαριστώ μέσα από τη καρδιά μου, Καλή σου νεράιδα.>>



Το ταξίδι όμως θα είχε εφύδια, όπως την προειδοποίησε η καλή νεράιδα, και το πρώτο που συνέβησε η μάγισσα είναι ότι θρέφθηκε να επιλέξει ανάμεσα σε τρία μονότια.

- << Και τώρα τι θα κάνω; Ποιο μονότι να διαλέξω; Η καλή νεράιδα μου είπε το πιο ωστόμο, όμως πως θα ξέρω ποιος είναι ο πιο ωστόμος άρσμος; >>



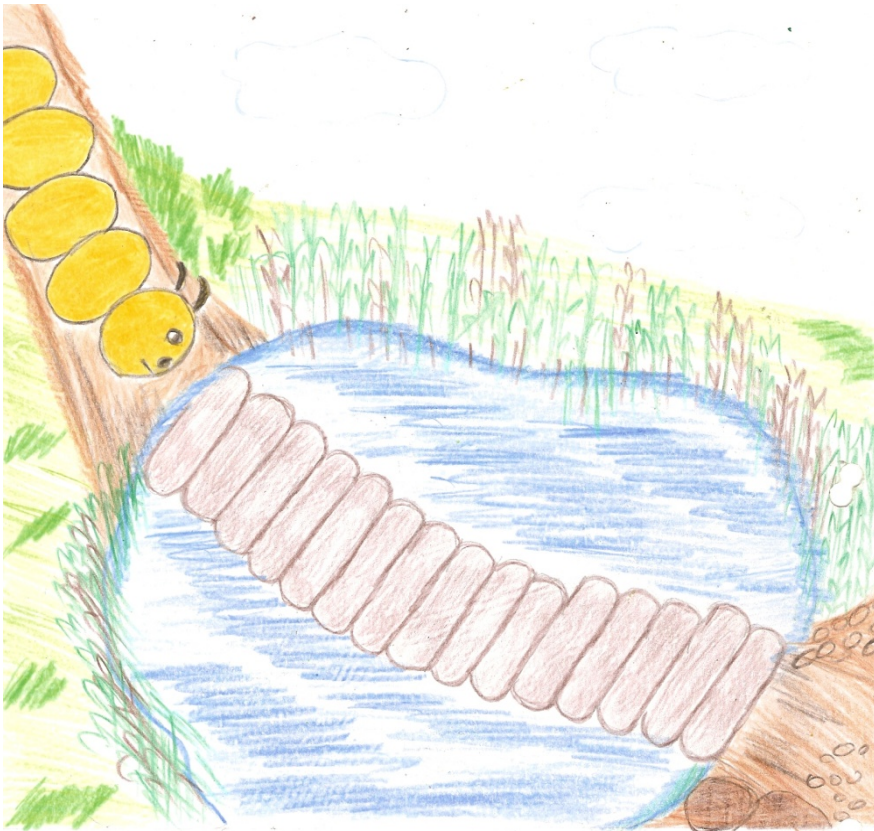


Και αφού η Νάντια προχώρησε στο μονοπάτι βρέθηκε μπροστά σε μια λίμνη. Μετά από ώρα, έφτασε στην όχθη της και έκαθε χια να ξεκαρραστεί. Η λίμνη όμως ήταν μεγάλη και είχε τόσες καλαμιές γύρω γύρω που δεν μπορούσε να περάσει. Έπρεπε να διαβίσει τη λίμνη.

- << Ουφ, φούραξε και ξέφουραξε, μα πως θα περάσω τη λίμνη; >>
Ξάφνου, άκουσε ένα "κρίτς κρίτς", "κρίτς κρίτς". Γύρισε και είδε λίγο πιο πέρα, μέσα στη λίμνη ένα κάστρο.

- << Έεε... κίριε κάστρο... !! Θα μπορούσατε να με βοηθήσετε; >>
Ο κάστρος βγήκε από τη λίμνη, χαιρέτησε τη γλυκιά Νάντια και άκουσε το πρόβλημά της.

- << Μμμ... Άρα πρέπει να περάσεις ανέναντι για να βρεις το μαγικό φίλτρο... Να σκεφτώ! Ίσως θα μπορούσα να σε βοηθήσω φτιάχνοντας σου ένα ειδικό. Όμως, υπάρχει ένα πρόβλημα. Δεν είμαι δίχως αν θα μου φτάσαν τα ξύλα... >>



Η Νάντια πέταξε από τη χαρά της!! Χοροπηδάει εδώ και εκεί!!

- << Σ'ευχαριστώ πολύ καστοράκι μου! ,είπε. Από 'δω και πέρα θα είσαι από τους καλύτερους μου φίλους!!!

- << Εντάξει, δεν έκανα και τίποτα!! , απάντησε ο καστοράς.

Τελικά, μόνο λίγα φυλάκια χρειάστηκαν! Εξάλλου, αυτή είναι η δουλειά μου και δεν θα μπορούσα να αρνηθώ σε μια τόσο χλυκιά κάμηλα! >>

Η Νάντια αποχαιρέτησε τον καινούργιο της φίλο και προχώρησε στην απέναντι όχθη της λίμνης.



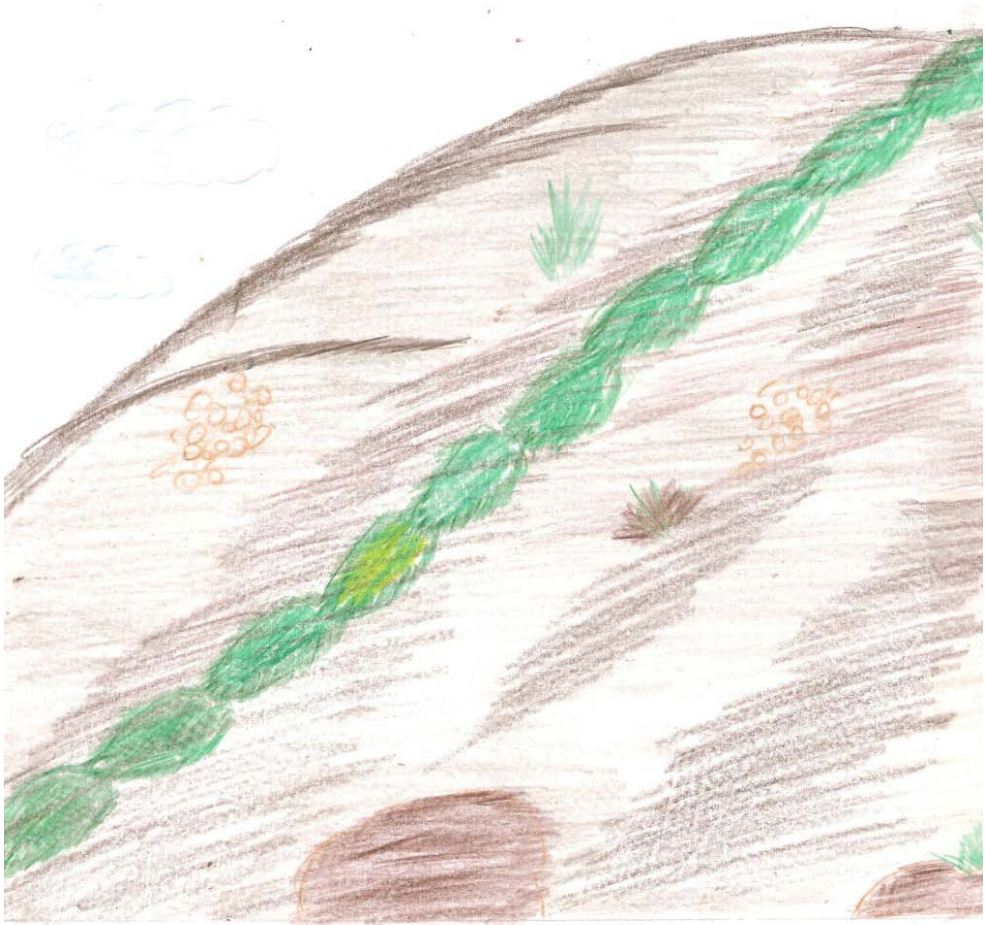
Η ανέαντι όχθη όμως ήταν αφιλόξενη, αφού το μονοπάτι ήταν χερμάτο βράχια και άγρια φυτά. Η Νάντια όταν μετά από ώρα έφτασε στο μεγάλο βουνό συνειδητοποίησε ότι δε θα μπορούσε να το ανέβει, αφού ήταν χερμάτο βράχια και θα πληγώνονταν. Κάθισε σε μια πέτρα και άρχισε να κλαίει από τη στεναχώρια της που δεν θα έφτανε ποτέ στο μαγικό φίλτρο. Ύπνου, ξαφνικά...

- <<Τι χυρδεύει μια όμορφη και μικρή κάμηλια σε αυτό το μέρος; Πώς βρέθηκες εδώ;>>



Κι αφού η μικρή Νάντια εξήγησε και στην αλεπού το πρόβλημα της, η αλεπούδίτσα που ήταν έξυπνη και δυνατή της είπε μ'ένα χαμόγελο!

- << Μη στεναχωριέσαι, μικρή μου Νάντια. Σύντομα, θα γίνεις πεταλωδίτσα με τη βοήθεια μου. Άκου τι σκέφτηκα... Εγώ θα σφίξω κι ανεβαίνω το βωμό και σε κάθε βήμα μου θα αφήνω πίσω μου μεγάλα φύλλα για να πατήσεις πάνω και να μη πηγαίνεις. Το μόνο πρόβλημα είναι ότι δε ξέρω πόσα φύλλα πρέπει να πάρω μαζί μου για να σου φτιάξω το μονοπάτι, γιατί δεν φαντάζομαι να σκέφτεσαι ότι αν δεν μου φτάσουν θα ξανακατέβω το βωμό. >>



Κι αφού η Νάντια βοήθησε την αλεπού να μαζέψει τα φύλλα, εκείνη έκανε ότι της υποχρέωσε, και παρ'όλο που είναι πονηρή δεν έκανε καμία βλαβηλιά. Η Νάντια την ευχαρίστησε και ήταν πολύ χαρούμενη που εκτός από τον κάδορα έκανε ακόμα μια καινούργια φίλη.



Μετά από πολλές ώρες και με τη βοήθεια της αδελφής, η Νάντια κατά-
φερε να διασχίσει το μεγάλο βανάκι και επιτέλους ορθώθηκαν μπρο-
στά της το μαγικό δέντρο...





Όλα τελικά πήγαν καλά και η Νάντια έφτασε στη κορυφή του δέντρου βιά και αβιασμένα. Εκεί τη περίμενε η νεράιδα, η οποία είχε έρθει από τα χελια βλέποντας την επιχείρηση που έστησαν όλες οι κάμπιες για να τη βοηθήσουν. Την πλάνιασε και της είπε:

- «Από ότι βλέπω όλα πήγαν καλά...» της είπε χαμογελαστά η νεράιδα.

- «Δε θα τα είχα καταφέρει χωρίς τη βοήθεια των καινούργιων φίλων που έκανα.» ένε ανικανοποίητη η Νάντια.

- «Καλή μου Νάντια, τίποτα δεν είναι εύκολο αν θέλωμε να πετύχουμε κάτι. Πάντα όμως έχουμε σιγά μας κάποιους που μας βοηθούν και αυτοί λέγονται φίλοι... κι εσύ στο ταξίδι σου αυτό έκανες πολλούς φίλους... και αφού την αγάπησε βίχτρα ένε... "τέρμα τα λόγια... ήρθε η ώρα να βινεις αυτό που νάντια σκευεύω και να πετύχεις μακρεια..."

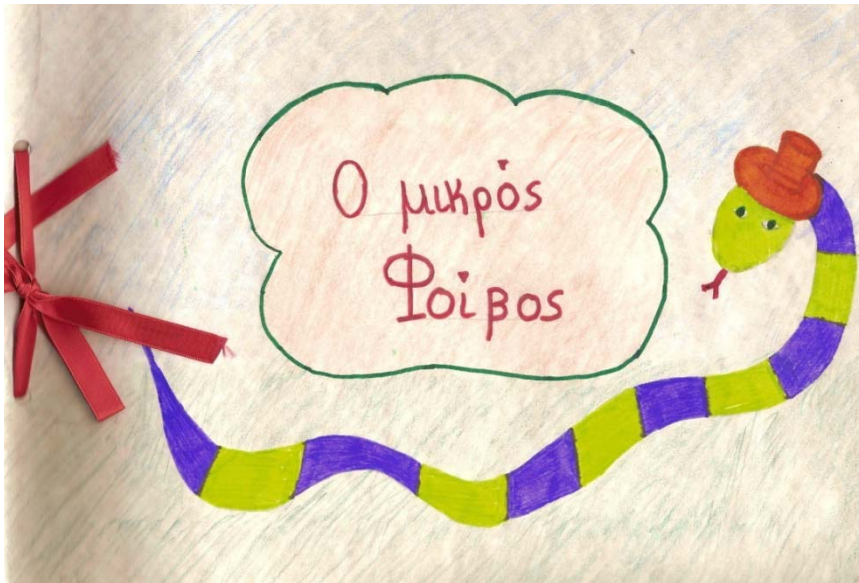
και τσουη...!!! Δίνει το μαγικό φίλτρο στη Νάντια και δείτε τι έγινε...!!!

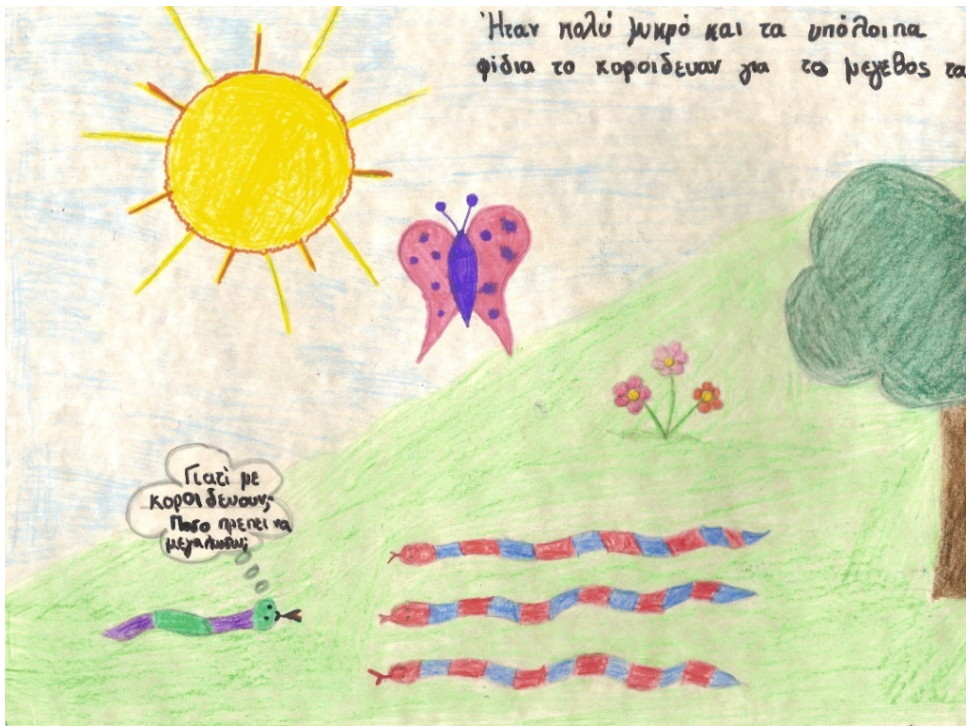


Η Μύρτια έγινε τόσο όμορφη μεταλλαδα, περισσότερο και από όσο φανταζόταν. Και αφού ευχαρίστησε τους φίλους της και πάνω απ' όλα τη καλή νεράιδα, έπρεξε να βρει τη Νίτζα και τη Μαρτζα, γιατί παρ'όλο που είχαν καινούργιους φίλους και τώρα πια μπορούσε να πετάξει μακριά, τους είχε δώσει υπόσχεση ότι δεν θα χώριζαν ποτέ. Έτσι, με μια φιλιά πέταξε ψηλά στον αέρα, πήρε το δρόμο του χυρισμού! Και έζησαν αυτοί καλά κι εμείς καλύτερα!!!!

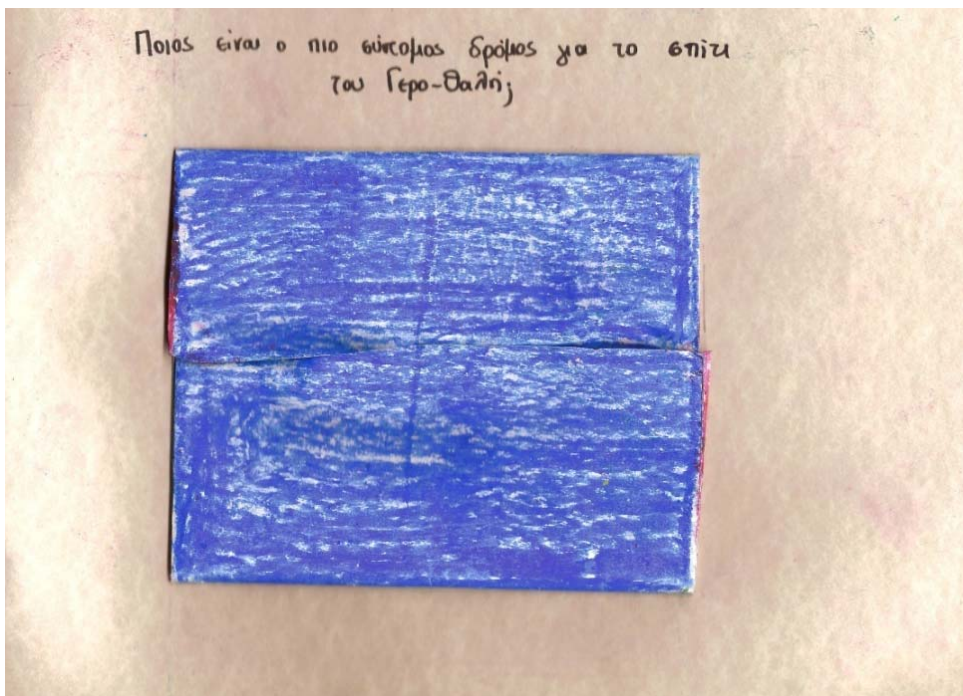
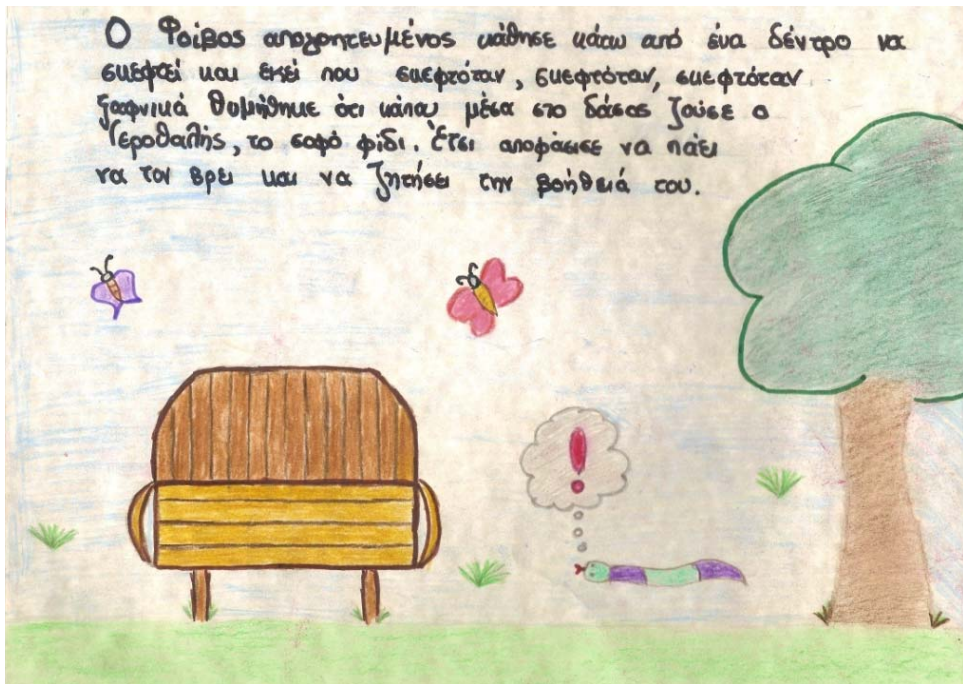
Phoebus

Phoebus is a snake who wonders when he will grow up in order to pass over the fence and get to the music box. By selecting the shortest path manages to meet the wise snake to help him ... The children following Phoebus' route, make comparisons and estimations of sizes and distances with the use of various auxiliary means.

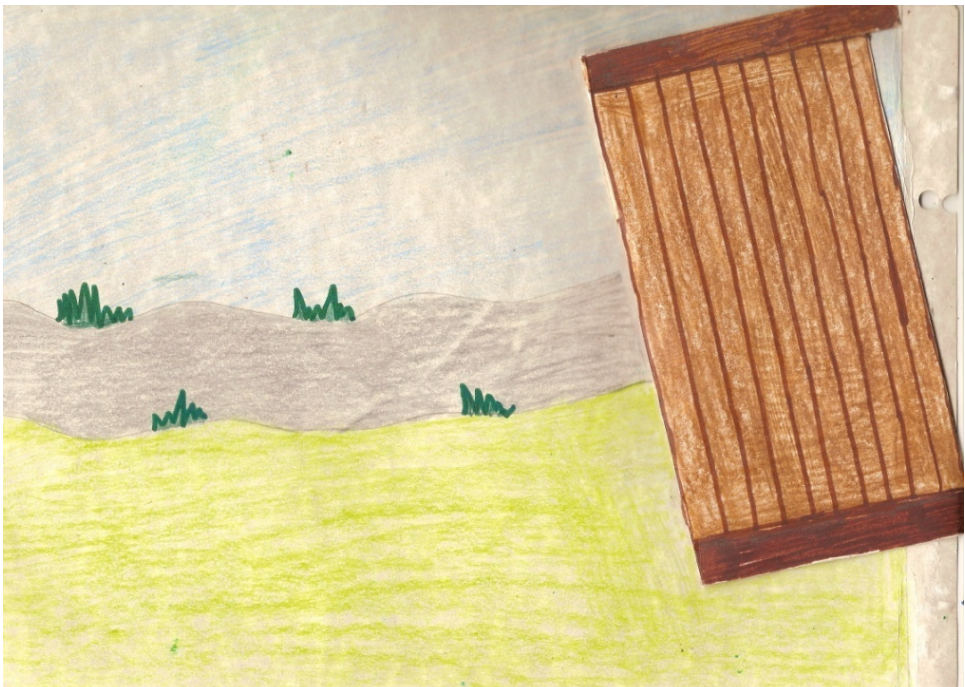














Board Games

The adoption of games in mathematics education, even today, is not given, but it seems to depend on the educational setting in which would take place. Some educational environments do not stimulate children to the game as a means of learning and development (Wood and Attfield, 1996). They consider, that children may assume a false idea about the nature of mathematics (Szendrei, 1996), that a mess can be created during the game (Perry and Dockett, 2007) and that the conditions that can lead through the game to learning is not always obvious (Bennett, Wood and Rogers, 1997). For other educational settings, game is the basis of the educational process (Perry and Dockett, 2007) and plays an important role as an auxiliary means for teaching/learning mathematical concepts and procedures, particularly in young children (Abbott, 1994).

The games seem to strengthen students' relationship with mathematics (Ceglowski, 1997; Williams, 1986) and to cultivate specific skills and abilities. Also, games develop mathematical reasoning (Bishop, 1991; Szendrei, 1996), computational skills (Olson, 2007), logicomathematical thinking (Kamii and Rummelsburg, 2008; Kamii, Miyakawa and Kato, 2004) as well as combinatorial and probabilistic thinking (Ernest, 1986; Gerdes, 2001). The games allow students to confront and overcome, in a pleasant way, their fears about mathematics, adopting a positive attitude towards them (Caldwell, 1998). The children know that they are expected to lose in a game, but that is a sign of failure when making the same mistakes in mathematical tasks. Also, through games can be achieved the interconnection of different mathematical concepts and of mathematics with other sciences (Caswell and Nisbet, 2005; Epstein, Gelfand and Lock, 1998).

There are many factors that enhance the learning of mathematics through playing. According to Griffiths (1994), these factors are the purpose, the context, the control, the time and the procedure. When children play, they have a clear purpose to have fun. The game

provides a context which is interesting and meaningful for students. In the game, the learner acquires control of the activity that is involved. When children play, they have the time to redo things and to gain skills without necessarily feel bad about their previous unsuccessful attempts. In the game, the emphasis is on the process rather than in the written result.

The games that have been further explored for their contribution to the mathematics of primary school are board games. Research on the board games mainly concern the investigation of their role in challenging mathematical discourse in the classroom and in the emergence of problem solving strategies (Skoumpourdi, Kafoussi and Tatsis, 2009; Tatsis, Kafoussi and Skoumpourdi, 2008).

Research reports the difficulties for obtaining mathematical knowledge through play and highlights the factors that influence the game, such as the previous experience and the team composition (Σκουμπουρδή, 2010) as well as the game rules management (Skoumpourdi, 2012). They investigate the components that are influenced from the management of the rules, such as the democratic playing and the communication in the mathematics classroom. They record the views about games, of anyone involved in the educational process such as teachers, students and parents (Skoumpourdi and Kalavassiss, 2007; Σκουμπουρδή and Καλαβάσης, 2009) as well as the practices used by adults during the game playing (Skoumpourdi, 2011b).

A board game can be educationally useful, according to Kamii and DeVries (1980: 4), if it proposes something interesting that stimulates children to deal with it, if it enables players to judge their success and to participate actively throughout the game. When choosing a game for the class, first we have to play it, in order to get familiar with its rules and peculiarities as well as to identify the mathematical ideas that are incorporated in it and how they can emerge from the game.

However often children play a board game without gain any mathematical knowledge (Griffiths, 1994). In order to have a functional relationship with the teaching concepts, to explore mathematical ideas as well as to create mathematical discourse, the game which will be used in the mathematics classroom, should cover three conditions, according to Olson (2007): The first condition, concerns the planning of how the game will be introduced in class, how much time will be allocated, how the children will be divided into groups. It takes time to players to understand the game and to get familiar with the game's environment and function.

The second condition, concerns the monitoring of the children's play from the teacher in order to create queries for discussion. The third condition, concerns the patience that has to be shown so that complex strategies, mathematical concepts and procedures will be developed.

Sometimes, children do not have the necessary skills to deal successfully with the game and to benefit from the experiences offered, and for this they need to be taught how to play. Being a proficient player does not always occur spontaneously (Bennett et al., 1997).

With the active participation of an adult, a more complex game can be achieved (Edwards, Gandini and Forman, 1998). The intervention of the teacher, in a way that meets the intent of the children, can make the game more valuable in an instructional designing (Σκουμπουρδή and Καλαβάσης, 2007). The intervention of adults can vary in the quality and the time it happens (Skoumpourdi, 2011b). As regards the quality of the interventions, five types are distinguished. In the first type, the adult does not intervene in any way. In the second type, the adult intervenes after the child's movement by reminding him/her the rules or by proposing him/her alternative movements.

In the third type, the adult prevents the child to act impulsively by saying him/her to think about the rules. In the fourth type, the adult repeats all or part of the rules to the child who is about to play. In the fifth type, the adult indicates/suggests a movement to the child. Regarding the time that the intervention happens, it seems that when the intervention is done early, it gives the child the opportunity to develop a strategy. When it is guided, leaves no room to the child to think. When it is too late, is not useful for the child because it has finished his/her movement.

The board games' designing to support early childhood mathematics education often occurs as a need, despite the wide variety of board games in the market. This need arises from within the educational environment i.e. the various conditions of each class and the specific goals of each teacher to meet specific objectives.

When students construct their own games and deal with them, it seems that they understand better the procedures they apply (Barta and Schaelling, 1998). A game in the mathematics class can be designed and created by the teacher, by the students or by the cooperation of teacher and students.

The principles for the designing of board games are based on their features. The features of board games negotiate a particular context in which underlies the construction of the board, of the route, of the pawns, of the rules, of the cards and of the means used to set the order of the players and the continuation of the game. Games with context familiar to students of this age, make sense to them, engage children in an active reflection and ensure their enthusiastic participation.

The simplicity or complexity of the game's features makes the game easy or difficult. Simple board, specific route, functional pawns and comprehensible rules make a game differ from another with a complicated board and path, non-functional pawns and incomprehensible rules.

The game board can be simple or complicated, it can be two-dimensional or three-dimensional etc. The route may be circumferential, helical, multifaceted, spiral, circular, zig zag (Kamii, 1989: 125) etc. The pawns should be in a size to fit in the boxes of the path. They must also have different colors that can be easily recognized by the players. Their shape may be the classic, like small skittles or related to the context of the game, ie animals, people, cars etc. The combined use of pawns of different colors and shapes in the same game can help people suffering from color blindness, to trace the pawns without difficulty.

In every case however, the pawns should either have faces on all the sides, or be shaped so as not to influence the direction of the next movement (often, young children are affected from where their pawn is facing, for the direction of their next movement). The cards should be easy to use, in the appropriate size, with simple and understandable instructions.

The rules is one of the key features of board games because they define the game and their management can be done in different ways, leading to different experiences (Skoumpourdi, 2011b). The rules may be simple, complex, well-written or no, easy or difficult to be understood. The creation of comprehensive and clear rules is not always easy to achieve. Taking the view that rules interpretation is subjective, there are criteria that can minimize players' misunderstandings: i.e. the creation of clear rules that meet the needs of children and the assessment of their clarity not by those who designed them, namely the creators of the rules, but by independent players. If the rules are too difficult, it can be agreed before the game starts to be simplified so as not to create disappointment to the players. If the rules are very simple, they can be tailored so as to meet the needs and abilities of children. To

determine whether the rules are clear and concise they must answer the following questions: Who plays first? When the game ends? Who is the winner? How the pawns move? How the cards are used?

The means, by which the order of players and the next steps in the evolution of the game is defined, is usually the dice, the spinners and the lottery. The dice can be the classic, i.e. cube with bullets or numbers up to 6, in the precise configuration and location. It may be other cubes with numbers, symbols, shapes or colors, as well as 10-faced and 12-faced dice. According to Kamii (1989), the dice can be used in board games to serve different objectives, such as the set partition, the recognition of the odd and the even numbers, of the doubles and double plus one, of the addition and subtraction, of the numbers that when combined create a specific number, as well as for the finding of the multiples of a number. The spinners are usually divided into two, three, four, six, eight or more equal parts (Skoumpourdi and Kalavassis, 2003). In the sections may be listed numbers, letters, words, expressions, pictorial representations, symbols, shapes, colors, rates etc. The lotteries may be boxes or bags with tokens, cards, numbers, letters etc. The cards can have letters, words, expressions, directions, instructions, pictorial representations, shapes, numbers, symbols, operations etc.

The means used to determine the different functions of a game must be constructed accurately and in all cases they must meet the needs of their use. For example, in the games that there is money, the coins and the notes that are used must be presented as they are in the reality. In the games that there are cards, their different content must be distinguished by their color, by their shape etc. If there are, in the game, geometric shapes they must be constructed with geometric precision. If there are pictures, they have to be easily comprehensible and interpretable by all, so that all players understand the same thing.

A board game to be easy for use and functional for a math class should be placed in a box. The game name and picture on the top and the side of the box helps in arranging it and in searching for it. To be familiarized with the game, the picture on the box can depict a snapshot of the game to show both the way it is played and the parts it consists.

The type of the game is one factor to be taken into account in the designing, in the development and in the managing process. Board games are classified into different categories depending on the criterion chosen each time. The age, the number of the players and the game's context can serve as criteria for classification. What the players must do in the game is another criterion and according to that, Kamii and DeVries (1980: 55) classify board games into four categories: 1) Games in which all players move their pawns on a given route. 2) Games in which players try to fill gaps in certain ways. 3) Games in which players try to collect as many pawns as they can. 4) Games in which players move their pawns in many different routes.

Another way of categorizing board games is related to whether they depend on chance, strategy or tactic. The chance games depend on luck rather than on ability. In these games what is applied is dictated by the chance. The strategy games provide an incentive to the player to think alternative movements, taking into account what the opponent can make in order to maximize the likelihood of success. They require from the player to make a plan to base on before the game starts. In tactical games, the player acts without a predefined plan (Levy, 2002). It is necessary, in such games, for the player to think quickly, to negotiate with the changing conditions and not adopt a stable way of playing. The tactical games are usually presented in the literature as strategy games. According to Olson (2007: 464), children of different ages prefer different types of games. Young children prefer chance games, whereas

children of 3rd and 4th grades prefer strategy games in which players have to think in advance their next movements. Indicative examples of designed board games are the "Going up and down", "Cat and mice", "The tower of triangles", "The city of shapes", "Cicadas and ants" and "Seeking the shape". The game "*Going up and down*" helps children understand the numbers' sequence as they count and match numbers. It is played by two or more players on a board with numbered, from 1 to 50 (Figure 14), gridded squares. A number of "ladders" and "slides" are pictured on the board, each connecting two specific board squares. Some numbers on the board are shown in two different colours similar to those on the cards (for very young children the cards are not used because they contain operations with numbers). There are classical dice with dots and many pawns skittles. It is similar to the 'Snakes and ladders' board game but with three variations⁵: 1. fewer numbers are used on the board, 2. the direction is defined by arrows and 3. there are cards with actions. The objective of the game is to navigate pawns from the start (bottom square) to the finish (top square), helped or hindered by ladders and snakes, respectively. The game, without the use of cards, is a simple race contest lacking a skill component. The game becomes a skills game if the cards are used.



Figure 14. "Going up and down".

The game "*Cat and mice*", is both a tactical and strategy game that combines luck because the movements of the players depend on the indication of the dice. The board game consists of 10x7 gridded squares and doesn't provide a numbered route (Figure 15). The pawns are four mice in different colors. There is also a cat pawn and a basket with cheese belonging to all the players that moves away each player when his turn comes. The dice, that defines the movements of the players, is dotted. The context of the game is related to the children's experiences of their real life both from the fairy tales and the popular cartoon.

⁵ The observation of kindergarten children playing the game "Snake" showed that children were tired of the many numbers (100) on the board, had difficulty in identifying the series of numbers and confused the direction of their next movement.



Figure 15. "Cat and mice".

The heroes of the game are the cat and the mice, which are in constant pursuit. The game is realised in the dining area, with the mice trying to eat cheese while avoiding the cat who hunts them. The lack of a specific route allows each player to decide in each round, which is the best direction to move its mouse to, so as to avoid the cat, to approach the cheese, but also to move the cat to the rival mice. The game ends when the last cheese from the container, has been eaten. Winner is the player who has the biggest amount of cheeses.

The game *"The tower of triangles"*, helps children to recognize the different kinds of triangles and their different positions match the same triangles by overlap and find which is the best triangle placement as to allow the tallest construction. It is played by two or more players, on a board consisted of 25 spaces in a circumferential path, with triangles in some of them (Figure 16).

The order of the players is determined by the indication of the dice. The first player is the one who has brought the smaller number. Each time a player stops on a place with triangle, selects from the paper triangles of the centre of the board, the one that tangent perfectly on the triangle where he/she has stopped. Then he/she matches the triangles in order to make sure that is the same, and keeps it. If a wrong triangle is chosen he/she leaves it the centre of the board and the game continues.

The game is over when the triangles are finished. The winner is the player who will build the tallest tower with his/her triangles.

The game *"The city of shapes"*, helps children to learn about the plane geometrical shapes such as square, rectangular, circle, triangle, rhomb as well as solid geometrical shapes such as cube, rectangle parallelepiped, pyramid, prism, cylinder, sphere, cone, and their interrelations. The game's board consists of 44 spaces in a circumferential path. At each location of the path there is a plane geometrical shape.

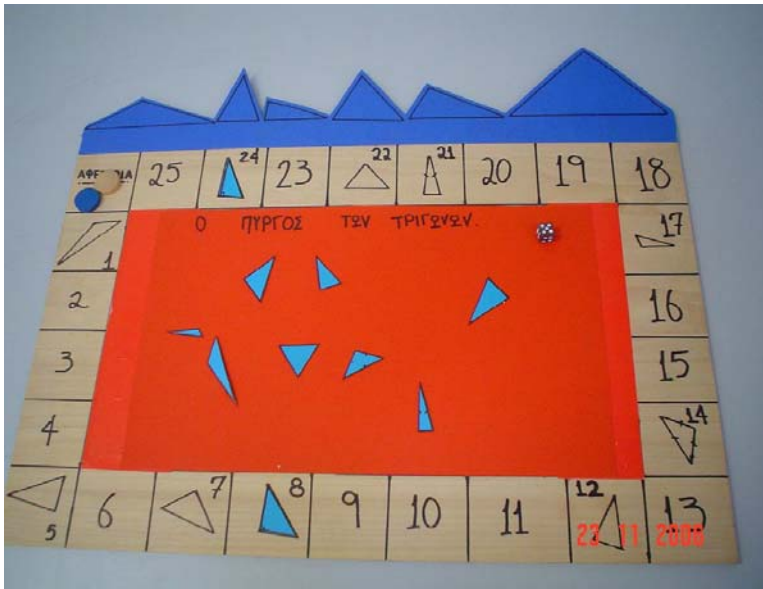


Figure 16. "The tower of triangles".

The rest area is covered by 24 empty squares. Furthermore, there are cards in shapes same to those of path as well as solid shapes (Figure 17). The four pawns are small cubes. Each player moves his/her pawn according to the dice indication.

Each player gets a card of a same shape as that exists in his/her place on the path and he/she follows the instructions. The instructions on the cards are related to constructions and reconstructions with the use of the solid shapes. In this way every child builds his/her own city in the six square "areas" in front of him/her (Figure 18). The winner of the game is the player who first completes his/her city.



Figure 17. "The city of shapes".

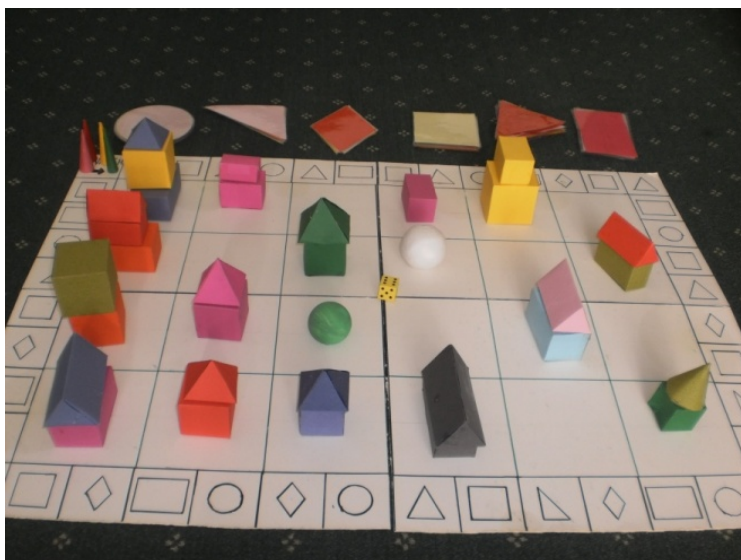


Figure 18. "The city of shapes".

The game "*Cicadas and ants*", encourages children to take important decisions during the development of the game by doing both various calculations and considering the sequel of the game. The main route of the game is a rhomboid with ramifications. Apart from the board, the game has 1 pouch-lottery with numbers from one to five (each number is twice in the pouch), 5 ant pawns of different colours, 3 cicada pawns, 50 spores and 5 pouches in five different colours as the pawns (Figure 19 and 20). In the game the ants start from the village and should reach the nest with no more than eight spores because they are not able to lift them. In the case that spores are more than eight they are all lost and the ant returns to the village. Each player chooses an ant and a pouch to put the spores that he/she picks up. The players pick from the big pouch two numbers and keep the number that they want as to move on their pawn. The pawn moves in any direction desires the player, respecting the lines of the board.

The beginners play, the game with one cicada, which is placed in the central circle of the board. Advanced players can play the game with two or three cicadas, placed on the three main cycles at the center of the board. The cicada moves a step by the player who plays. The aim of each player's ant is to go away from the cicada and approach the nest. If an ant falls on a cicada, the cicada gets from it two spores.

When an ant drops on a black circle, takes optionally up to three spores. If it falls on a red circle, takes compulsory two spores. It is possible during the game, for an ant to enter the nest so as to pursue a new path. The same may happen with cicada. Indeed, if the cicada places in the nest, then, any ant reaching the nest after it, loses two of its spores and the game continues for it to gather again the spores. Winner is the player who reaches the nest with eight spores (or at least more spores than the other players).

For beginners, the game is played with one cicada, which is placed in the central circle of the board. Advanced players can play the game with two or three cicadas, which are placed on the main three cycles at the centre of the board. The cicada is moved a step by the player who plays. The aim of each player's ant is to go away from the cicada and to reach the nest. If an ant falls on a cicada, the cicada gets from it two spores. When an ant drops on a black

circle, takes optionally up to three spores. If it falls on a red circle, takes compulsory two spores.

During the game it is possible for an ant to enter the nest in order to pursue a new path. The same may happen with cicada. If the cicada reaches the nest, then any ant reaching the nest after it, loses two of its spores and the game continues for it to gather again the spores. Winner is the player who reaches the nest with eight spores (or at least more spores than the other players).

The game "*Seeking the shape*", helps children learn about plane and solid geometrical shapes and their characteristics. The game includes a board, dice, pawns, hourglass, clipart, pencil and three types of cards (Figure 21). In the first category, cards are depicting lips and the players must describe with words to his/her team mates the figure depicted on the card but not to say the name of the shape.



Figure 19. "Cicadas and ants".



Figure 20. "Cicadas and ants".



Figure 21. "Seeking the shape".

In the second category, cards are depicting hands and the players describe the shape on the card with their bodies, without speaking. In the third category, the cards depict question mark and the players mention the name of the shape on the card. Their team mates must indicate objects from everyday life that have the same shape or design the shape on the paper. The number of players that can take part in the game is 4 or more, because the game is played in teams.

A player or team player raises questions to the other players of the same team who try to answer as many questions as they can, before time is over. Then they move their pawn as many places as their right answers. If any team stops in a place that has two hourglasses, it has double time available to answer questions. The winner is the team that arrives first at the end of the path.

CONCLUSION

The need for designing educational materials for mathematics education arises from many factors related to the teacher, the student, the negotiated meaning as well as the material itself. Materials are never designed in a final form. They gradually develop and they become more efficient, relevant and transparent through their systematic use in specific activities through specific types of social interactions, and through the transformations that they undergo in the hands of users. The use of educational materials are useful to the extent that they encourage students to think in problem solving ways, they play an important role in the discovery and expression of mathematical relationships, they engage students in mathematical activities and argumentation, they give equal opportunities to all students to develop and understand the concepts, the procedures, and other aspects of mathematics and to set new ideas into practice and to the extent that they generate and help explore new mathematical ideas. However, the existing or designed materials do not present, on their own, the

importance of mathematical concepts. The teacher has a very important role in adopting effective practices for their use in the mathematics classroom. The teacher by knowing, the mathematical concept, his/her students, the features, the possibilities and the limitations of materials and the way to orchestrate them in his teaching, includes these elements in the design of his/her instructional intervention. Thus, he/she can help students to connect their mental actions through their actions with the materials to achieve learning. Students realize that there is a relationship between the material and the mathematical concept being taught, understand how the hardware components associate with the concept, transform their actions with the material in acts done on the concept and are driven to the formation of the mathematical concept. In other words, the development of mathematical concepts can be initiated by handling a variety of materials and media in such a way, that leads children in the transformation of real objects they deal, to mental objects and thus to start thinking to a more abstract level. This can be achieved by encouraging the children to contemplate their actions, to formulate and describe them, in order to achieve a deeper mental understanding beyond manipulation of materials. In any case, the subtle distinction between the characteristics of the materials and tools, and how mathematical ideas are constructed from the materials and tools, should be made clear. The inclusion of materials in mathematics education can support the teaching/learning processes by acting positively in children's and teachers' cognitive, emotional and communicative level.

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Chapter 2

ADDITIVE BILINGUALISM OF IMMIGRANT CHILDREN: INTRODUCING A MULTISENSORY PROJECT IN KINDERGARTEN

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ABSTRACT

This paper presents a descriptive account of a multidisciplinary project to be introduced with the aim to foster bilingual development (L1 and L2) of immigrant children attending Greek kindergartens. The reason for proposing the introduction of this interdisciplinary project stemmed from the growing number of second-language students in Greek education, given the fact that for the last two decades Greece has been an immigrant receiving country, especially from Albania and the countries of the former Soviet Union. Although the Greek education system, through language policies for primary and secondary schools, has tried to promote English as a foreign language learning from an early age and to develop a plurilingual competence in the 'strong' European languages, it has not managed to deal with the question of immigrant languages effectively. Thus, bilingualism of immigrant children has been overlooked, impeding, as widely believed, the acquisition of the Greek language.

The *proposed project* aims to promote additive bilingualism and establish the children's bilingual skills through their participation in movement activities in a story-based context, employing stories from the two cultures (Greek-Albanian, Greek-Russian). In such a context, a combination of games will be adopted: Intercultural games, physical activities, role-play games, dancing activities, communicative games, all of which focus on the successful exchange of information and on free expression. It is suggested that the interdisciplinary project is to be carried through the following stages: a) Identification of the children's needs in the two languages and of their bilingual repertoire; b) Development of 'a story and game based syllabus', which will include bilingual (Greek-Albanian and Greek-Russian) courses designed having taken the students' perceived needs into consideration; c) Implementation of the bilingual modular syllabus (BMS) in a multisensory teaching -visual, auditory, and kinaesthetic- context; d) Evaluation of the effectiveness and feasibility of the interdisciplinary project.

1. INTRODUCTION

The reason for conducting the proposed interdisciplinary project stemmed from the growing number of second-language students in Greek primary schools, given the fact that Greece has been an immigrant receiving country for the last two decades, especially from Albania and the countries of the former Soviet Union. Given the fact that immigrant children are subject to assimilation processes in the Greek primary education, they are expected to learn the Greek language once they enter school, receiving no instruction in their home language (August and Shanahan, 2006). Nevertheless, children build on the knowledge acquired in their home environment and bring a range of knowledge, skills and experience to the classroom a fact, which cannot be ignored. For this reason, the varied needs of these students, especially of those who come from different cultural and linguistic backgrounds should be considered and addressed (August and Shanahan, 2006). In particular, knowing how children learn a second language (L2) and understanding all the issues which surround bilingualism are basic requisites for language teachers in order to reach decisions on what intervention or remedial approaches are needed.

For the last decades, there has been an increment in immigration throughout Europe, resulting in a plurality of languages permeating European societies and reshaping the linguistic and cultural landscape of Europe (EC 2008). The value of linguistic diversity is underlined in a number of treaties and other legal documents, such as the United Nations Declaration on the Rights of Persons Belonging to National or Ethnic, Religious and Linguistic Minorities (Council of Europe, 1992), the Document of the Copenhagen Meeting of the Conference on the Human Dimension of the CSCE (CSCE, 1990), the Council of Europe Framework Convention for the Protection of National Minorities (Council of Europe, 1995) and the European Charter for Regional or Minority Languages (Council of Europe, 1999). All these are evidence of the trend to reorientation towards immigrant/minority group rights. However, these recommendations have been unequally followed by the different member states of the European Union. Specifically, in 1995, the Council of Europe promulgated the Framework Convention for the Protection of National Minorities, which is a statement of principles rather than a detailed set of obligations. The *European Charter for Regional or Minority Languages* (Council of Europe, 1999) is one of the most detailed legal instruments aimed at protecting and promoting the linguistic diversity of Europe. It has been widely accepted among the member states of the European Union, since it defines the linguistic and cultural diversity of Europe as an integral part of the continent's heritage. In 2000, the *Charter of fundamental rights of the European Union* (Official Journal of the European Communities, 2000) provided a framework for minority rights in Europe and proclaimed that member states should respect cultural and linguistic diversity. In the same year, the *European Centre for Minority Issues* (ECMI) decided to launch a research project under the title "Evaluating policy measures for minority languages in Europe: Towards effective, cost-effective and democratic implementation" with the purpose to support for action to promote and safeguard regional and minority languages.

However, in Greece bilingualism of immigrant children has been overlooked, impeding, as widely believed, the acquisition of the Greek language. According to Makri (2003), the first attempt of the Greek policy to set aside the assimilation approach and establish an intercultural approach, encompasses a paradox; Instead of advocating for education in the

students' mother tongue and the advancement of multiculturalism, it focused on the promotion of the Greek cultural identity, the Greek language and the Greek orthodox tradition. Moreover, according to law 2413/1996 (Official Gazette, 1996), intercultural education does not concern all students but only those "with educational, social and cultural particularities", contradicting the essence of intercultural education, which is destined to embrace all children without discrimination and encourage their interaction, instead of reproducing social exclusion.

1.1. Bilingual Development

Additive bilingual programs, which encourage developing the second language (L2) without losing proficiency of the first language (L1) are the most effective bilingual education programs, in terms of fostering bilingualism, biliteracy and student academic attainment. Such programs provide for the development of a sufficient bilingual threshold in students who experience cognitive, cultural, social and educational advantages. They are based on the language interdependence principle, which allows for transfer of the literacy skills in one language to another one and contributes to biliteracy. There are considerable advantages to early and additive bilingualism, such as the development of students' multilingual and multicultural awareness (Griva and Chostelidou, 2011a, 2011b; Jessner, 1999), which enable them to communicate across countries, help them to acquire a wider sense of citizenship and develop an understanding of their rights and responsibilities as mobile citizens across European countries (Griva and Chostelidou, 2011c). Studies have demonstrated that quality bilingual kindergarten programs have long-lasting positive effects on children's academic achievement (Burmeister, 2006; Met and Lorenz, 1997; Wesche, 2002).

Lightbown (2008) reinforces this view, by highlighting that children are capable of acquiring two or more languages in early childhood since bilingualism does not 'confuse' them.

Also, he supports that the provision of adequate input and opportunities for interaction, can lead to outcomes of bi/multiple language acquisition, which are similar to those in L1 acquisition.

The findings of many studies suggest that additive bilingualism can positively affect both intellectual and linguistic progress, since bilingual children exhibit greater sensitivity to linguistic meanings, greater metalinguistic awareness and are more flexible in their thinking and in analyzing meanings than monolingual children are (Bialystok, 2001; Cummins, 2000; King and Mackey, 2007). Recent research indicated that the earlier a child is exposed to a L2, in an environment rich in L2 input and interaction, the better the outcome can be (e.g. Birdsong and Molis, 2001; Flege, 1999).

It has been identified that there is a maturational limit around puberty; beyond this limit, more effort is needed to learn a second language, since it is regarded a more difficult process than before this point (Long, 1985; Scovel, 2000). It should be noted that children who are adequately exposed to two languages at an early age, experience certain gains compared to monolingual peers, such as communicative flexibility, creativity and high levels of cognitive ability (Curtain, and Pesola, 1994; Hamayan, 1986).

Children who learn two languages simultaneously can also be expected to have advantages with respect to their academic achievement, and the development of positive

attitudes towards the target languages and cultures (Kumaravadivelu, 2006; Lightbown, 2008).

Moreover, young children have been recorded to present more positive attitudes towards learning other languages and be more motivated due to their general positive attitude towards learning and their openness to new experiences (Blondin et al., 1998; Cenoz, 2003; Donato et al., 2000; Garcia Mayo and Garcia Lecumberri, 2003; Hurrell, 1995; Johnstone, 1996; Nikolov, 1999; Pinter, 2006;).

Bilingual and multilingual students present a different type of linguistic/strategic competence as compared to that of monolinguals (Cook, 1995). Grosjean (1992) considered the bilingual individuals as making use of their two languages depending on the requirements of the situation. That is, a bilingual individual may move from a monolingual speech mode when talking to a monolingual speaker, when he uses one language only, the other remaining deactivated, and then change along the continuum to the bilingual speech mode (Hoffmann, 2001).

The learners' personal characteristics such as age, motivation, affective factors (Singleton, 1989), the context of learning as well as the teaching methods (Ioup, 1995; Krashen, 1982; Singleton, 2001) were proved to have an important impact on language learning. However, the age at which a child should be initially exposed to a second language has been one of the issues most researched (Birdsong, 1999; Cenoz, 2003).

A number of issues are associated with the bilingual students' language development and educational attainment, such as the students' personal characteristics, ethnic and linguistic origin, socio-economic factors, parents' education and basic skills, and parental involvement (Lindholm-Leary, 2001). However, despite the fact that school plays a vital role in literacy development, other influences which are likely to affect the children's everyday life in and out of school cannot be underestimated.

It cannot be ignored that since effective education responds to the learning needs of individual children and the needs of their families, collaboration between school and family is essential in order to achieve education for all (Kemppainen, et al., 2004; Lao, 2004; Tembe and Norton, 2008).

2. THE PROPOSED PROJECT

2.1. Rationale and Context of the Project

The proposed project is to be implemented in all day kindergartens in Northern Greece, where there is a large number of immigrant children of Albanian origin and of origin of the former Soviet Union countries with the purpose to contribute to the additive bilingualism of these groups of immigrant children. Developing early bilingualism is in line with a bulk of international research, which highlighted the advantages of simultaneous development of L1 (first language) and L2 (second language) and is in vein with E.U. policies related to the protection of the languages of immigrants (Council of Europe, 2006).

Although the Greek education system has tried to promote foreign language learning from an early age and to develop a plurilingual competence in the 'strong' European languages, it has not managed to deal with the question of minority languages effectively. In

other words, while the European languages are highly valued, the languages of immigrant populations are associated with poverty and exclusion. Policy makers still ignore the bottom-up ‘impulse’ for pluralism. Abolishing instruction of the immigrant languages indicates that these languages are not admissible in the classroom or within the educational context.

When immigrant children begin preschool or primary school, they have to learn the Greek language (L2) in order to fit in socially and succeed academically. Nevertheless, these educational programs do nothing to support immigrant children to develop competence in L1. In such a context, teachers are expected to meet the varied needs of immigrant students and support them. However, they often express their anxiety and uncertainty to teach to such groups of students, due to inefficient training on issues related to bilingualism and multicultural education. Moreover, they appear to share certain misconceptions, which could have an impact on the teaching process. One of the most common misconceptions about bilingualism is the so-called “balance theory” which claims that first (L1) and second language (L2) are to be kept distinctly separately (Mehmedbegovic, 2008).

This is in contrast to the theory which considers language interdependence (Cummins, 2001), based on the maxim of ‘underlying cognitive/ academic proficiency’, common across languages, and which can be transferred from one language to another (Baker, 2001). The belief that cognitive and linguistic delay is a byproduct of bilingualism, because of the burden of handling two languages, has been a misconception of Greek kindergarten teachers for years (Griva, Dinas and Stamou, in press). Nevertheless, it was indicated that children educated in bilingual programs can have a cognitive advantage over monolingual ones (Bialystok, 2001). They also perform better than monolinguals on some aspects of literacy based on metalinguistic awareness (Griva and Chostelidou, 2011a). Children build on the knowledge acquired in their home environment and bring a range of knowledge, skills and experience to the classroom, which cannot be ignored. For this reason, the varied needs of students, especially of those who come from different cultural and linguistic backgrounds should be considered and met. Knowing how children learn a second language (L2) and understanding all the issues, which surround bilingualism are basic prerequisites for teachers in order to decide on what intervention or remedial approaches are needed.

2.2. Purpose and Objectives of the Project

The proposed multidisciplinary project is introduced with the aim to foster bilingual development (L1 and L2) of immigrant children attending Greek kindergartens. It is grounded in international frameworks, theories about dual language acquisition, and research data about the impact of bilingual education initiatives. Its ultimate goal will be to a) stimulate the children’s linguistic, physical, affective and cognitive engagement in the process of dual language learning, b) organize the learning context, including play, real-life experiences through stories and routines, which are responsive to the children’s needs and interests aiming at the children’s holistic development and communicative skills development in the two languages. Moreover, an attempt will be made to develop their intercultural competence including both the cognitive (skills and knowledge) and affective dimension (behaviour and attitudes). The focus of the project is laid on recognizing and building on the children’s diverse backgrounds and experiences, as well as their interaction in the target languages and cultures in ways, which develop their self conceptions in the two languages and cultures.

More precisely, the main objectives of the project are:

- Enhancing the children's involvement in learning through their senses by making provision for multi-sensory learning;
- Developing the children's receptive and productive skills in L1 and L2 so as to achieve additive bilingualism;
- Stimulating the young students' interest in the two cultures through stories;
- Developing their fine and gross motor skills;
- Fostering their creativity and promoting divergent thinking ability;
- Stimulating their expressive capacities in L1 and L2.

We expect that in such a context children will respond physically, verbally and affectively in a meaningful framework, which offers comprehensible input. Furthermore, an attempt will be made to facilitate creativity, foster divergent thinking, which is a major cognitive process important in establishing creativity as well as stimulate problem-solving abilities and develop language and cultural awareness. Specifically, we expect the following benefits to be achieved:

Benefits related to students' bilingual development:

- Dual language acquisition;
- Bilingual and bicultural awareness;
- Enhancement of cognitive development and flexibility;

Benefits related to teachers' teaching practices:

- Improvement of current practices in bilingual learning, in line with the end-users' needs;
- Enriching training experiences;
- Transferring of new practices in bilingual education and training.

Benefits related to bilingual policies:

- Transferring of results to establish practices for immersion bilingual programs in kindergarten;
- Designing and implementing a bilingual syllabus inventory (Greek-Albanian, Greek - Russian) for children aged 5-6.

2.3. Bilingual Development through Games in a Story Based Context

Although it is beneficial to have early bilingual development, an early start does not itself guarantee success, unless certain teaching conditions are created and proper teaching techniques are employed (Blondin et al, 1998; Wyn Siencyn, 2007). The *proposed project* aims to establish the children's bilingual skills through their participation in movement activities in a story-based context, employing stories from the two cultures (Greek-Albanian, Greek-Russian). In such a context, learning is perceived as a cognitive, psycho-dynamic, cultural and social process (Illeris, 2001). For this purpose, a combination of games will be adopted, such as intercultural games, physical activities, role-play games, dance, communicative games, all of which focus on successful exchange of information and free expression. Furthermore, the children will be encouraged to learn through collaborative group

work, which allows for interaction and active engagement as naturally as possible. They also learn better feeling secure and relaxed and learning in a multisensory way, since they need to be engaged both affectively and cognitively in the language learning experience (Arnold, 1999; Masuhara, 2005; Tomlinson, 2000). A basic prerequisite for language acquisition is that the learners are exposed to a rich, meaningful, and comprehensible input of the language in use (Krashen, 1999; Long, 1985; Munoz, 2008; Tabors and Snow, 1994).

Moreover, children are reported to learn best through getting involved with peers, objects and events in authentic settings (Kersten et al., 2010). Authentic input can provide for the type of environment that is conducive to learning; Games, stories and play tend to be attractive activities, which children enjoy participating in as they do not feel much stress (Martinez, 2002) during the process of being engaged in them. In any case, the selected tasks should be meaningful and help the children to make sense of the new experiences by relating them to what they already know, as children tend to use their existing experiences and background knowledge to construct new input and develop their skills. Play with language is regarded as a basic strategy of the children to experience the language, and as a child-centred activity which promotes learning (Kagan and Britto, 2005; Kagan and Lowenstein, 2004). In effect, learning while playing is considered one of the best ways to learn a language; It allows for creating emotional attachments and focuses on the children's participation and enjoyment in a non-threatening and relaxed situation (Dryden and Rose, 1995; Dryden and Vos, 1997). In addition, it is suggested that the children need to get involved in contextualized and comprehensible language experiences and achieve deep and multidimensional processing of the language (Masuhara, 2005; Tomlinson, 2000). In a pedagogical context, stories, games and drama activities provide opportunities for children to use different combinations of their Multiple Intelligences (linguistic, visual-spatial, musical, kinaesthetic, logical-deductive, interpersonal, intrapersonal, naturalist) as "entry points" to learning (Gardner, 1999).

Stories seem to be a valuable tool for young learners, since they offer both linguistic and personal benefits to the children in a safe and relaxing environment (Shin, 2006), which lowers the young learners' stress and anxiety thus, leading to more successful language acquisition (Mixon and Temu, 2006 in Georgopoulou and Griva, 2012). In this way, the children are able to exercise their imagination and creativity (Halliwell, 1992), as stories are considered to provide a wide appeal to children who share different learning styles, and different language levels. They are invaluable in gaining and maintaining the students' interest in language learning and make them see learning from a different perspective -as entertainment and not as a chore (Ellis and Brewster, 1991). They can "stimulate the students' creative imagination so that they want to use the language to share their ideas" (Halliwell, 1992: 7). In addition, "listening to stories allows the teacher to introduce or revise new vocabulary items and sentence structures by exposing the students to language in varied, memorable and familiar contexts" (Halliwell, 1992: 7). Furthermore, *games* are highly motivating and entertaining, and they can offer even the shy learners ample opportunity to express their opinions and feelings (Hansen, 1994). They encourage the students to speak, and give them the chance to communicate, even with limited language repertoires by encouraging the use of non verbal communication (Desiatova, 2009). Physical games can provide the learners with a rich experience of L2 through engagement into listening to the instructions and rules of the game, seeking for clarification from the teacher and interacting with other peers-players. Besides, physical games can support the young learners' speaking and listening skills and have the potential to enhance their self-esteem, as teaching language skills through

play and movement provides the children with a context for listening and speaking in a meaningful and challenging context (Wright, Bettridge and Buckby, 1984). In addition, they provide children with every opportunity to practice various language aspects assuming a role, which they may encounter outside the language classroom and draw on whatever resources are available to them (Livingstone, 1983; Richards, 1985).

In fact, children gain directly from the games and activities, and many of the outcomes are also beneficial for them in other areas of their school life. Also, learning takes place more effectively in a secure and relaxing context and when it takes place in a multisensory way since the learners need to be engaged both affectively and cognitively in the language experience (Arnold, 1999; Masuhara, 2005; Tomlinson, 2000).

Consequently, the expectations from such a program involve among other the children learning through active involvement as they tend to enjoy movement. The project will be carried out through the following stages.

3. IMPLEMENTATION PROCEDURES

3.1. Initial Stage

A pre-record and analysis of the needs of immigrant children of Albanian and of former Soviet Union countries origin who attend mainstream classrooms in Northern Greece will be conducted. To this end, visits are planned to be made to kindergartens in Northern Greece, attended by a large number of immigrant children.

The purpose of these visits is to involve all stakeholders - kindergarten teachers, directors and parents - in the project.

- I Focus group discussions on issues related to bilingual children attending their schools, bilingualism and bilingual education will be conducted with kindergarten teachers and directors. Moreover, the selection of the teachers of Albanian and Russian presents a crucial issue of the specific stage for the set up of the proposed bilingual project. In addition, a number of workshops/training events will be organized and addressed to the teachers of Greek, Albanian and Russian on how to deploy and employ the proposed syllabus with the ultimate aim to provide optimal conditions for the immigrant children to develop bilingual competence and maximize the learning outcomes. Through these training events, the teachers are expected to have the opportunity to further develop particular competences, i.e. skills, knowledge and strategies in order for the learners' to be able to effectively cope with tasks requiring the development of language skills and strategies through the implementation of the syllabus.
- II Questionnaires will be distributed to immigrant parents in order to record their engagement in biliteracy practices at home, as well as to identify their views on the project. The attitudes to be shown by parents are believed to have an important effect on their children's learning progress. Studies revealed that parents are enthusiastic about immersion mostly when they work together with pre-school teachers (Mushi, 2000). Also, parental involvement in their children's school life as well as in out of

school activities has been proved to have a lot of advantages for the children's school attainment and smoother inclusion. Children's experiences at preschool age are of fundamental importance and parents play a key role in determining their children's experiences and their academic attainment (Domina, 2005). Moreover, parental expectations for their children's future academic achievements and their beliefs about developing their cognitive skills have a strong impact on the children's school performance (Jeynes, 2005).

- III Before the initiation of the project the following tests will be administered to the target population in order to identify and record their skills in L1 and L2, their rate of creativity and their motor development.
- a All participants will be assessed for general competence by using the Raven progressive Matrices (1998), a non verbal, culture-free instrument.
 - a Specific tests will be administered individually to the children to measure their performance in L1 and L2:
 - Word Finding Vocabulary Test (the Greek version, Vogindroukas, Protopappa and Sideridis, 2009);
 - Screening test on story-based comprehension and production in L1 and L2.
 - c A test of creativity will be administered individually to the children (Torrance Test of Creative Thinking, 1990).
 - d A self-report scale of intrinsic and extrinsic motivation (Harter, 1981) will be used, which assesses the extent to which the students see themselves as either more intrinsically or more extrinsically motivated in school. The scale has been extensively used with diverse cultural groups and various age groups and has proven to effectively determine the degree of intrinsic and extrinsic motivation within the classroom context.
 - e Interviews, which will be designed and conducted to identify the children's bi/multilingual profile, are organized into the following parts: Children's demographic data; Language background in Greek and the other language; Intercultural background; Language skills, language difficulties and preferences in relation to learning styles.

3.2. Development of Bilingual Story and Game Based Syllabus Inventory

Theoretical understandings about bilingual acquisition, along with different goals for the children's language development, have provided a range of language-in-education models for bilingual education. These models vary in terms of the number of months spent in transition and the amount of time devoted to mother tongue maintenance (Thomas and Collier, 2002).

Bilingual preschool programs also vary in terms of the adopted pedagogical approach the structure of the group whether open, semi-open, or closed and the identified focus on content, conceptual design, the choice of languages and their implementation in the everyday routine of the bilingual preschool (Kersten et al., 2010).

In the case considered the adopted model is based on 'two-way bilingual education' also known as dual language instruction, and involves the use of two languages as media of instruction (Ball, 2010). In particular, the adopted model allows for minority and majority language children to be taught in both minority and majority languages.

The syllabus is regarded one of the most important constituents of a good educational system as it has multiple effects on the children's personality concerning the development of cognitive, emotional and social aspects. Therefore, in acknowledgement of its impact on the life of a school going child, it is regarded that drawing up a syllabus should always be taken as a professional liability prepared with the specifics of the teaching situation in mind and aligned with the social, cognitive and language development of children. In the case considered, after analyzing the data collected in the first stage and considering the children's needs a *story and game based syllabus* will be designed to serve the perceived needs of the learners in bilingual courses (Greek-Albanian and Greek-Russian). The bilingual project is based on a fact-finding study on the likes, dislikes, attitudes and preferences of the young learners employing their favorite story and most liked games for implementation in the classroom.

Two modules of ten units each -one for the first grade and one for the second grade- will be produced in Greek and the two other languages, Albanian and Russian, based on the data of the needs analysis project and reflecting the philosophy of story based and game based learning. The proposed framework of needs-based course design will encompass the following interrelated components: a) Needs assessment; b) Determining goals and objectives, c) Conceptualizing content; d) Selecting and developing materials (representative samples); e) Organization of content and activities; f) Evaluation.

The development of a syllabus inventory which aims to reflect the broader needs of the particular target group in terms of physical activities, dance activities, and role play games, related to the young learners' foreign language skills development will provide a corpus of trilingual activities (Greek-Albanian-Russian) for young children (aged from 5 to 7) to be used by the teachers in an interdisciplinary way. This syllabus, which will be in essence multidimensional, based on and reflecting different parameters such as settings, topics, roles, notions, functions, lexis, motor skills and language skills will aim to yield specific linguistic outcomes.

3.3. The Proposed Syllabus: Aims and Objectives

The aim of the proposed story and game based syllabus document will be to promote comprehension, a skill which is focused on throughout the **pre primary school years, since it is considered an** integral part of language development. Moreover, it will focus on the development of fluency and accuracy of the young learners through active participation in a range of appropriate tasks and the development of their emergent reading and writing, and communication skills. In addition, it aims to introduce them to language items (e.g. structures, vocabulary) in L1 and L2 within the context of the stories, which will be processed for this purpose. In this respect, the stories and games provide the scaffolding around which the language will grow and develop. In result, the function of the syllabus is to generate appropriate units of work for the identified group of learners, and to provide the necessary conditions and motivating experiences for L1 and L2 to be acquired. Therefore, a large pool of different types of resources and tasks will be provided so as to address the varying needs of the young learners allowing for differentiation to take place.

In this direction, year-wise objectives are laid out whereby emphasis is laid on the children's:

- a Cognitive development; It is considered that the active use of L1 and L2 allows for cognitive development as it raises the children's cognitive control, their working memory, their capacity to focus on one language without suppressing the other, and their general planning and problem solving abilities (Bialystok, 2001).
- b Knowledge and understanding of the world as well as development of bicultural awareness; The pre-school project will be developed to facilitate the children in understanding and exploring their immediate environment and the physical world. Moreover, it will enable them to learn the basic technique of exploring, questioning and making general statements in result of their learning. Also, in the bi-cultural context of a preschool it is made possible for educators to raise awareness of and tolerance for cultural differences (Gerlich et al., 2010). Since language is an integral part of our identity and of the most direct expression of culture, recognizing and building on the children's existing cultural experiences and language practices is the basic principle of the project.
- c Physical and personal development; This is considered paramount for the children's development of fine and gross motor skills. Stamina, balance, rhythm, strength, agility, and concentration can be developed using a variety of enjoyable games and activities (Bennett, 2005; Fjørtoft, 2001).
- d Social development; It is considered that the children will grow confidently and develop a strong sense of self image through stories, role-plays, pair and group activities, and show and tell activities. The children will be encouraged to listen to and respect others' views and opinions, to differentiate between good and bad, to be aware of rules and positive discipline and learn to respect different cultures (Kariuki, et al., 2007).

3.4. The Proposed Syllabus: Selecting Content

Conceptualization of content in the syllabus at issue acknowledges that the teaching provided should be related to the children's world, a world of fantasy and make-believe, with dragons, monsters, talking animals, and alien beings. In this world there are no schemas labelled 'grammar', 'lexis', 'phonology', or 'discourse'. Therefore, planning the syllabus should essentially involve re-discovering and inhabiting the world of the children so as to make sure that it would be experientially appropriate for the young learners (Bourke, 2006). In result, the syllabus will be based on topics of interest to the specific group children and contain: a) Stories, games, and fun activities; b) Songs, chants, rhymes and materials from the Web; c) Children's literature. Also a print-rich environment of bilingual labels, books, storyboards, pictures, posters, maps, photographs, paintings music drawing, games, role-plays, and touching objects and realia, will contribute to language-rich environment that encourages comprehension and production and stimulates the children's interest in emergent reading, writing and communication in the two languages.

The project encompasses: a) Functional communication (information-gap) activities, such as comparing pictures, discovering missing features in a map or picture, giving instructions, following directions, or problem-solving; b) Social/cultural interaction activities (Nunan, 1991), which encompass dialogues, role plays, and simulations; c) Problem-solving activities; d) Physical activities.

Language learning is promoted through implementing activities which involve authentic communication and involve the learners in meaningful language use (Richards and Rodgers, 2001). The underlying principle for any of the selected pair and group work tasks employed will be to bring acquisition into the classroom and act as a pivot point to more genuine communication. The themes function as vehicles for contextualizing L1 and L2 in a way which makes sense to the young learners while the language input has to be not only comprehensible, but also memorable. This way a natural context for the integration of language input and skills development can be provided.

Moreover, the multidimensional approach to language suggested by the syllabus will not entail a blindly followed sequence of teaching items in the syllabus (i.e. grammar, language functions, lexical items and skills) but it will be organized around the demands of the tasks which the learners will be presented with. It is regarded that language learning is a complex, non-linear, process during which the learners do not master one item before moving on to another (Larsen-Freeman 1997).

Task based learning is ideally addressed to the younger learners because it presents an entirely natural way to learning by doing rather than by memorizing sentence patterns (Nunan, 2002: 23). Therefore, the tasks are the major organizing principle in the syllabus in acknowledgement of the major benefits they hold for the young learners. In particular, following Hudelson (1991: 2-5) the following principles of language learning are embedded in a task-based approach:

- I A task-based approach provides the young learners with the opportunity for learning through hands-on experiences, and allows working on meaningful tasks and use language to accomplish those tasks' (Hudelson, op. cit.).
- II Also, it allows for cooperative situations to be introduced in the language classroom in which the students can learn from their peers as some of them know more than others. This can take place through meaningful interaction while the teacher can also interact with the children and use 'scaffolding' (Ellis, 1997: 48) in order to challenge them to go beyond their present level of expression.
- III Moreover, through tasks, acquisition becomes a discovery process enabling the learners to figure out how the language works as well as use and experiment with the new language (Hudelson, op. cit.). Learners must be free to make errors so they can re-structure their emerging language system.
- IV Furthermore, in the task-based approach language acquisition takes place through social interaction while meaning is constructed through joined efforts and exchange of messages necessitated in order to negotiate meaning.

In any case every effort will be made to create optimal conditions for L1 and L2 language learning by providing adequate comprehensible input, a stress-free environment, the right to be silent, copious interaction and some focus on form (Larsen-Freeman, 1997).

3.5. Implementation of Bilingual Modular Syllabus (BMS)

The project will be carried out for a semester and will be implemented for four hours per day, two hours in Greek and two hours in the other language either Albanian or Russian. By

using stories of the two cultures an attempt will be made to develop the children's understanding of L1 and its culture in relation to L2 and its culture.

Every day, the children are led into listening to two stories of the two countries either Greek-Albanian or Greek-Russian stories, and participate in re-telling or acting out the story based on the script. Although each culture has its particular stories, children will recognize that there are some resemblances among certain stories in different cultures (e.g., Cinderella). Also, the teachers will use the intercultural stories to engage children in a variety of topics related to their interests and a wider range of vocabulary, as well as to introduce grammatical and functional structures. Furthermore, role play games and physical activities which follow the stories, will provide the children with opportunities to: a) Use L1 and L2 and communicate either verbally or non-verbally with their peers even if they have limited knowledge of vocabulary either in L1 or L2; b) Engage in the pragmatic, functional use of language for communicative purposes in semi-authentic situations and express their creativity through miming and role playing.

A multisensory teaching approach -visual, auditory, and kinaesthetic- will be followed; the children are approached via more than one sensory modality (multi-sensory learning) and are appealed to multiple intelligences in a rich and naturalistic environment (Gardner, 2006). In such a bilingual classroom which includes children at different stages of language development, it is necessary to approach them in a variety of ways by teaching them via multiple means. A basic target is to provide rich and meaningful input and to achieve multidimensional representations when children receive and produce language. A wide variety of print and other symbolic forms will be employed in order to increase the amount of labelling in the environment; The use of flashcards, pictures and objects will be adopted by the teachers to support explanations about stories and describe games and actions. In this way, the children will feel more activated, their motivation will be enhanced and their interest and willingness to communicate in the two languages will increase.

The major anticipated problems which the project is expected to encounter are related to the weak positions of Albanian and Russian in the society (see also Zalvide and Cenoz, 2008), since the minority status of Albanian and Russian in the society limits the opportunities to use them outside school given that there is no communicative need to use Albanian and Russian outside the classroom except for the family environment. Genesee, Paradis, and Crago (2004: 53) speculate that, "children are likely to experience more success with dual language learning if they are preschool age and have more language exposure outside school...".

Pre-Stage: Activating the Children's Linguistic and Cultural Background

The purpose of this stage is to attract the children's interest in the theme of the story, introduce and enhance certain vocabulary, and develop concepts and functions in the two languages. First, the teacher 'explores' the topic with the students (Willis, 1996), either by exploiting pictures, flashcards, slides and objects or by narrating/reading pictures to elicit and provide vocabulary. The focus is on what the children bring to their classroom and how that shapes their interactions with bilingual and bicultural learning/awareness (Haertel, et al., 2008).

The basic techniques and activities employed in this stage are the following:

- Explaining new words through a bilingual concept map;
- Explaining vocabulary in L1 and L2 interchangeably;
- Making deliberate comparisons with the first language and culture;
- Using questions to prompt students' conceptions;
- Using various ways of representing words and concepts (e.g. visuals, technologies)
- Looking and talking about the pictures in both languages is an effective way of reminding the children of certain vocabulary included in both stories (Greek and Albanian or Greek and Russian);
- Inviting the children to predict vocabulary in a story, or 'read' the title of the story or predict vocabulary items which they think might be in the story.

While Stage: Listening to Intercultural Stories

Through stories the children communicate their bicultural experience, understand the experience of other peers, 'liberate' their imagination and make sense of the world and their own position within the two cultures (Maynard, 2005). The story will be projected to the wall of the classroom while the students are seated in a semi-circle, as a story has greater effect on 'reading' when it is visualized or pictured and has pleasing sounds and rhythm. While reading the story, the teacher can use gestures, mime, vary the pace and tone, and disguise her/his voice for some characters in order to convey the meaning more smoothly. At certain points he/she stops reading and asks questions to involve the children.

Since listening to stories is regarded as an interactive and co-creative process, it is used in this project as an enjoyable tool for provoking the children's curiosity, practicing listening sub-skills and verbal expression, as well as a tool for bridging the two cultures. Also, listening to stories is a shared social experience and it develops the students' listening and concentration skills (Griva, 2008). During this stage, certain techniques will be employed, such as:

- *Rereading* the story from the part of the teacher, with the active participation of the children, in order to ensure participation of the whole class and overcome any problems with comprehension.
- *Jig-sawing* listening of a story; The children are divided into small groups and each group listens to a different part of the story related to the same topic. Then the groups exchange information to draw a picture.
- *Retelling* the story; The teacher rereads the story and asks the children to retell it. The ultimate purpose is to help them learn how to organize their thoughts, recall appropriate vocabulary and integrate their prior knowledge into the retelling.

Post-Stage: Participating in Games

The purpose of this stage is to expand on the topic or the language of the story (Underwood, 1990). The expectations from this stage involve the children building on their own creativity and enthusiasm, developing non verbal and verbal communication in two languages, learning about the world as they experience it through playing.

An attempt will be made to involve students into:

- a Physical games: Playing the games, communication in L1 and L2 and successful use of code switching is emphasized, without the children worrying whether they are

doing right or wrong. The teacher will act as facilitator by easing anxiety, creating an enjoyable learning atmosphere and encouraging the children's interaction, creativity and use of imagination.

- b) Dramatization of the story: Some groups of the children will present the story, while the rest will form the audience. The role of the audience is vital and active, as they will have to watch carefully, encourage and help the 'actors'. Children delight in imagination and fantasy. According to Halliwell (1992: 7), "it is more than simply a matter of enjoyment, however, in the language classroom this capacity for fantasy and imagination has a very constructive part to play".

3.6. Evaluation of the Effectiveness and Feasibility of the Project

Overall evaluation of the project will be both formative and summative (Ecclestone, 2003) in order to ensure effectiveness and feasibility of the bilingual project with the aim to collect a considerable amount of data which estimate:

- a) Consistency with initial aims and objectives;
- b) Coherence of activities in respect of the stated objectives and clarity of planning;
- c) Responsibilities of the various participants involved in the project.

Evaluation comprises an integral part of the project with the purpose to reflect on its outcomes, and make further remediate as needed. It is considered as an ongoing process which involves gathering information and giving feedback on the way the project works so that improvements can be made. All stakeholders are engaged in the evaluation of the project in order to provide sufficient information on its effectiveness. However, particular emphasis has to be laid on the role of the learner who is placed at the centre of such venture, in the light of implementing a learning-centred approach to developing biliterary skills (Lynch, 1996).

Evaluation components typically focus on methods, materials, and teaching processes as aspects of a comprehensive program evaluation (Kiely and Rea-Dickins, 2011) with a clear focus on the improvement of a language program at the classroom level through evaluation of various curriculum aspects (Kiely and Rea-Dickins, 2011 in Chostelidou, 2012).

It will be conducted by employing a combination of the following quantitative and qualitative methods:

- I Post-measurements (tests) of L1 and L2 (performance) achievement:
 - a) Word Finding Vocabulary Test (the Greek version, Vogindroukas, Protopappa and Sideridis, 2009);
 - b) Screening test on story based comprehension and production in L1 and L2;
- II Post-measurement of creativity will be administered individually to the children (Torrance Test of Creative Thinking-verbal, 1990);
- III Journals will be kept by the teachers once a week in order to reflect on learning and teaching issues;
- IV Structured interviews will be conducted with the children, at the end of project, to record their degree of interest in the project, and the difficulties they encountered;

- V Semi-structured interviews will be conducted individually with the teachers in order to obtain data on their views and beliefs;
- VI Questionnaires will be administered to children's parents.

CONCLUSION

Through the proposed project, we expect that the children without any fear of ethnic and linguistic erosion can develop the Greek language, without losing contact with their mother tongue. In this way the bilingual children will decipher much more language input than the monolingual children who are exposed to only one language system and profit cognitively, socially and linguistically. The envisaged objectives to have bilingual and biliterate students could be difficult to achieve in the educational contexts if only the Greek language dominates for these children as a sole language of instruction in kindergarten and primary education, respectively.

Through a process of careful consideration, additive bilingual educational approaches should be designed and implemented even from the very early years bringing connections between theories on the advantages of early bilingual development and modern instructional practices related to young children. The benefits of early childhood bilingualism as indicated by research are summarized by Lightbown (2008: 8). More specifically, it is suggested that: a) In early childhood children are capable of acquiring two or more languages; b) Bilingualism does not confuse children; c) The developmental path and the outcomes of L2, L3 etc. acquisition provided adequate input and opportunities for interaction are offered, are similar to those observed in the acquisition of L1; d) There are cognitive advantages which are associated with the development of proficiency in more than one languages. After all, children learning two languages are according to Kan and Kohnert (2005: 380) one of the fastest growing segments of the global population.

In the case considered, we expect the following linguistic, cognitive and affective outcomes to be achieved: Development of receptive and productive language skills in L1 and L2; Verbal and non verbal communication; Being open to cultures and knowing the other; Motivation and participation in L1 and L2 game-based activities. Moreover, all stakeholders need to be trained on how important it is for immigrant children to master both L1 and L2 and do away with certain misconceptions and myths such as that bilingualism can lead to cognitive and linguistic confusion (Griva, Dinas and Stamou, in press).

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Chapter 3

EVOLUTION OF GRAPHOMOTOR PARAMETERS IN KINDERGARTEN CHILDREN'S HANDWRITING

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ABSTRACT

The longitudinal study presented in this chapter focuses on the acquisition of writing skills in a group of preschoolers. Eighteen four-to-five year old preschoolers copied six-letter Catalan words (disyllabic and trisyllabic) on a digitiser. The words were presented and copied in capital letters. Data were collected at three different times over two academic years (February; November; and May). We compiled eight kinematic and perceptual variables in each of the three sessions, including measures of execution time (both on paper and in air), pressure, fluency, number of strokes, gaze lifts to the stimulus and duration of intervals between letters (ILI). These measures were compared over the three sessions in order to assess the development of handwriting skills.

The results show that motor and perceptual parameters developed positively. However, at the last session there was a decrease in the quality of movement execution (longer duration, less fluency, more segmentation of the stroke), which is interpreted in terms of the impact that linguistic knowledge has on writing execution. The duration of the intervals between letters shows the effect of syllable structure on the programming of the stroke at the different sessions of data collection.

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INTRODUCTION

In this chapter, we present a longitudinal study describing the evolution of graphomotor skills in a group of preschoolers during the first stages of handwriting development. Preschoolers were four and five year-olds from a school in Catalonia, in the Northeast of Spain, where Catalan language is used for literacy learning and general educational purposes.

There are a number of studies in the literature on literacy development during preschool years. Topics range from the learning process of the correspondences between graphemes and phonemes (Fernández-Ojanguren et al., 2003; Hagiliassis, Pratt & Johnston, 2006) to the evolution of orthographic knowledge (Borzzone de Manrique & Signorini, 1998; Defior et al., 2000; Ferreiro & Teberosky, 1979; Kamii et al., 2001; Martinet et al., 2004). Other covered topics are which variables can facilitate learning throughout preschool years (Casillas & Goikoetxea, 2007; Defior, 2008; Dunsmuir & Blatchford, 2004; Elliot & Olliff, 2008; Mäki et al., 2001; Ritchey, 2008) or which variables can predict learning success in literacy (Dunsmuir & Blatchford, 2004; Molfese et al., 2006; Mäki et al., 2001).

Another type of studies has focused on kinematic parameters of writing performance during the learning process. These studies have used a digitizer that allows on-line recording of data. In a seminal study, Meulenbroek & Van Galen (Meulenbroek & van Galen, 1988) observed that absolute velocity, curvature and fluency of movement during handwriting decreased in children aged eight to twelve years when writing new letters.

Rueckriegel and collaborators carried out a developmental study about graphomotor skills across four domains of hand writing movement: velocity, automation, variability and pressure, in drawing and writing tasks. Their participants were aged between six and eighteen years. Their results show that speed, automation and pressure increased with age, whereas variability decreased (Rueckriegel et al., 2008).

Also using a digitizer, Rosenblum and collaborators have described the diagnosis of difficulties in handwriting in children older than seven (Engel-Yeger et al., 2009; Rosenblum et al., 2004; Rosenblum & Livneh-Zirinski, 2008). Lange-Kuttner assessed the evolution of graphomotor skills by means of recording drawing productions of four to six year-old preschool children (Lange-Kuttner, 1998). In a similar vein, van Mier studied graphomotor skills in children aged four to twelve years when drawing curved or crooked lines, following a pre-fixed pattern (van Mier, 2006).

To the best of our knowledge, there are no developmental studies focused on the parameters related to motor execution and stroke programming during the first stages of learning to write, at the age of four and five. In this chapter we present the first results obtained from a small sample of preschool children using a digitizer.

1.1. Handwriting Processing

Handwriting is a complex cognitive ability that requires the coordination of different kind of internal representations. According to van Galen (van Galen, 1991), writing production can be conceptualized in a similar way to speech production; that is, as the result of several processing levels hierarchically structured, so that output information from a certain level constitutes the input of the next level.

The first processing levels in handwriting production parallel those from speech production, but from lexical selection processes onwards, processing is specific for written language. Handwriting specific levels of processing include a module for orthographic information retrieval and a motor module, which carry out allograph selection, control for letter size and muscular adjustment. Kandel et al. (2011) suggest that sublexical units, such as graphemes and syllables, have also their processing modules just below lexical access.

Due to the cascaded organization of the different modules in the model (van Galen, 1991; van Galen & Weber, 1998), an increase in cognitive load at high-level processes will be reflected in low-level processes, e.g., motor modules. Several studies show that retrieval of linguistic, orthographic or syllabic information causes a longer duration of the stroke, probably because there is a competition between the retrieval of this information and motor planning (Hulstijn & van Galen, 1983; Lambert et al., 2008; Zesiger et al., 1993; Zesiger et al., 1994). We will get back to the effects of word syllabic structure on writing programming later on. In addition, factors such as learning new characters can influence stroke execution measures, as Meulenbroek & van Galen (1988) showed in the study above referred.

1.2. Learning to Write and Read

Learning to write and read involves a number of aspects: the acquisition of grapheme-phoneme correspondences, perceptual information about the form of letters and motor information about the proper movement when producing these forms on a paper (Vinter & Chartrel, 2010). A characterization of the graphomotor developmental stages in learning to write has been proposed by Zesinger (Zesiger, 1995; Zesiger et al., 2000), based on the evolution of the graphic execution and the type of control performed on it by the writer.

This author states that the child needs a good control of the upper part of the body (trunk, head and arms) before he/she can free the arm and the hand to produce scribbles. At the first stages of developing handwriting skills, children generate big letters, which look more like a drawing than like a sign. Characters are irregular and written segment by segment (see an example in Figure 1). For each traced line, there are several acceleration /deceleration pairs of movements, indicating the scarce fluency of movement execution. When writing rounded segments, the direction of the stroke follows a clockwise movement, whereas in adults it follows the counterclockwise direction.

In the next developmental stages, handwriting will gain fluency and letters will become smaller. Handwriting control varies during writing development. First, children perform a proactive control on the line: they perform the movement in the direction they want and do not correct the trajectory. In a second phase, children show a retroactive control: they alternatively write and review the result of the movement on the paper, so that they correct the trajectory after each written segment. This leads to the segmented letters typically produced at this stage.

As children improve their knowledge about letter forms, they are able to program their movements in order to write them. In this way, the control becomes proactive, that is, the handwriting movement is prepared before being performed. In mature writing, both types of control combine, resulting in a greater fluency in the elaboration of characters and their proper arrangement on the writing space (Zesiger et al., 2000).



Figure 1. Example of writing from a 4 years-old (MERCAT, original data, February 2008). In this stage characters resemble more drawings that signs, although the preschooler knows he is writing letters. In the air movements (light grey), irregularities in the strokes (particularly in the circle from the R), and an uneven disposal of letters can be observed.

Around the age of eight or nine, handwriting becomes automated and organized (Feder & Majnemer, 2007) and, from ten years on, it becomes personalized.

Rueckriegel et al. (Rueckriegel et al., 2008), in their developmental study with six to eighteen year-olds as participants, found evidence that motor maturation has a large influence on kinematic parameters. The authors observed that writing velocity (measured in frequency of strokes) and pressure on the surface increase with age, and movements become more automated and less variable. They claim that maturation of handwriting is not complete until children are seventeen years old. At that age the parameters observed when writing a sentence are fully stabilized.

It is important to bear in mind the development of tonicity in children. Following Ajuriaguerra, between ages five and seven the trunk tends to lean on a side, dragged by the distal movement of arm and hand when writing. Children must learn to use and distribute their energy among the movements they are performing. Therefore, it is necessary to conceive the development of handwriting skills as an interaction between children's maturation and education (Ajuriaguerra & Auzias, 1975).

In Catalan schools children start their literacy training throughout the preschool years. In the majority of schools, learning to write begins the first year of preschool education (P3). At the age of three, children learn to write their name in capital letters and get familiar with written language. During the next courses (P4 and P5), preschoolers will continue practising activities involving copying and reading names, specially the names of their mates and the names of the usual activities in a school setting. The prevailing teaching method in Catalan schools is the constructivist one, based on the idea that by means of experience children will progressively integrate the knowledge that will give them access to literacy (Tolchinsky Landsmann, 1993; Tolchinsky & Simó, 2001).

During this period, one of the most used tasks is copying words. This is a task requiring a sequence of cognitive processes. Firstly, children must analyze the string of characters from the word. Then, this visual information must be encoded as graphic information that will be stored in working memory. Finally, motor modules will use this graphic information in order to program the writing gesture.

Obviously, during the first phases in learning to write, children have not yet learned to read. They will thus analyze the sequence of letters letter by letter, without paying attention to linguistic information in words. As soon as they gain knowledge on reading and writing, learners segment the visual entry in bigger units, which can have different sizes. As suggested by the recent Psycholinguistic Grain Size theory (Goswami et al., 2005; Goswami & Ziegler, 2006; Goswami, 2008; Goswami, 2009; Ziegler & Goswami, 2005; Ziegler & Goswami, 2006), the size of orthographical representation units depends on the degree of orthographic transparency from the language the child is learning to write. In other words, when learning to write, children associate new orthographical representations with the phonological representations they already have. In languages with an opaque orthography the grapheme-phoneme correspondence is not direct, so that children store orthographical representations in units from different size. Since languages with a transparent orthography have a more direct grapheme-phoneme correspondence, children can handle smaller units, with the size of a phoneme, and can group them more easily. That is why in some languages the process of learning to read is faster than in other languages.

1.3. Handwriting Programming

Perceptual segmentation units relate with handwriting units, as shown by Kandel and Valdois (Kandel & Valdois, 2005). In this study, first and second graders copied regular and irregular words in a digitizer. Results showed an increase in the duration when writing orthographically irregular words (in words acquired at a late age). Data indicate that children make a phonological recoding without difficulty for regular words, allowing them to write faster. However, in case of irregular words, they have to retrieve specific orthographic information from the word, and the retrieval of such information implies a cognitive load that slows down handwriting execution. It is interesting to mention that a subsequent study shows that francophone children from third, fourth and fifth grade program their handwriting as a function of orthographic syllables and not anymore as a function of phonological syllables (Kandel et al., 2009).

Syllabic organization of handwriting programming in schoolchildren has been shown in several studies. The study by Kandel and collaborators, with francophone children from first grade, made clear that graphomotor programming depends on graphemic and syllabic structure of words (Kandel, Soler et al., 2006). Comparative studies between French and Spanish speaking children confirmed differences in the way they organize their handwriting, which can be attributed to the different degree of transparency in their languages (Kandel & Valdois, 2006a; Kandel & Soler, 2010; Soler et al., 2004).

A study with Catalan speaking children (Soler & Kandel, 2009) has yield to slightly different results from French and Spanish. This is not surprising, since Catalan is a language between Spanish and French as for its orthographic transparency. In terms of structure, Catalan has clear syllabic boundaries, like French, but it displays features such as variable

position of stress and vowel reduction, like English (Badia, 2002; Cantin Mas & Ríos Mestre, 1991; Sebastian-Galles et al., 1992). In terms of grapheme-phoneme correspondences, in Catalan at least 9 letters do not correspond with a single phoneme (a, e, o, r, s, c, g, b, d), besides letter h, which has no correspondence to any phoneme; in addition, there are 12 phonemes that do not correspond to a single letter (Tolchinsky & Simó, 2001).

In the above mentioned study (Soler & Kandel, 2009) a group of first graders copied seven-letter words, five bisyllabic and five trisyllabic words. Results show a syllabic structuring of handwriting, since for both word-types an increase in the duration of last syllable's first letter was observed. This increase can be attributed to a raise in cognitive load, due to the programming of the last syllable. If first graders program their handwriting according to the syllabic structure of words, it is interesting to find out when this type of planning emerges.

2. THE STUDY

The present work is a longitudinal study that consisted on collecting graphomotor and kinematic writing data from a group of preschoolers along two academic years. The data obtained in three transversal cuts is presented: A first session (February in P4), a second session (November in P5) and a third session (May in P5). The children copied ten six-letter words in capital letters on a sheet fixed on a digitizer. In order to study stroke programming, half of the words were disyllabic and half were trisyllabic.

Firstly, the study aims to assess learning development of this group of kindergarten children. We expect to find a decrease in the values of the different parameters measured (writing time, dysfluency, pressure on the writing surface, number of strokes needed to write each letter, number of gazes to the stimulus). The expected decrease will show the development of motor and perceptual skills during the learning of handwriting.

Secondly, the study aims to determine the development of motor programming depending on the syllabic structure of the words, measured through the comparison of the time elapsed during the intervals between letters and between syllables.

2.1. Methods

2.1.1. *Participants*

Eighteen right-handed children (ten boys and eight girls) of a total of a class group of 24 children participated in the study. A girl with Down syndrome who had not yet started to learn to write, a left-handed boy, and three boys with behavior difficulties were excluded from the sample. The mean age of the children at the beginning of the study was of 4 years and 8 months. All participants showed normal vision. The socioeconomic level of the school was medium-low. As in the rest of public schools in Catalunya, literacy is carried out exclusively in Catalan.

2.1.2. Materials

The stimuli consisted of ten six letters words with a medium-high frequency, based on the Catalan Frequency Dictionary (Rafel, 1996). The words were common substantives known by 4-year-old children in order to facilitate its reading as soon as they master the skill. Five stimuli were three-syllable words with a CV-CV-CV structure (*botiga* – shop; *cadira* – chair; *ferida* – wound; *galeta* – biscuit; *sabata* – shoe); and five were two-syllable words with a CVC-CVC structure (*mercat* – market; *perfum* – perfume; *pintat* – painted; *portal* – doorway; *vestit* – dress). The order of stimuli presentation was randomized and the resulting list was presented in the same order during the three sessions. None of the children recognized the target words as previously presented in the past sessions.

2.1.3. Procedure

The sessions were conducted individually in a quiet classroom during the school schedule (9-12:30pm; 3:30-5:30pm). The task consisted on writing a word presented in the center of a laptop screen (Toshiba Portegé R500). Ductus software (Guinet & Kandel, 2010) was used for stimuli presentation and data recording. The words appeared in Times New Roman size 18 capital letters and remained in the screen for as long as the participant needed. Children performed the copy task on a white A5 sized sheet attached to a digital tablet surface (Wacom Tablet Intuos3) using a standard electronic pen that writes in ink (InkPen). This pen allows registering data about the position of the tip and the pressure against the pen's axis with a 200 Hz sampling frequency. In order to familiarize the participants with the tablet and the pen, they practised by writing their name and two sample words (*poma* – apple; *casa* – house) before copying the target words. No temporal or speed restrictions were imposed and each word was presented when the participant had finished copying the previous one. The total duration of a session was of 20-30 minutes.

2.2. Data Analyses

Ductus software has a semi-automatic module for writing analysis (see Guinet & Kandel, 2010, for information about the analysis procedure). The data were smoothed with a Finite Impulse Response filter (Rabiner & Gold, 1975) with a 12 Hz cut-off frequency. A total of eight variables were obtained in each of the three sessions. Three types of durations (in seconds) were registered: total word duration (Total); duration of the effective writing period (Script); and duration of air strokes (InAir). The duration of effective writing period (Script) and duration of air strokes (InAir) were standardized as percentages in relation to the total time.

Percentage standardization allows establishing comparisons between participants who show different execution speed, which is a frequent kindergarten feature. If a child takes 100ms to write a letter while another takes 200ms, but in both cases the durations represent the 15% of the total of the word, it can be assumed that both children organize movement in a similar way (Kandel & Valdois, 2006b). Percentage standardization also allows calculating children's writing efficiency by comparing the percentage of effective time used for writing and the time in which the pen is not in contact with the writing surface.

Other measures analyzed were pressure on the digitizer (Pressure), motion dysfluency (Dysfluency or lack of fluency, calculated with the total of velocity peaks reached by word);

and the number of total strokes used to write each word (Stroke) were analyzed. These variables show execution and motion programming features thus providing information on motor skills.

The number of gazes (GazeLift) to the stimulus on the screen, counted from the first, was recorded in order to evaluate the chunks of visual information about the word recalled by the child (Reiben & Saada-Robert, 1991).

Finally, in order to study the possible effects of the syllabic structure on graphomotor planning, the time elapsed on each letter interval (Inter-Letter Interval, ILI) was also registered. The comparison of the inter-letter intervals allows assessing whether movement has been planned according the syllabic structure of the words. Thus, if the duration of the inter-letter intervals is shorter than that of the inter-syllable intervals it can be assumed that there has been a processing time between syllables that probably corresponds to the next syllable programming (Kandel et al., 2006). Moreover, the comparison between types of words (two and three syllables) allows assessing whether the duration pattern differs as a function of syllabic structure. For the two-syllable words the syllabic boundary coincides with ILI3 (*por-tal*: P – ILI1 – O – ILI2 – R – ILI3 – T – ILI4 – A – ILI5 – L), whereas for three-syllable words the syllabic boundaries are placed in ILI2 and ILI4 (*pi-lo-ta*: P – ILI1 – I – ILI2 – L – ILI3 – O – ILI4 – T – ILI5 – A).

These comparative analyses were carried out for the three sessions. Due to the reduced sample size, we used non-parametric tests. The parameters were longitudinally compared throughout the three sessions using the Friedman test and pairwise comparisons were performed with the Wilcoxon signed-rank test.

3. RESULTS

3.1. Evolution of Temporal Parameters

Mean values of duration for each session are shown in Table 1. As explained above, the median of the Total time (in seconds) obtained in each session were compared. This measure equals the total time elapsed between the beginning of writing a word and the point in which the child raises the pen after the last letter. Effective writing time (Script) and the time in which the pen is not in contact with the tablet surface (InAir) were transformed into percentages in relation to the Total time.

The evolution of total time (Total) of the words showed significant differences between the three sessions ($\chi^2_{(2)} = 20,33$; $p < .001$). The Wilcoxon signed-rank test showed a significant decrease between the first and the second session ($Z = -3.02$, $p < .005$); and between the first and the third session ($Z = -2.28$; $p < .05$); while a significant increase between the second and the third session was found ($Z = -2.19$; $p < .05$). The latter result indicates that children took longer to write the words in the third than in the second session.

Regarding the total percentage of time devoted to effective writing (Script), results showed a slight increase throughout the three sessions ($\chi^2_{(2)} = 6.333$; $p < .05$). The percentage of writing time did not vary between the first and the second session but increased significantly between the first and the third session ($Z = -2,5$, $p < .02$) and between the second and the third session ($Z = -2.5$, $p < .02$). In the same trend, InAir time decreased progressively.

Although there were no significant differences between the first and the second session (February-November), there were differences between November and May ($Z=-2.5$, $p< .02$) and between February and May ($Z=-2.5$, $p< .02$). Taken together, it is worth noting that in the last session the children employed only half of the time on In Air movements.

Table 1. Word execution values (Standard Deviations in parentheses)

Measure		Session 1 (February)	Session 2 (November)	Session 3 (May)
Time	Total (s)	20.42 (6.3)	13.22 (5.9)	16.23 (6.5)
	Script (%)	39.70 (6.9)	41.07 (9.8)	48.53 (10.1)
	InAir (%)	60.29 (6.9)	58.92 (9.8)	51.46 (10.1)
Motor	Dysfluency	55.63 (27)	33 (12.6)	44.33 (19.9)
	Strokes	12.11 (2.1)	10.55 (1)	11.02 (1.3)
	Pressure	739.31 (126.2)	719.9 (143.8)	549.4 (171.3)
Perceptual	Gaze-Lift	5.4 (.7)	3.6 (1.6)	1.8 (1.9)

3.2. Evolution of Motor Parameters

Friedman test on the dysfluency values (Dysfluency; see Table 1) revealed significant differences between the values obtained in the three sessions ($\chi^2_{(2)} = 8.11$, $N=18$; $p< .02$). The Wilcoxon comparison test showed a significant decrease between values of the first and the second session ($Z=-2.7$, $p< .01$) and a significant increase between the second and the third session ($Z=-2.3$, $p< .02$), which was an unexpected effect.

The Strokes parameter, or segments used to write the words, provides information about graphomotor planning. As can be seen in Table 1, the number of segments did not vary too much between the three sessions. Yet, results showed significant differences between these values ($\chi^2_{(2)} = 11.14$, $N=18$; $p< .005$) and the value obtained in the second session (November) was lower than in the first (February, $Z=-2.9$, $p< .005$), and in the third session (May, $Z=-2.2$, $p< .05$). We did not observe the expected decrease between the second and third.

However, pressure values (Pressure) clearly decreased between November and May sessions. The value obtained in May was significantly lower than the value obtained in February ($Z= -3.68$, $p< .0001$) and in November ($Z= -3.54$, $p< .0001$).

3.3. Evolution of Perceptual Measures (GazeLift)

Regarding the number of gazes to the stimulus, they went from one gaze per letter in February to a bit less than four gazes per word in November, and less than two in May (See Table 1). The global differences were significant ($\chi^2_{(2)} = 28.55$, $N=18$; $p< .0001$), and so were the comparisons between the three sessions. This result supports the progressive reading ability of the children, who were more able to obtain information about the stimulus with just one gaze in May.

3.4. Evolution of Motor Programming. Analysis of the Inter-Letter Interval Durations (ILI)

First, we analyzed disyllabic words (see Figure 2). An analysis conducted on the ILI durations in each session showed differences as a function of ILI position in the first session ($\chi^2_{(4)} = 20.981$, $N=18$, $p < .0001$) and in the second session $\chi^2_{(4)} = 20.981$, $N=18$, $p < .0001$). However, the differences vanished in the May session although there was a trend towards significance ($\chi^2_{(4)} = 9.434$, $N=18$, $p = .051$).

The pairwise comparisons of the adjacent ILI durations of the first session showed a significant difference between the first and the second ILI ($Z = -2.330$, $p < .05$), and between the fourth and fifth ILI ($Z = -2.853$, $p < .001$). These intervals do not correspond to the syllabic boundary, which is placed in the third ILI. In order to observe a syllabic effect, a significant increase on this duration in relation to the previous ones should be obtained. Thus, we can conclude that the stroke programming of the sample in the first session (February) did not follow a syllabic pattern.

In contrast, the analysis of the differences between pairs of ILIs of the second session (November) revealed a significant increase between the first and the second ILI ($Z = -2.461$, $p < .02$) and a significant reduction between the third and the fourth ILI ($Z = -2.483$, $p < .02$). The significant reduction of ILI4 could be indicating a syllabic effect in the two-syllable words during the second session.

Because Friedman test results were non-significant for the values of the third session, we do not report the results of the pairwise comparisons between adjacent ILIs.

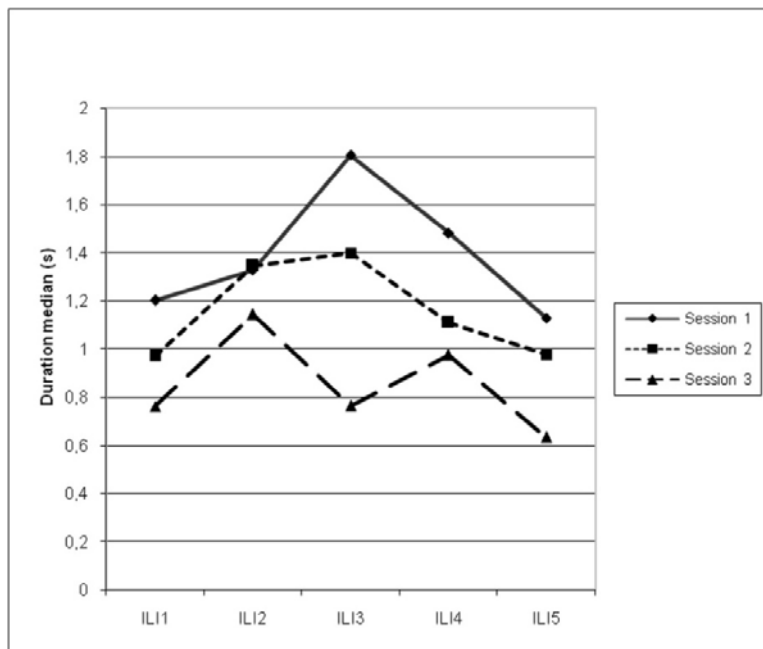


Figure 2. Durations of each ILI by session, disyllabic words.

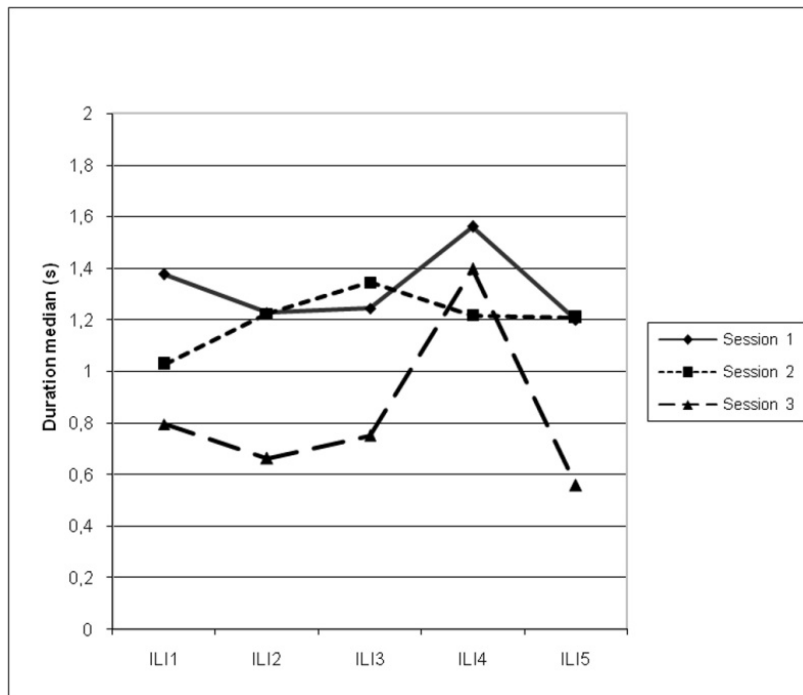


Figure 3. Durations of each ILI by session, trisyllabic words.

Thus, there seems to be a syllabic effect in session 2 (November) for the two-syllable words, that is shown by the longer duration of ILI3 in relation to ILI4, probably indicating that the strokes of the letters of the second syllable had been programmed during this interval.

Regarding three-syllable words (see Figure 3), no significant differences were obtained between ILI durations of the first and second sessions. However, the values of the third session did significantly differ between them ($\chi^2_{(4)} = 19.689, N=18, p < .005$). The pairwise comparisons indicated a significant increase of the ILI4 duration in relation to ILI3 ($Z = -2.025, p < .05$) and a significant reduction of ILI5 duration in relation to ILI4 ($Z = -3.65, p < .001$). This increase in ILI4 suggests that children programmed the stroke of the last syllable during this inter-syllable interval.

CONCLUSION

In this study, kinematic and perceptual writing values of 18 kindergarten children were recorded and analyzed in three sessions along 16 months. Results of the analyses on these parameters partially confirm the proposed hypothesis. We expected to find a progressive decrease of values of the different variables, in line with the evolution of children graphomotor skills. This expected decrease was found for Script, Pressure and GazeLift. Conversely, Total Time, Dysfluency and Strokes increased at the last session when compared to the values of the previous one.

One of the variables that behaved as expected was the Pressure variable, which decreased over time. This decrease may indicate a lesser tension performing the movement, thus

showing an improvement of the motor skill. In much the same way, Ajuriaguerra (1975) has pointed the necessity of an adequate tension degree and a non-excessive strength when writing. Oddly, previous research have suggested that pressure increases with age, as in the work of Rueckriegel et al. (2008), although in this case it has to be pointed out that participants in that study were between 6 and 18 years-old. Rueckriegel himself does not give much credit to the evolution of this parameter, suggesting that pressure increase of in elder students may be caused by a change of the writing instrument. Lange-Kuttner (1998) also found also a pressure increase on 4 to 6 year-old children drawings, which she explained in terms of higher tension of 6 year-olds when drawing. In our study, children did not draw, but copied characters which are gradually more familiar, doing a task that becomes more familiar day by day. It is possible that preschoolers were tenser at the beginning of the learning process of writing and, as they mastered the execution of movements, they may relax the tension of the hand and exert less pressure, as Ajuriaguerra suggested (1975).

The number of looks to the stimulus, or GazeLift, progressively diminished as well. At the last session, in May, the mean number of gaze-lifts was two, approximately. The decrease of gaze-lifts is attributable to a better knowledge of letter shapes, reading acquisition, and grapheme-phoneme correspondence. Catalan is a nearly transparent language, which from the Psycholinguistic Grain Size Theory perspective (Goswami, 2008a; Goswami, 2008b; Ziegler & Goswami, 2006) allows children to handle small units during the learning process, making it easier to group them for handwriting programming.

Other interesting progresses of variables were the increase of effective writing time (Script), and the decrease of the in-air writing time (InAir), that show a progressive optimization of the execution of graphomotor movement.

The positive evolution of these mean values indicates that participants in this study evolved through the first period of their learning process. Children used their writing time in a more optimal way, wrote in a more relaxed way, learned how to chunk perceptive information units during the recovering of information for the copy, and therefore stopped copying the words letter by letter.

On the contrary, it is surprising that children in this sample wrote slower in the last session than in the second one, as shown in Total Time analyses. The decrease of fluency in the last session was also unexpected, revealing a more irregular movement in terms of velocity; as was the fact that letters were written with more strokes in May than in November, indicating a more segmented programming of characters.

In sum, these results seem contradictory. On the one hand, the evolution of children motor skills, confirmed by the decrease of pressure and the increase of effective time use, indicates a progress of participants' writing skills. On the other hand, participants give the impression to have more difficulties for the stroke execution in May than in November; their movements are slower, less fluent and more segmented.

This apparent decrease of children skills may be interpreted as a discontinuity on the writing development, observed at other developmental stages. Meulenbroek and Van Galen (1988), in a study with children from elementary school, found that 8 to 9 year-olds of their sample seemed to lose skill on variables such as movement duration, absolute velocity, curvature and writing fluency. The hypothesis proposed by Meulenbroek and Van Galen's was that, as children were more demanding on shape production, they conducted a visual and motor control of their movements that interfered with segment production. Focusing on our preschoolers' sample it is possible that they switched from a totally proactive control at the

first session, to a retroactive control at the third session, with a big effort to perform a better letter trajectory.

Another feasible interpretation of these results may be attributable to the effect of a higher cognitive load on the stroke execution in May. An explicative hypothesis could be that in November, participants had a pretty good motor dominance of the written stroke, but their linguistic knowledge on spelling and word structure was limited, as the GazeLift indicator shows (3.66 gazes per six letter word, 0.61 per letter). In May, motor aspects of the stroke did improve and participants' number of gazes halved (1.8 gazes per six letter word, 0.3 per letter). So, what disrupts handwriting execution at the third session?

It is likely that GazeLift data indicate that children have more spelling knowledge than in the previous session. As pointed by Martinet et al. (2004), spelling knowledge is acquired since the beginning of literacy learning (in a study with 6 year-olds). We can presume that, while conducting the copy task in May, children used bigger units than the letter. These units were coded as graphical information, retrieving at the same time the already learned orthographic representation. Afterwards, this information was transformed into motor programs, to finally conduct the graphic stroke. Incorporation of the spelling information represents an increase of cognitive load in comparison with the previous session, especially in these early stages of learning. In May, children brought this spelling knowledge into operation to copy the words, and this caused the decrease of movement speed and fluency. Of course, this hypothesis must be confirmed with future studies that include a deeper follow-up of the evolution of spelling learning with specific tests.

Finally, we are going to discuss the motor programming pattern studied across the ILI intervals. All the words used in this study had six letters, although half of them were disyllabic and the other half were trisyllabic. Differences on the duration of the ILI on words of two and three syllables suggest a distinct process in terms of word type. We observed a possible syllabic effect on disyllabic words at session 2, in November, but the effect disappeared at session 3. In November, the inter-syllable interval was longer than the subsequent inter-letter interval, which indicates that children may be programming the last syllable during this interval.

Conversely, with trisyllabic words, it seems that the only syllabic effect is observed at session 3, in May, where an increased syllabic interval ILI4 occurs, indicating the programming time for the last syllable. It is possible to assume that children processed the first two syllables before starting to write and then the third one on line.

These results probably show the same effects of the perceptual and motor grouping units commented above. Children learn to use units bigger than the letter, on perception as well as on motor programming. In November, children programmed the first syllable of disyllabic words letter by letter, but they were skilled enough to group the second syllable as a single programming unit. It seems that trisyllabic words, in opposition, were programmed letter by letter at this session. At the May session, the peak of duration of ILI4 of trisyllabic words indicates the grouping of the first two syllables and the programming of the third as an independent unit.

Duration profiles of ILI are analogous to those obtained in a previous study with 1st grade students (Soler & Kandel, 2009). The stimuli target words of the 1st graders had seven letters, and children wrote in italics without pauses between letters. Despite these differences, results are comparable since we observed a similar increase of time at the syllabic boundaries. For dysyllabic words, we observed an increase of duration of the fourth letter (first letter of

the second syllable). For trisyllabic words, we observed the same increase on the fifth letter, that is, the first letter of the third syllable. We can state that increases of the durations have occurred in the same syllabic boundaries, in both the 1st graders' study and in the preschoolers' study. Nevertheless it has to be noted that with preschoolers the increases at the inter-syllabic intervals occurred only at the November session for the disyllabic words and in May for the trisyllabic words.

To summarize, in this chapter we have presented the results of a longitudinal study on graphomotor parameters of handwriting, following a small sample of 4 to 5 year-old children along two preschool years. The collected kinematic and perceptual data shows their graphomotor skills progression along three sessions (February in P4, November in P5, and May in P5). Children of the sample optimize their writing time, exert less pressure on the surface, and increase the size of perceptual units.

However, although total writing time decreases from February to November, it increases in May. At the same time, fluency, which improves from February to November, worsens in May. Finally, the mean number of segments used to write words is bigger in May.

We have proposed two hypotheses to explain the decline of children's execution. The first one is that the cause of this decrease may be the change of children's graphomotor control. When children exert a retroactive control, they are very careful on performing a correct letter shape. This effort is probably interfering on fluency, speed, and number of segments.

The second explanatory hypothesis refers to the linguistic knowledge of preschoolers. It is possible that in May, these preschool children had acquired new orthographic knowledge that they did not have in November. The processing of the orthographic information represents a superior cognitive load, disturbing the execution of the movement during the copy task. Obviously, both hypotheses should be undertaken with extreme caution, due to the small number of participants. Further studies with bigger samples are needed, adding specific measures to assess children stroke control and orthographic learning.

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Chapter 4

FOUNDATIONAL SKILLS: MULTISENSORY HANDWRITING CURRICULUM CAN ENHANCE KINDERGARTEN STUDENT SKILLS

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ABSTRACT

Fostering educational development and advancement of students is one of the many roles of teachers in America today. Delivering the necessary academic content at an appropriate developmental level to promote foundational skill achievement in kindergarten is not a simple task. Teachers face multiple challenges including: (1) increased academic demands, (2) developmental appropriateness of instruction, (3) varied college training of teachers, and (4) varied skill development of students prior to kindergarten. Because of changes in education, ability of kindergarten teachers to provide the most effective instruction requires a combination of new skills, creativity, patience, flexibility, and compassion. One skill, handwriting, is a critical foundational skill introduced in kindergarten.

One half-day kindergarten program at a private school recognized the importance of the development of handwriting skills and the challenges of students to produce written language. This school decided to implement a multisensory, developmentally-based handwriting curriculum in order to teach kindergarten students the foundational handwriting skills necessary to foster academic achievement. As the teachers embarked on a journey of improving the classroom education for their students, data were collected on student performance for comparison with a control group who had not used this multisensory curriculum. This chapter will describe the history surrounding the current kindergarten educational environment, the importance of handwriting skills, the handwriting curriculum used in the study, and the research that substantiates the use of a multisensory handwriting curriculum to build the foundational skills necessary in kindergarten for future academic success. Implications for educators of kindergarten students will be discussed as well as directions for future research.

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INTRODUCTION

The kindergarten classroom is an amazing and unique place where children from various backgrounds, skill levels, learning styles, interests, and personalities come together with a common purpose: to learn. Even though a common purpose is shared, the teaching methods, expectations, and challenges within a kindergarten classroom have changed and evolved over the years.

Historically, kindergarten had served as a major life transition point for students. Traditionally, this was the first significant separation from the home environment and full-time care of the parent(s). It also served as the stepping-stone from home to the public elementary school. Students were exposed to new challenges such as getting along with others, working as a team, and learning basic classroom rules such as raising a hand to talk (Graue, 2010). As American culture has advanced, so has the curriculum and expectations of kindergarten students.

With advances in technology and changes in curriculum demands, some foundational skills are becoming neglected in kindergarten classrooms (Kiss, 2007). One important foundational skill that permeates through all academic curriculums is the ability to produce written language: handwriting. Research has demonstrated handwriting instruction is important not only for motor skill development but also neurological development of children (James, 2009). Research has also indicated that handwriting fluency challenges have a significant impact on composition length and quality; thus indicating a strong relationship between handwriting fluency which requires mastery of handwriting mechanics, and writing quality which incorporates ideation (Berninger, 2000; Graham, Harris, & Fink, 2000; Rosenblum, Weiss, & Parush, 2003). However, teachers are reporting little time available to teach this skill as well as limited training in handwriting instruction (Asher, 2006; Donica, Larson, & Zinn, 2012; Graham, Harris, Mason, Fink-Chorzempa, Moran & Saddler, 2008). In addition, multiple learning styles and achievement levels of kindergarten students creates a challenge for teachers to provide differentiated instruction to meet the needs of all students in a skill area not regularly taught to teachers. However, the demands for legible handwriting skills are critical for future academic success. This chapter will explore kindergarten classrooms past and present and will conclude with results of a research study that examined the effectiveness of one multisensory, developmentally-based handwriting curriculum.

LITERATURE REVIEW

General Kindergarten Education

Kindergarten expectations, challenges, and teaching methods are areas of constant change. However, some consistencies have remained. These components will be discussed in relation to theoretical foundations and current issues.

Kindergarten Teaching Expectations

Graue (2010) identified that the purpose of kindergarten “is to build on children’s experiences, needs, and interests in a way that will enhance all domains of development and

that is aligned with expectations in later grades” (p. 31). The expectations of success on standardized tests in later grades have impacted the demands placed on kindergarten teachers (Goldstein, 2007; Parker & Neuharth-Pritchett, 2006). Because of these expectations, the focus in the curriculum has become achievement of benchmarks thus teaching methods are focused on what is to be tested which does not always align with developmentally appropriate instructional methodology (McLennan, 2011; Goldstein, 2007; Graue, 2010; Gullo & Hughes, 2011; Parker & Neuharth-Pritchett, 2006).

In recent years, the Common Core Standards (NCA Center & CCSSO, 2010) have been developed to help identify expectations of student achievement across all grade levels and core subjects. Common Core Standards were designed to identify what all students are expected to achieve; however, the instructional methods used by teachers are not identified within the standards. Teachers have the freedom to use their own creativity, experience, and professional judgment in determining the instructional methods (NGA Center & CCSSO, 2010). The language standards themselves identify that “students who meet the standards develop the skills in reading, writing, speaking, and listening that are foundation for any creative and purposeful expression in language” (NGA Center & CCSSO, 2010, p. 3). It is primarily within the language standards where specific handwriting skills are reflected at the kindergarten level. However, written expression permeates through most all of the Common Core Standards.

Kindergarten teachers of today are presented with unique challenges because of achievement expectations place on students. In order to teach the content necessary for students to achieve these expectations, teachers are finding the need to sacrifice the developmentally appropriate teaching methods of the past. Therefore, teaching has become more academically and teacher-directed and less child-directed (Goldstein, 2007; Gullo & Hughes, 2011; Parker & Neuharth-Pritchett, 2006).

Kindergarten Teaching Methods

Controversy over teaching methods in kindergarten has occurred throughout history. Teacher-directed instruction that is structured and carefully planned versus child-directed free and playful discovery activities both have arguments supporting them (Beatty, 2011; Graue, 2010; Gullo & Hughes, 2011; McLennan, 2011; Parker & Neuharth-Pritchett, 2006; Vodopivec, 2010). Three primary theories exist that provide a foundation for kindergarten curriculum. Just as the teaching methodology is contradictory, so is the supporting theory. First, behaviorism is a theory grounded in the idea that environment is the primary influential force on behavior and therefore learning (Parker & Neuharth-Pritchett, 2006; Vodopivec, 2010). Alternately, cognitive theory is very different from behaviorism. Whereas in behaviorism, the specific traits and characteristics of the person have little significance on behavior; in cognitive theory, the child does not just absorb knowledge from the environment, but actually has a direct influence on knowledge taken in. Activities requiring challenge but are achievable seem to be most motivating (Parker & Neuharth-Pritchett, 2006; Vodopivec, 2010). Last, in psychoanalytic theory, a child’s heredity and environment integrate to impact a child’s learning and development (Vodopivec, 2010). The way that these theories integrate to reflect in curriculum impact the instructional methodology employed.

A child’s development is the outcome of new learning merged with past experiences. A kindergarten classroom must be supportive to foster optimal development (Vodopivec, 2010) in order to facilitate academic achievement. Goldstein (2007) identifies three primary learning

methods that occur within kindergarten classrooms reflecting various roles of academic standards and developmental needs: integration, demarcation, and acquiescence. Integration is a methodology where the standards of achievement and developmental needs are incorporated together in a meaningful and creative way. An activity may begin to address one standard, but based on the child's interest and involvement, it may freely change into another activity (Goldstein, 2007). Within demarcation, teacher-directed academic activities and developmentally appropriate child-directed activities are presented as distinctly different activities within the classroom. These types of activities are not merged nor do they flow freely from one type to another. Last, acquiescence is the deliberate teaching of academic standards through teacher-directed means in order to meet a standard. These methods are often not developmentally appropriate (Goldstein, 2007; Graue, 2010; Parker & Neuharth-Pritchett, 2006).

Teacher-directed and child-directed activities may be combined in various ways through the methods described above, or one method may be adhered to completely and solely by a given teacher. Parker and Neuharth-Pritchett (2006) identified that in practice, teachers who ascribed to teacher-directed methods felt less pressure than child-directed teachers to prepare students for the next grade level. However, teachers using child-centered and child-directed methods were perceived to have more freedom and control over their instructional practices than those using teacher-directed methods. Teachers have found that even though the academic standards do not dictate the manner in which content is delivered, use of child-centered instructional methods is often discouraged directly or indirectly by external sources such as administrators, upper grade teachers, and parents (Goldstein, 2007; Graue, 2010; Parker & Neuharth-Pritchett, 2006).

Conflicting theories as well as conflicting teaching methods set the stage for challenges in creating effective kindergarten classrooms. According to Gullo and Hughes (2011), "today's kindergarten classrooms must be able to serve the developmental, social, and academic needs of all children" (p. 325). Therefore, a kindergarten curriculum identified as high quality must blend elements of teacher-directed and child-centered instruction (Graue, 2011; Gullo & Hughes, 2011; Parker & Neuharth-Pritchett, 2006).

Current Kindergarten Challenges

Kindergarten teachers face a variety of challenges while striving to best prepare children for future academic success in a developmentally appropriate manner. Academic standards mandate faster-paced instruction and additional content to cover in a limited amount of time (Goldstein, 2007). There are real and perceived limits in flexibility of teaching methods that can be used which limits opportunities for socialization, imagination, and creativity among children (Goldstein, 2007; Gullo & Hughes, 2011). Administrators, parents and upper grade teachers' perceptions place pressure on kindergarten teachers to increase student outcomes (Goldstein, 2007; Graue, 2010; Parker & Neuharth-Pritchett, 2006). Because of these challenges, it is difficult to balance the developmentally appropriate play-based methods with the academically driven methods (Goldstein, 2007; Parker & Neuharth-Pritchett, 2006). Lastly, differentiated instruction demands cause challenges to meet the varying needs of students (Gullo & Hughes, 2011; NAEYC, 1998).

Handwriting Skills – The Forgotten Foundation

“Kindergarten education should be based on children’s abilities and lead them to acquisition of new experiences, encounters and understanding by means of setting reasonable requests and problems that encourage children’s active learning which in turn enables expression, involvement and a strong social and emotional engagement” (Vodopivec, 2010, p. 104-105). As demands have increased, appropriateness of activities is questioned. As standards are enforced, critical foundational skills are easily overlooked. One of those critical developmental and academically necessary skills is handwriting.

Why is Handwriting Important?

As established by research, the importance of handwriting skills remains evident in American culture, especially for students (Cahill, 2009; Case-Smith, 2002; Graham et al., 2000; Hoy, Egan & Feder, 2011; James, 2009; Naidoo et al., 2009). Research supports this importance in a variety of ways. First, when analyzed, approximately 30%-60% of a typical school day required the use of fine motor skills. More importantly, 85% of the activities which required fine motor skills included handwriting and writing skills (McHale & Cermak, 1992). However, research indicates anywhere from 10%-34% of students have difficulty with handwriting (Parush, Lifshitz, Yochman, & Weintrub, 2010; Smits-Engelsman, Niemeijer & Van Galen, 2001). To further validate the impact of handwriting skills, the World Health Organization (2002) has identified writing difficulties as a limit to school performance (as cited in Clark, 2010) which was supported by prior research regarding the impact of handwriting fluency on writing skills (Berninger, 2000; Graham et al., 2000; Rosenblum, Weiss & Parush, 2003).

Limited handwriting skills can decimate a student’s school performance. Students who have not mastered the mechanics of handwriting have difficulty shifting attention from these basic mechanics to composition, ideation, planning, and organizing written text (Jones & Christensen, 1999; Medwell & Wray, 2007). Kindergarten is a critical time to address this skill because students who demonstrate poor handwriting skills in kindergarten often continue to demonstrate poor handwriting skills in first grade (Marr & Cermak, 2003). Therefore, performance at the kindergarten level sets the precedence for future performance. Limitations in writing speed can also limit a student’s ability to complete time sensitive evaluations and assignments thus tainting the true representation of student abilities (O’Mahony, Dempsey, & Killeen, 2008).

Illegibility is another primary factor that limits student performance. Multiple studies indicate how a teacher’s grading of written work may be reflective of handwriting legibility when content is held constant (Chase, 1986; Graham et al., 2000). Students with handwriting difficulties may not only struggle with the aforementioned components of school, but it may also impact their emotional well-being and social functioning (Cornhill & Case-Smith, 1996).

Handwriting skills are also linked to reading abilities. Research has indicated that reading skills are significantly correlated to handwriting skills and students at risk for reading challenges are also a risk for handwriting challenges (Berninger, 2000; Clark, 2010). Clark (2010) reviews and expands on this link between reading and writing indicating they both share some important concepts. Understanding the alphabet principle, linking letters to sounds and words, is critical to both reading and handwriting. Letter names and phonemes are important to both reading and writing tasks (Berninger, 2000; Fitzgerald & Shanahan, 2000).

Handwriting was also significantly correlated with word recognition (Berninger, 2000). However, in kindergarten classrooms the reading skills are addressed much more effectively than handwriting skills (Clark, 2010).

Handwriting and Academic Standards

Common Core includes many standards that necessitate mastery of written language for success. Based on the kindergarten Common Core language standards, students are expected to print many upper and lowercase letters, capitalize, recognize punctuation, and spell phonetically by the end of the year. This is the precursor to the first grade expectation to print all upper and lowercase with correct capitalization and punctuation. These foundational handwriting skills provide the structure for future writing success at upper grades that span across content areas including opinion papers, narratives, research, and math skills (NGA Center & CCSSO, 2010).

In addition to written expression, skills necessary for handwriting are also foundational for reading. These skills, noted in the Common Core standards, include following words top to bottom and left to right on the page, understanding words are separated by spaces, and recognizing and naming all upper and lowercase letters (NGA Center & CCSSO, 2010).

A definition of what constitutes proficient handwriting has been the subject of research and controversy over the years. The two most commonly accepted aspects of good handwriting are speed and legibility. Naidoo et al. (2009) defines legibility as “general appearance, accuracy, size, slant, rhythm, reversals, and preservation” (p. 20). In addition, speed and fluency with handwriting are required for effective written expression (Berninger, 2000; Graham et al., 2000). Even though there are not a multitude of Common Core standards that specifically dictate handwriting legibility achievements, the process of handwriting is a necessary foundational skill that supports academic success through the Common Core Standards. Because of the impact of handwriting skills on reading, writing, social and emotional skills, math, and other language skills, it is critical that handwriting be instructed in a method offering opportunity for future academic success (Berninger, 2000; Chase, 1986; Clark, 2010; Cornhill & Case-Smith, 1996; Fitzgerald & Shanahan, 2000; Graham et al., 2000).

College Training for Teachers

College education programs for teachers historically have taught handwriting skill instruction to upcoming teachers (Donica, 2010a; 2010b). However, recent surveys of teachers have indicated that only 12-35% of teachers are receiving training in college on handwriting instruction (Graham, et al., 2008; Donica, Larson, & Zinn, 2012). Not only are the children entering the classroom with such a variety of skill levels (NAEYC, 1998), but the teachers are not prepared to teach handwriting skills to the average student, let alone those that require differentiated instruction. Teachers also indicated that although many of them did not receive training in handwriting skills, 94.6% of them felt that handwriting skill instruction was important for upcoming teachers to receive in their college education programs (Donica, et al., 2012). This is a missing component in efforts to improve the foundational skill of handwriting.

Handwriting Curriculum

Due to the importance of handwriting and the incidence of students with handwriting challenges, there has been much debate and study over the best way to instruct handwriting skills. There are two common approaches to handwriting instruction: a cognitive function approach and a multisensory approach. The cognitive function approach utilizes visual cues, self-instruction strategies, self-monitoring, and a task oriented approach that requires direct instruction and practice (Wientraub et al., 2009). The multisensory approach utilizes sensory experiences, media and instructional materials (Amundson, 2005). The aim of the multisensory approach is to offer different sensory experiences so the sensory input is integrated through the nervous system thus facilitating effective execution of motor skills (Amundson, 2005). Although research is conflicting regarding which approach is more effective (Weintraub, et al., 2009; Woodward & Swinth, 2002; Zwicker & Hadwin, 2009), the Handwriting Without Tears® program has elements of both approaches integrated in one curriculum.

Handwriting Without Tears®, known to and utilized by both teachers and occupational therapists, was developed in the 1970s by occupational therapist Jan Olsen (Donica, 2010b; Olsen & Knapton, 2008). Handwriting Without Tears® (HWT) utilizes a cognitive function approach including visual cues, self-monitoring, and direct teacher demonstration followed by student practice. In addition, HWT includes a multisensory approach to assist through the use of hands-on manipulatives, music, and consistent child-friendly language in addition to addressing posture, pencil grasp, and the use of the non-dominant hand (Donica, 2010b; Olsen & Knapton, 2008). The capital letters are taught first as they are deemed easiest (Olsen & Knapton, 2008; Clark, 2010). Letters are then taught in groups based on level of difficulty, frequency in use, and beginning stroke (Olsen & Knapton, 2008). Since its development, the program has grown to include a preschool readiness program and a full curriculum for kindergarten through fifth grade (Donica, 2010b).

Research has been published on the HWT curriculum, but there has been little research on the effectiveness of HWT with kindergarten-aged students. Both Kiss (2007) and Benson, Salls and Perry (2010) found that the teachers' perceptions of HWT included that it was easy to use and had a positive effect on their students' handwriting. When looking at program effectiveness, Lust and Donica (2011) determined that the Handwriting Without Tears® – Get Set For School preschool program had significant positive impacts on handwriting development when implemented two times per week in a Head Start classroom. However, due to this limited body of research to support the curriculum selection process of school administration, the research study described in this chapter was conducted to broaden the research base for effectiveness of a handwriting curriculum to enhance the handwriting skills of kindergarten students. One hope is that this study may help administrators execute evidence-based decision making when determining appropriate curriculum and teaching methods for their kindergarten classrooms.

It is clear that the development of handwriting skills is important to the role of students. Research described within this chapter shows how much time is spent utilizing these skills, the relationship of these skills to other critical developmental skills, and the frequency of challenges demonstrated by students. Often, because of the frequency of handwriting challenges, students are referred to occupational therapy within the school system to evaluate and address handwriting and associated motor skills. While this process is effective for students who have underlying deficits which manifest through poor handwriting skills, many

students may effectively learn the skill of handwriting through a structured, developmentally appropriate, and multi-sensory curriculum.

Purpose

The purpose of this study was to determine if kindergarten students who were educated in the classroom using the Handwriting Without Tears® (HWT) curriculum would demonstrate better handwriting skills than students who were not educated through a formal developmentally-based handwriting curriculum. Specific research questions included:

1. Will students who participated in handwriting instruction using HWT demonstrate better overall legibility than students who did not?
2. Are there specific handwriting skills (ie. letter, number, word, or sentence writing) that were significantly better for students using HWT than those in the control group?

It was hypothesized that the students who participated in the HWT formal handwriting instruction would demonstrate higher scores overall on a handwriting legibility assessment than students who did not receive the formal handwriting instruction. In addition, specific handwriting skills were hypothesized to be better for students in the HWT experimental group than the control.

METHOD

Research Design

A static group comparison was used for this study. A control group and manipulation of an independent variable occurred; however, there was not randomization due to the logistics of the study and no pretest scores were secured since the data collection had not begun at the appropriate time to conduct a pre-test with the control group. The participants were kindergarten students at a half-day kindergarten program in a private school in eastern North Carolina. This half-day schedule accentuated some of the aforementioned teaching challenges including time constraints to include developmentally appropriate content to meet the academic standards. The HWT curriculum required 15 minutes per day of teacher instructional time. The student participants completed the Test of Handwriting Skills – Revised (THS-R) (Milone, 2007) administered to the entire class near the conclusion of their kindergarten year. The research study was approved by the university Institutional Review Board and it was identified as less than minimal risk.

Procedure

Students were selected out of convenience for participation in this study. There were two cohorts of students, one year apart. The same teachers taught both cohorts. The first cohort, the control group, included two classrooms of half-day kindergarten students who received handwriting instruction through the use of handwriting worksheets generated in the D'Nealian style of writing. The control group included 25 total students who received traditional handwriting instruction and then was tested at end of the academic year with THS-R.

The second cohort, the experimental group, received HWT curriculum and then was tested at end of the academic year with THS-R. The experimental group consisted of 28 kindergarten students. The independent variable was the handwriting curriculum implemented while the dependent variable was the score on the THS-R. Demographic characteristics of the two groups are identified in Table 1.

Table 1. Characteristics of Control and Experimental Groups

Variable	Control (<i>n</i> =25)	Experimental (<i>n</i> =28)
Age in months <i>M</i> (<i>SD</i>)	75.73 (5.3)	73.43 (3.1)
	<i>n</i> (%)	<i>n</i> (%)
Gender		
Male	19 (76)	16 (57)
Female	6 (24)	12 (43)
Hand Dominance		
Left	4 (16)	2 (7)
Right	21 (84)	26 (93)

Although the THS-R assessments were coded and scored blindly, the two cohorts were scored by trained occupational therapy graduate students at different times, so the scorers were not blind to the cohort. However, this kindergarten study was part of a larger study including first grade THS-R assessments as well as additional administrations of the THS-R with the experimental cohort. Therefore, even though the scorers were aware of the year of the assessments they were scoring, they were blind to the grade level or the specific timing during the academic year the assessment occurred. Although no formal inter-rater reliability was calculated between the two scorers, both were trained by the author and by the DVD included in the assessment. They both scored four sample handwriting assessments and discussed their differences in scoring for consistency prior to scoring the participants' assessments. The scorers were randomly assigned assessments to score but the author ensured that there was an equal mix (by classroom and assessment time) of assessments for each scorer to complete.

Curriculum Implementation

Prior to the implementation of HWT within the experimental group, the two kindergarten teachers attended a full-day workshop on the HWT curriculum, which included information on the kindergarten curriculum. This workshop was designed to help teachers understand the fundamentals of the program, the developmental sequence, and multisensory components. It provided a foundation for them to integrate the curriculum into their classrooms. Some degree of training is recommended by Handwriting Without Tears® to help answer questions and facilitate this integration of the new curriculum; however, training is not required to use the program.

During the 2011-2012 school year, the kindergarten teachers implemented the HWT kindergarten handwriting curriculum into their respective classrooms. Implementation was approximately 15 minutes daily. Each lesson typically began with a gross motor activity coordinated with a handwriting related song on the Rock, Rap, Tap, and Learn CD, which is part of the curriculum. Next, a learning activity was implemented following the Teaching Guidelines (Olsen & Knapton, 2008) as a guide. The learning activity may be specific letter formations with multisensory manipulatives (i.e., rolling dough, chalk and slate, wooden pieces to form capital letter) or writing in the uniquely designed workbook. In addition, an occasional review activity often with manipulatives was used as a morning work activity. One time per week a registered occupational therapist and/or two occupational therapy graduate students were present in the room during the 15 minute handwriting instruction time. This presence allowed the occupational therapy personnel to answer questions regarding the implementation of the curriculum as well as to provide occasional assistance to struggling writers. The teachers worked together to develop their lesson plans based on the HWT teacher's guide. These lesson plans were then implemented by the classroom teachers. In order to address fidelity to instruction, approximately one lesson per week was observed by the author.

Instruments

The Test of Handwriting Skills-Revised (THS-R) was designed to assess a child's neuropsychological integration skill and can be used to test both manuscript and cursive writing. For this study, the manuscript component was used (Milone, 2007). The test is standardized for children ages 6 years 0 months to 18 years 11 months. Students were asked to write both upper and lower case letters in alphabetical order from memory, a non-alphabetical sequence of all upper and lower case letters from dictation, and a non-numerical sequence of 8 numbers. In addition to the writing tasks requiring visual memory, students were asked to copy twelve uppercase letters, copy ten lowercase letters, copy six lowercase words, copy two sentences, and write six words from dictation (but not spelled aloud) (Milone, 2007). All of the writing tasks were done on pages within the testing manual that had no lines for letter placement. Therefore, letter legibility and scoring did not include a measurement of alignment. In addition, the test booklet has pages indicated by picture instead of letter or number as to not provide a cue for the student during assessment. However, because of imposition upon the teacher's time and classroom to remove all of the letter and number displays as well as all of the name plates on the desks that also included these models, letter

and number displays were not removed from the classroom walls during testing either control or experimental groups. The THS-R was administered over about an hour to all students within the each class simultaneously (one class at a time) by a single administrator.

The Test of Handwriting Skills-Revised provides an overall standard score, scaled subtest scores for each of the 10 subtests, and subsequent percentile scores. The test norms are a nationally stratified sample of 1,500 students. This standardized test also has established reliability and validity. The test-retest reliability was found to be 0.82 for the total test score with an interrater reliability that ranged from 0.75 to 0.90 based on the authors of the assessment (Milone, 2007). The authors of the test indicate that content validity is built into the test by careful consideration of task design and whether or not the task may engage other behaviors that can confound the results. They suggest that with a task like handwriting it is almost impossible to assess visual and motor abilities independently from one another. The tasks of the test were designed to be common to a wide variety of students in a standard academic setting as to minimize confounding of results (Milone, 2007). Although standard scores are ideal, most of the student participants in this study were not 6 years of age at the time of testing. Therefore, the results are presented in raw scores.

RESULTS

The subtest raw scores and total raw scores of the THS-R (Milone, 2007) were used for data analysis as opposed to the standard and scaled scores. When looking at the data, initially, comparisons were made between the groups for the total raw scores representing overall handwriting legibility. In addition, analysis was completed on each subtest to identify specific skills within handwriting that reflected differences between groups. The mean (M) and standard deviation (SD) for each subtest and overall is reported in Table 2. When controlling for age and gender, ANCOVA was used to determine significance as indicated in Table 2.

Table 2. ANCOVA Results for Mean Raw Score Differences Between Kindergarten Control (n = 25) and Experimental (n = 28) Groups

THS-R Subtest	Control M(SD)	Experimental M(SD)	Adjusted <i>p</i>	Treatment Effect (<i>d</i>)
Airplane- UC letters from memory alphabetical	43.4 (11.6)	51.8 (7.3)	.002	.90
Bus - LC letters from memory alphabetical	43.1 (11.7)	52.6 (11.3)	.012	.84
Butterfly - UC out of sequence from dictation	41.7 (11.2)	49.8 (8.0)	.011	.86
Frog – LC out of sequence from dictation	44.3 (9.0)	47.7 (13.0)	.183	.31
Bicycle – Single digit numbers from dictation	17.5 (4.2)	18.0 (3.2)	.264	.14
Tree – Copy selected UC letters	25.6 (4.0)	28.8 (2.8)	.002	.96
Horse – Copy selected LC letters	18.6 (3.1)	20.7 (3.4)	.007	.66
Truck – Copy words from a model	41.8 (7.6)	43.8 (5.5)	.312	.31
Book – copy sentences from a model	57.6 (9.0)	62.5 (8.1)	.193	.59
Lion – Writing words from dictation	32.8 (12.9)	40.9 (9.6)	.056	.73
Raw Total	366.3 (54.9)	415.1 (44.5)	.002	1.00

Note. UC = upper case; LC = lower case; M = mean; SD = standard deviation. For all results $p < .05$ is significant.

The treatment effect was also calculated for each subtest and the overall score of the THS-R. This calculation was calculated using Cohen's d . This calculation serves as a frame of reference for the effect of the independent variable and is valuable due to the small sample size. The effect size is indicated as small if $.20 \leq d \leq .49$, medium if $.50 \leq d \leq .79$, and large if $d \geq .80$ (Cohen, 1992; Thalheimer & Cook, 2002).

The total raw score for the experimental group was significantly higher than the control group (See Table 2). With such a large difference between the control and experimental total raw scores ($M_s \pm SD_s = 366.3 \pm 54.9$ control and 415.1 ± 44.5 experimental, $p = .002$), each subtest mean was compared to determine significance for the specific skills addressed. The total raw score demonstrated a large treatment effect ($d = 1.00$). The experimental group subtest scores reflected higher raw score means when compared to the control group for all subtests (See Figure 1). ANCOVA showed significant differences for 5 out of the 10 subtests ($p < .05$). The subtests with significant differences included the skills of writing upper and lowercase letters from memory with a large treatment effect for both (upper case $d = .90$; lower case $d = .84$), writing upper case letters from dictation with a large treatment effect ($d = .86$), copying selected upper and lowercase letters with large and medium treatment effects respectively (upper case $d = .96$; lower case $d = .66$). The 5 subtests that did not show significant differences included writing lowercase letters out of sequence from dictation with a medium treatment effect ($d = .31$), copying words from a model with a medium treatment effect ($d = .31$), and printing numbers out of order from dictation with no treatment effect ($d = .14$), and copying sentences with a medium treatment effect ($d = .59$). The subtest of writing words from dictation was approaching significance with a medium treatment effect ($d = .73$).

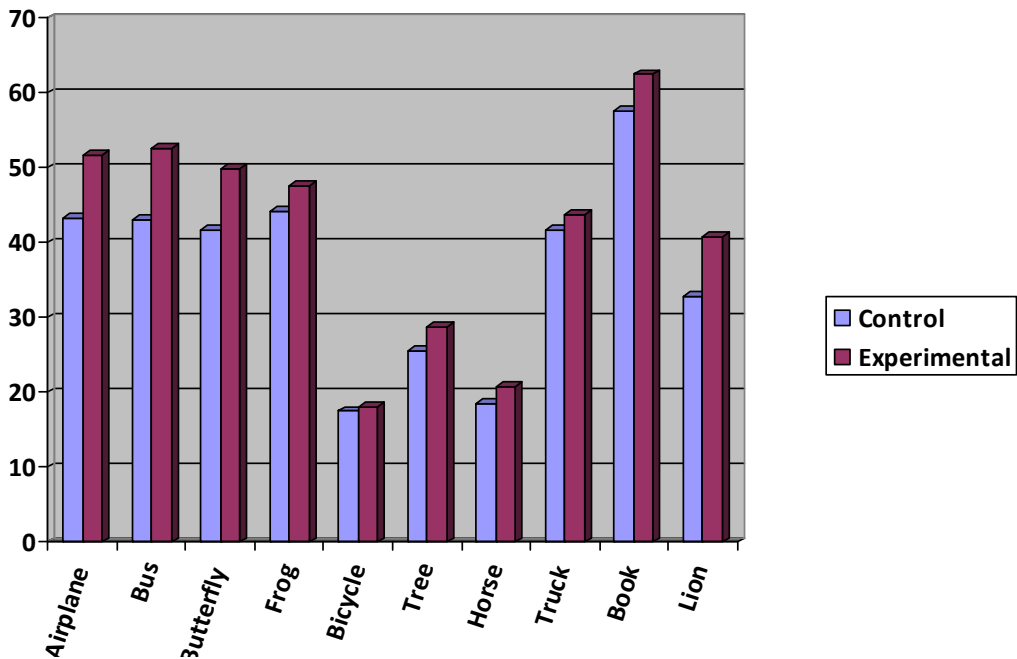


Figure 1. Comparison of raw score means for the experimental and control groups on the subtests of the Test of Handwriting Skills – Revised (Milone, 2007).

CONCLUSION

This study looked at the effectiveness of the Handwriting Without Tears® (HWT) curriculum in a half-day kindergarten program after one full year of handwriting instruction. From the results, it is evident the kindergarten students who were taught using the HWT curriculum had significantly higher scores on the THS-R for handwriting legibility than those who used only the D'Nealian style with no formal handwriting program. Even though the experimental group was an average of 2 months younger than the control, the experimental group outscored the control on all subtests and total raw scores with 5 of the 10 subtests reflecting significant differences when adjusting for age and gender ($p < .05$). This data supports prior research (Benson et al, 2010; Lust & Donica, 2011) showing the effectiveness of the HWT program on student's overall handwriting abilities. The results support both hypotheses that kindergarten students receiving HWT instruction would outscore the control group overall as well as with specific subtest performance.

When reflecting on the subtest data, explanations for results are as follows. Since the HWT curriculum begins with capital letter formations through multiple media, it is not surprising that the experimental group outscored the control group on subtests involving the printing from memory and copying uppercase letters. Because research supports the repetition of letter writing for improved letter memory (James, 2009), this finding is to be expected, especially for the airplane subtest where students wrote the uppercase letters from memory in alphabetical order.

Of the 10 handwriting subtests, four clearly did not reflect significance between groups and one was approaching significance. Number writing was a subtest where the scores of the experimental group were not significantly higher than the control. In the math curriculum used in these particular kindergarten classrooms, number writing is required very early in the school year. Because of the placement of the numbers in the HWT curriculum being very flexible and their location being in the back of the workbook, the numbers were not introduced through the handwriting curriculum until the spring. Therefore, the students were not actually instructed how to form their numbers through the HWT curriculum, but through the math curriculum. The HWT curriculum introduction of numbers would have been review rather than new learning due to timing. Therefore, both groups would have learned the printing of the numbers in the same manner, through the math curriculum. As a result, it is not surprising that there was not a significant difference between the mean scores of the two groups on this subtest.

Copying words from a model, copying sentences from a model, and writing words from dictation are more advanced skills. Even though the experimental group outscored the control on all three of these subtests, the differences were not significant. It was noted for the experimental group that the teachers expressed how pleased they were with the students' progress in the curriculum and how well they were doing when sentence writing during the second half of the year.

Limitations

Although the hypotheses were supported, there were limitations to this study, which need to be recognized. Because this study was conducted in a private school setting, there was a smaller teacher to student ratio than the public school setting. However, this ratio was consistent between the experimental and control groups. The number of total students in each group was also relatively small.

Another limitation involves the introduction of a formal handwriting curriculum. Teachers involved in the study received training on the HWT curriculum prior to the implementation with the experimental group but after the year of instruction with the control group. Also, occupational therapy support was provided once per week to the teachers to answer questions regarding implementation of the curriculum. This support was not provided to the control group.

Interpretation of the data is limited by the lack of a pre-test and randomization of students into groups. However, statistical analysis controlled for differences in gender and age which are typically known to play a role in skill development. Handedness was considered as a confounding variable but there were relatively few students in each group who were left-handed (See Table 1) so this is noted but not controlled for within the analysis.

Last, the THS-R is a handwriting assessment that is not standardized for children younger than 6 years of age. This limited the use of the standard scores in data analysis. Also, the copy sections of the THS-R depicted letters in a style more similar to the HWT style of print than the D'Nealian slanted style of print. However, the scoring of the assessment allowed credit for either style of writing. Another limitation is the small sample size and the impact that this has on power analysis.

Implementations for Education

As academic standards continue to impact kindergarten education and new challenges unfold for kindergarten teachers, evidence-based curriculum is important to impact teaching methods for the kindergarten classrooms. As the foundational skill of handwriting is a critical skill not only in development but also academic achievement, discovering successful methods of handwriting instruction are very important. This study focused on the use of a handwriting curriculum that included both cognitive function approach and the multisensory approach, which are both documented in education literature. The data from this research study supports the use of Handwriting Without Tears as a curriculum that can be implemented by the teacher into a day already limited by time constraints. More generally, it supports the use of using a structured handwriting program to facilitate writing success of students. The results of this study may be helpful to administrators when considering effective curriculum for the kindergarten classroom that helps meet the demands of both teacher-directed academically related content as well as student-directed developmentally appropriate tasks. This study also supports the teachers understanding the handwriting process and how to effectively teach that to a diverse group of learners. As the culture, demands, and environments change, so must the methods of instruction to help promote the successful students of the future.

Future Research

The data collected from this pilot study revealed some interesting discoveries. Collecting data on a larger and more diverse group of students will assist in the generalizability of the results to multiple settings and populations. Future studies could also compare the long-term effects of the Handwriting Without Tears® program. The data could be collected from multiple intervals to reveal the maintenance of the effects of the handwriting program as students continue their educational careers. This would help to determine the effects of using the curriculum in multiple grades and determine the benefit of using it consistently not just during the kindergarten year. Although research has already been done on teacher perceptions of using the HWT program, adding that component to a quasi-experimental research study would add to the richness of the data. Handwriting is a critical skill that continues to play an important role in education and future research will help determine how this skill can be effectively incorporated into instruction to maximize student performance.

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Chapter 5

FAMILY ENVIRONMENT AS A PREDICTOR OF BEHAVIORAL COMPETENCIES IN THE EARLY ELEMENTARY YEARS*

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ABSTRACT

In this paper we examined perceptions of family environment of 84 kindergarten ($n = 34$), first- ($n = 18$), and second-grade ($n = 32$) students identified with behavior challenges according to teacher-completed systematic screening tools. First, we examined the degree to which these 58 boys and 26 girls varied in their behavior problems and social skills from their teachers' perspectives. Results indicated teachers rated girls with higher levels of problem behaviors than boys, although there were no differences in social skills for boys and girls. Second, we examined the degree to which these children's family environments vary for boys and girls in dimensions such as relationship (cohesion, expressiveness, conflict), personal growth (independence, achievement orientation, intellectual-cultural orientation, active-recreational orientation, moral-religious emphasis) and system maintenance (organization and control) as measured by the Family Environment Scale (FES; Moos & Moos, 2002). Results indicated no differences were

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reported for families in this sample. Finally, we examined the relation between family environment and socio-behavioral performance. For boys, the level of Cohesion predicted problem behavior and the level of Cohesion and Intellectual-Cultural Orientation predicted social skills. For girls, there were no significant family characteristics predictive of problem behaviors; however, families with an Active-Recreational Orientation and Intellectual-Cultural Orientation predicted social skills. Educational implications for supporting home-school partnerships for young students upon initial school entry are presented. Limitations and future directions for future inquiry are offered.

Keywords: Emotional or behavioral disorders, families

Teachers and other professionals are challenged to seek new ways to support students exhibiting emotional and behavioral disorders (EBD) within general education contexts. This is a formidable task with current estimates suggesting 12% of students experience moderate to severe EBD (Forness, Freeman, Paparella, Kauffman, & Walker, 2012), while less than 1% of these students are identified with Emotional Disturbance (ED) and served through special education programs under Individuals with Disabilities Education Act (IDEA, 2004). In the primary grades (grades K – 2) students' behavior patterns remain malleable and are more responsive to intervention efforts (Walker, Ramsey, & Gresham, 2004). As such, educators must have the tools and structures in place to address early indicators or “soft signs” of potentially persistent behavior before they become engrained (Lane, Little et al., 2009). For example, soft signs of EBD may include off-task behaviors, mild classroom disruption, peer difficulties, and covert behaviors such as dishonesty.

Prevention science offers a conceptual framework for examining risk and protective factors when developing practices to support the healthy development of children and youth (Coie et al., 1993). Risk factors (e.g., poverty, disability, early onset aggressive behavior, coercive parenting practices) increase the chances of a student experiencing negative school and post school outcomes, while protective factors (e.g., economic support programs, high-quality teachers, early intervention, parenting education), improve the chances of successful outcomes despite the presence of risk factors (Frey, Walker, & Perry, 2011; Patterson, DeBaryshe, & Ramsey, 1989). A national agenda moving prevention research forward has led to the development of schoolwide prevention frameworks. Prevention research offers the tools for early detection of risk factors through universal screening practices at the preschool (e.g., The Early Screening Project; ESP, Walker, Severson, & Feil, 1994) and elementary (e.g., Systematic Screener for Behavioral Disorders; SSB, Walker & Severson, 1992; and Student Risk Screening Scale; SRSS, Drummond, 1994) levels. Structures for evidence-based instruction and intervention are a means for integrating protective factors within school practices. These are provided through three-tiered models of prevention such as Response to Intervention (RTI; D. Fuchs & L. Fuchs, 2006) for literacy (i.e., reading and math), Positive Behavior Interventions and Supports (PBIS; Sugai et al., 2000) for behavioral and social domains, and Comprehensive, Integrated, Three-tiered Models of Prevention (CI3T; Lane, Kalberg, & Menzies, 2009) addressing students' academic, behavioral, and social skill sets. Such multi-tiered models of prevention account for communication and participation by families; however, in preschool settings, the Teaching Pyramid model (Fox & Hemmeter, 2009) makes the importance of the family even more explicit by adding a foundational layer

for relationship building between caregivers (e.g., teachers and other educators) and students' families. Consequently, in this model supporting preschoolers, educators are intentional about developing strategies for supporting families and creating partnerships. The inclusion of families is critical for prevention work in the preschool years and throughout schooling. The consideration of family factors on student behavior and achievement is longstanding (Patterson et al., 1989). Thus, examining family characteristics offers useful information for prevention and intervention practices across the K-12 continuum, particularly in the primary grades when learning and behavioral discrepancies between current and desired performance patterns are most narrow and most amenable to change (Lane & Walker, 2012).

Rana and Malhotra (2005) found that family characteristics served as a predictor of aggressive behavior, the most salient form of EBD (Walker et al., 2004). The authors examined student aggression (Direct and Indirect Aggression Scale; Bjorkqvist, Lagerspetz, & Osterman, 1992) and family environment (Family Environment Scale; Moos, 1989) for 200 students (100 females and 100 males) ages 15 – 18 in India. Differences were found between males and females in terms of correlations between aggressive behavior and family environment characteristics. For males, family cohesion and organization were significantly and negatively correlated with verbal, physical, and indirect aggression. For females, family expressiveness and organization were significantly and negatively correlated with aggression. Family conflict and active recreational orientation were significantly and positively correlated with verbal aggression. Thus, males living in cohesive and organized families and females living in expressive and organized families exhibited less aggression (Rana & Malhotra, 2005).

In another study, Lucia and Breslau (2006) examined family factors that predicted problem behaviors from parent and teacher perspectives for a clinical sample of 823 low and normal birth weight children in the US at age 6 and the stability of the behavior problems for students at age 11. Students were assessed by parents using the Cohesion and Conflict scales of the Family Environment Scale (FES; R. Moos & B. Moos, 1994) and the Child Behavior Checklist (CBCL; Achenbach, 1991). Teachers assessed student behavior using the Teacher Report Form (TRF; Achenbach, 1991). Results indicated students with higher family Cohesion had fewer internalizing and attention problems at ages 6 and 11. Higher family Conflict resulted in more parent reported internalizing and attention problems which was stable across time points. Parents who reported low family Cohesion and high family Conflict also rated children to have more externalizing behavior problems. Teacher ratings for students with internalizing and attention problems were consistent with the parent ratings (i.e., low family Cohesion was associated with increased student difficulties). Teacher ratings for students with externalizing behavior problems were not associated with family characteristics. Gender differences were not examined for this sample. Collectively, these findings highlight the importance of family cohesion and conflict in better understanding various facets of problem behaviors exhibited by elementary age students. Yet, further inquiry is needed to fully understand the relation between family context and behavioral and social performance in the school setting. This information may hold important insight to inform multi-tiered systems of support, with increased attention on how to focus family involvement and intervention efforts.

Purpose

In this paper we extended the work of Rana and Malhotra (2005) and Lucia and Breslau (2006), by examining the relation between family environment and the socio-behavioral competencies of young students in the United States (US) in a public school context. Our goal was to determine if family environment influenced behavioral patterns at school in the same or similar fashion found by Rana and Malhotra (2005) in their work with adolescents. Also, we sought to extend the work of Lucia and Breslau (2006) for students served in a public school context with teacher-identified behavioral and social skill concerns, examining additional family characteristics and gender differences. We examined three research questions: (a) To what extent do young elementary-age boys and girls vary in their behavior problems and social skills from their teachers' perspectives? (b) To what degree do these children's family environments vary for girls and boys from their parents' perspectives? And (c) What is the nature of the relation between family environment and socio-behavioral performance?

METHOD

Participants

Participants were 84 parents, 35 teachers, and 84 kindergarten, first-, and second-grade students (58 [69.05%] boys and 26 [30.95%] girls) from seven schools (4 rural and 3 suburban) in a southern state in the US. Students ranged in age from 5.42 to 9.06 years ($M = 7.06$, $SD = 0.95$), with the majority White (92.86%; see Table 1). Chi square analyses contrasting Gender X Locale, $\chi^2(1, N = 84) = 1.36$, ($p = 0.2430$); Gender X Grade Level, $\chi^2(2, N = 84) = 1.05$, ($p = 0.5926$); and Gender X Number of Schools Attended $\chi^2(1, N = 84) = 0.02$, ($p = 0.8777$); were not significant. Similarly an independent t -tests revealed no significant differences in the ages of students attending rural and suburban schools, $t(82) = -0.92$, $p = 0.36$. Mean scores fell in the average range for intellectual functioning as measured using a short form of the Wechsler Intelligence Scale for Children-Third Edition (WISC-III; Wechsler, 1991) for students ages 6 to 9 and the Wechsler Primary and Preschool Scale of Intelligence-Revised (WPPSI-R; Wechsler, 1989) for students ages 5 and below. The short form included two subtests: vocabulary and block design, with intellectual functioning estimated using Sattler's (1991) formula for conversion to a deviation quotient ($r = 0.91$). Result of an independent t -test indicated no significant differences between boys and girls on these estimates, $t(82) = 0.09$, $p = 0.7627$ (see Table 1).

Table 1. Student Participant Characteristics

Variable	Level	Gender		Total N = 84
		Boys n = 58 (69.05%)	Girls n = 26 (30.95%)	
Ethnicity % (n)	White	89.66 (52)	100 (37)	92.86 (78)
	Black	6.90 (4)	0.0 (0)	4.76 (4)
	Asian	1.72 (1)	0.0 (0)	1.19 (1)
	Other	1.72 (1)	0.0 (0)	1.19 (1)
Grade % (n)	Kindergarten	43.10 (25)	34.62 (9)	40.48 (34)
	First	22.41 (13)	19.23 (5)	21.43 (18)
	Second	34.48 (20)	46.15 (12)	38.10 (32)
Age M (SD)		7.00 (0.93)	7.21 (0.99)	7.06 (0.95)
IQ M (SD)		102.30 (17.54)	103.57 (18.22)	102.69 (17.65)
Retained in grade % (n)		10.34 (6)	0.0 (0)	7.14 (6)
More than 2 schools attended % (n)		20.69 (12)	19.23 (5)	20.24 (17)
Receiving Special Education Services % (n)		1.72 (1)	3.85 (1)	2.38 (2)

Notes: IQ refers to intelligence quotient as estimated using a short form (vocabulary and block design subtests) of the Wechsler Intelligence Scales IQ was estimated using Sattler's (1991) formula for conversion to a deviation quotient ($r = 0.91$).

All teachers were female, with each fully certified to teach elementary school. Additional teacher demographic information was not requested to increase the likelihood of participation.

Of the 84 consented parents, 73 respondents who completed the Family Environment Scale (description to follow) were mothers (86.90%), 9 (10.71%) were fathers, and 2 indicated other (but did not specify the relationship, but did note they were females). Seventy-nine respondents reported their age, which ranged from 25 to 57 years ($M = 36.94$, $SD = 6.00$).

Participants were involved in *Project PREVENT: Screening and Intervening to Prevent the Development of Learning and Behavior Problems* (OSEP Field-Initiated Grant H324C030044). As part of Project PREVENT, parents of 578 students in kindergarten through second grade consented to have their child's teacher complete three systematic screening tools (descriptions to follow). One hundred ninety-six (33.91%) students met inclusion criteria for this study as they demonstrated soft signs of EBD. Parental consent was obtained for 134 students (68.37% of those identified by the screening procedures; see Table 2 for a description of the screening and consenting process). Parent-completed measures were received for 107 (79.85%) of parents who consented, however only 84 (63.69%) parents completed the FES.

Table 2. Identification Process

Consenting Step	Sample		
	Grade Level	<i>N</i>	Percentage
School Enrollment	Kindergarten	562	
	First	533	
	Second	531	
	Total	1626	
Students in Participating Teachers' Classes	Kindergarten	543	
	First	496	
	Second	355	
	Total	1394	
Screening	Kindergarten	248	
	First	189	
	Second	141	
	Total	578	41.46
Identified	Kindergarten	76	
	First	63	
	Second	57	
	Total	196	33.91
Consented	Kindergarten	54	
	First	42	
	Second	38	
	Total	134	68.37
Parent Completed FES	Kindergarten	34	
	First	18	
	Second	32	
	Total*	84	63.69

Note. * indicates the sample included in this study.

Participant Selection Procedures

After obtaining university and district approvals, project staff invited teachers to participate during regularly scheduled faculty meetings. Consented teachers ($N = 73$; 86.90%; Kindergarten $n = 30$, 96.77%; First $n = 26$, 92.86%; Second $n = 17$, 68.00%) completed three screening tools, the Social Skills Rating System (Gresham & Elliott, 1990) to measure social skills, problem behavior, and academic competence, and allowed research assistants to conduct direct observations of student behavior in class during instruction (see Lane, Little, Menzies, Lambert, & Wehby, 2010 for findings related to direct observations). Parent consent was obtained in two phases: (a) to allow their child's teacher to complete three screening tools ($n = 578$; 41.46%): the Systematic Screening for Behavior Disorders, (SSBD; Walker & Severson, 1992), the Teacher Report Form (TRF; Achenbach, 1991), and the Student Risk Screening Scale (SRSS; Drummond, 1994; descriptions below); and (b) to allow additional data to be collected on students identified by one or more screening tools as having soft signs for EBD.

Inclusion criteria for each screening tool were as follows. On the SSBD, students were considered to have soft-signs if they exceeded normative criteria on Stage 2 rating scales (the Critical Events Index and Combined Frequency Index rating scale). On the SRSS, students scoring in the moderate (total score 4-8) or high (total score 9-21) risk range were included. On the TRF, students scoring in the borderline or clinical range were included. For these students, a second parental consent form was sent home requesting permission to participate in Project PREVENT ($n = 196$; 33.91% of those screened). Research assistants (RAs) obtained assent for all students whose parents consented ($n = 134$; 68.37%). Of these 134 parents, 84 (63.69%) turned in completed Family Environment Scales, the primary measure in this study. See Table 2 for identification numbers by grade level.

Screening Procedures

Teachers completed three screening tools as part of Project PREVENT designed to explore the utility of behavior screening tools in identifying students showing soft-signs of EBD. Each tool identifies a range of characteristics believed to place students at risk for future behavior challenges. Teachers dedicated 2 hrs to complete the screening tools between October and January, individually or in groups. RAs conducted screenings with teachers at each of five schools over a 2-day period, meeting with teachers at a time convenient for them (e.g., prior to school, during two planning periods, or after school). RAs explained all procedures and checked for completeness prior to leaving the school. RAs scored and rescored each protocol to ensure accuracy, with all entries into databases verified by a second RA.

Systematic Screening for Behavior Disorders (SSBD)

The SSBD is a multiple-gating system developed to detect elementary-aged students with internalizing or externalizing behaviors. In Stage 1 teachers rank order students on internalizing or externalizing behavioral dimensions ranging from *most like* (1) to *least like* (10). The top three students with internalizing and top three with externalizing behaviors pass through the first gate to Stage 2. In Stage 2 teachers complete two rating scales, the Critical Events Index (CEI) and a Combined Frequency Index (CFI). The CEI (33 items) measures low frequency, high intensity behaviors (e.g., steals, damages others' property, and exhibits painful shyness). The CFI assesses high frequency, low intensity behaviors on adaptive (12 items; follows established classroom rules) and maladaptive (11 items; pouts or sulks) domains with teachers rating items on a 5-point Likert-type scale ranging from *never* (1) to *frequently* (5). Students exceeding normative criteria pass through this second gate to Stage 3 which involves direct observations in the classroom setting (academic engagement) and on the playground (peer-related social behavior) by an outside observer. For purposes of this study, Stages 1 and 2 were completed. Inter-rater agreements range from 0.89 to 0.94 for externalizing and 0.82 to 0.90 for internalizing dimensions. Test-retest stability estimates range from 0.74 and 0.79 for externalizing and 0.81 to 0.88 for internalizing dimensions (Walker et al., 1988).

Teacher Report Form (TRF)

Teachers also completed the aggressive behavior subscale of the TRF, a standardized measure used to assess adaptive functioning and problem behavior of students. Teachers rated each item on a scale ranging from 0 (*no problem*) to 2 (*severe problem*), identifying students with either borderline or clinically significant risk. The TRF is empirically validated, with test-retest and internal consistency values for broad and narrow band scales range from 0.62 to 0.96 and 0.72 to 0.95, respectively.

Student Risk Screening Scale (SRSS)

The SRSS is a 7 item mass screening tool developed to detect students with antisocial behavior tendencies. Teachers rate students on the following items: steal; lie, cheat, sneak; problem behavior; peer rejection, low academic achievement, negative attitude, and aggressive behavior using a 4-point Likert-type scale (range: *never* = 0, *occasionally* = 1, *sometimes* = 2, to *frequently* = 3). Items are summed to create a total score ranging from 0 to 21, with higher scores indicating higher risk. Drummond (1994) developed the following risk categories: low (0-3), moderate (4-8) or high (9-21). Initial studies showed significant correlations between SRSS total scores and the aggressive behavior subscale of the Child Behavior Checklist ($r = 0.79$; $p = <0.001$; Achenbach, 1991). Recent studies established predictive validity between SRSS scores and the externalizing dimension (and to a lesser extent the internalizing dimension) of the SSBD (e.g., Lane, Little et al., 2009). Internal consistency of the overall alpha value of the SRSS exceeded the 0.80 criteria (Nunnally & Bernstein, 1994).

Inclusion Criteria

Students in the current sample included those who: (a) exceeded normative criteria on Stage 2 of the SSBD, (b) scored in the borderline or clinical range on the TRF aggressive subscale (t scores ≥ 67), and/or (c) scored in the moderate or high risk categories on the SRSS. Furthermore, these students had parent-completed FES and teacher-completed SSRS scales (descriptions to follow).

Measures

Descriptive measures were completed to obtain an estimate of intellectual functioning and information on students' school experiences. Social and behavioral performance was assessed from the teacher's perspective using the Social Skills Rating System (SSRS). Parents provided information on family environment by completing The Family Environment Scale (FES).

Wechsler Intelligence Scale for Children-Third Edition (WISC-III)

The vocabulary and block design subtests of the WICS-III were used to obtain an estimated intellectual functioning for students older than 6 years of age (Sattler, 1991). The downward extension, the *Wechsler Primary and Preschool Scale of Intelligence-Revised* (WPPSI-R; Wechsler, 1989), was used to estimate intellectual function of students ages 5 and under.

School Archival Record Search (SARS; Walker, Block-Pedego, Todis, and Severson, 1991)

The SARS is a standardized instrument used to quantify school record data on the following archival variables: demographic information, attendance, number of grade retentions, number of schools attended, special education status, school referrals, number of negative narrative comments, and disciplinary contacts. Inter-rater reliability ranges from 94% to 100%.

Social Skills Rating System (SSRS)

Teachers completed the elementary version of the SSRS for all consented students addressing three subscales: social skills, problem behavior, and academic competence, with the social skills and problem behavior scales used in the current study. The social skills scale included 30 items measuring cooperation, assertion, and self-control skills. Teachers rated the frequency and importance of each item on two 3-point, Likert-type scales (frequency: *never* = 0, *sometimes* = 1, *very often* = 2; importance: *not important* = 0, *important* = 1, *critical* = 2), with the current study using importance standard scores ($M = 100$; $SD = 15$). The problem behavior scale included 18 items measuring internalizing, externalizing, and hyperactivity. Teachers rated the frequency of these items according to the same Likert-type scale. Internal consistency estimates range from .82 to .94.

Family Environment Scale (FES; R. Moos and B. Moos, 2002)

The FES is comprised of 10 subscales to measure the actual (Form R) social environment of families as reported by families. Subscales are organized into three dimensions; Relationship (subscales: Cohesion, Expressiveness, Conflict), Personal Growth (subscales: Independence, Achievement Orientation, Intellectual-Cultural Orientation, Active-Recreational Orientation, Moral-Religious Emphasis), and Systems Maintenance (subscales: Organization, Control). Descriptions of specific subscales are provided in the results sections. Family raters (typically parents) rate each of 90 items on a True (*True or Mostly True*) or False (*False or Mostly False*) scale. Items are then organized into the 10 subscales with 9 items in each for scoring and interpretation. Raw scores for each subscale range from 0-9 (see Table 3 for raw score ranges for each subscale). Raw scores are then translated to t-scores with a mean of 50 and a standard deviation of 10. Higher scores indicate the family environment aligns with that characteristic. For example, families with higher Cohesion subscales scores have a higher degree of commitment, helpfulness, and are more supportive of each other (e.g., *There is a feeling of togetherness in our home* [Scored if T]. *We rarely volunteer when something has to be done at home* [Scored if F]). Alternately, the Intellectual-Cultural subscale measures the degree of the family's interest and participation in political, social, and intellectual activities – items in this subscale tend to be of an individual nature (e.g., *Watching TV is more important than reading in our family* [Scored if F]).

Authors developed the FES based on conceptual and empirical criteria (R. Moos & B. Moos, 2002). Internal consistency estimates of reliability are adequate ranging from .61 (Independence) to .78 (Cohesion, Intellectual-Cultural Orientation, Moral-Religious Emphasis). Two month test-retest reliabilities range from .68 (Independence) to .86 (Cohesion). We used standard scores to address the research questions posed.

Research Design and Statistical Analysis

This is primarily a descriptive study, examining the relation between family environment and socio-behavioral competencies in the school setting. To address the first research objective, we computed a series of independent *t*-tests to determine if gender differences were evident in teachers' perceptions of problem behavior and social skills as measured by the SSRS. Specifically, mean standard scores for problem behavior and social skills subscale scores were compared for boys and girls, using an alpha level of .05 to determine statistical significance.

To address the second research objectives, we computed a second series of independent *t*-tests to determine any gender differences in the mean standard scores for each of the 10 scales constituting the FES. Again, an alpha level of .05 was established to determine statistical significance.

To examine the relation between family environment variables and socio-behavioral performance in schools, we first computed Pearson correlation coefficients between each FES variable and problem behavior and social skills standard scores for boys and girls. Then, we computed four stepwise regression analyses to identify the extent to which family environment characteristics predicted (a) behavior problems exhibited by boys, (b) behavior problems exhibited by girls, (c) social skills exhibited by boys, and (d) social skills exhibited by girls. Family characteristics included: Cohesion, Expressiveness, Conflict, Independence, Achievement Orientation, Intellectual Cultural Orientation, Active Recreational Orientation, Moral Religious Emphasis, Organization, and Control. We used a jackknife procedure to detect outliers (Kleinbaum, Kupper, Muller, & Nizam, 1998). In each of the four models, we examined the residual sums of squares, the multiple correlation coefficient, and *C_p* criterion values were examined to determine the most parsimonious set of predictors to retain (Borthwick-Duffy, Lane, & Widaman, 1997). We also computed and examined studentized residuals, leverage, and Cook's *D* values to evaluate the validity each regression model (Kleinbaum et al., 1998). Collective results indicated outliers were not present; consequently, the regression results were considered accurate.

RESULTS

Research Question 1: To what extent do young elementary-age boys and girls vary in their behavior problems and social skills from their teachers' perspectives?

Results of the independent *t*-test comparing mean problem behavior scores for boys and girls yielded a statistically significant difference $t(83) = -2.24$, with girls ($M = 113.81$, $SD = 10.35$) having statistically higher levels of problem behaviors than boys ($M = 107.34$, $SD = 12.98$). Thus, girls identified by systematic screening tools (although fewer in number than the boys representing 30.95% of the sample) had higher levels of problem behaviors compared to boys (see Table 3). However, it should be noted both mean scores for both groups were in the higher end of the average range (85 to 115).

Research Question 2: To what degree do these children's family environments vary from their parents' perspectives?

Results of the independent *t*-tests comparing mean FES subscale scores for boys and girls did not produce any statistically significance differences, although the Moral Religious Emphasis (i.e., the degree of family emphasis on ethical and religious topics; e.g., *Family members have strict ideas of what is right and wrong* [Scored if T]) subscale mean scores approached significance. This suggests parents of boys and girls who exceeded normative criteria on behavioral screening tools reported similar familial characteristics (see Table 3).

Table 3. Gender Comparison

Dimension	Gender		Total		Significance Testing				
	Boys <i>n</i> = 58		Girls <i>n</i> = 26		N = 84				
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>t</i> Value	<i>p</i> Value	
Relationship									
Cohesion (4 – 45)	57.21	10.50	57.08	10.09	57.17	10.32	0.05	0.96	
Expressiveness (16 – 71)	55.00	9.19	53.81	10.39	54.63	9.53	0.53	0.60	
Conflict (33 – 80)	46.66	12.23	43.62	11.08	45.71	11.90	1.08	0.28	
Personal Growth									
Independence (– – 96)	46.10	10.54	47.77	9.03	46.62	10.07	-0.70	0.49	
Achievement Orientation (16 – 72)	48.93	11.05	47.50	9.36	48.49	10.52	0.57	0.57	
Intellectual-Cultural Orientation (19 – 69)	55.05	8.64	54.77	11.40	54.96	9.51	0.13	0.90	
Active-Recreational Orientation (23 – 69)	53.74	9.87	51.35	13.38	53.00	11.05	0.92	0.36	
Moral-Religious Emphasis (27 – 71)	63.43	8.16	58.69	11.85	61.96	9.64	1.85	0.07	
System Maintenance									
Organization (21 – 69)	55.41	9.30	55.77	10.44	55.52	9.60	-0.16	0.88	
Control (27 – 76)	56.31	7.49	55.62	9.90	56.10	8.25	0.35	0.72	
Problem Behavior	107.34	12.98	113.81	10.35	109.35	12.53	-2.24	0.03	
Social Skills	93.09	12.19	90.58	11.40	92.31	11.94	0.89	0.38	

Note. Raw scores ranges are reported for each variable provided on the Family Environment Scales (Moos & Moos, 2002). However, mean scores for these variables reflect T-scores ($M = 50$; $SD = 10$). Standard scores for problem behavior and social skills as measured by the Social Skills Rating System (SSRS; Gresham & Elliott, 1990) have a $M = 100$; $SD = 15$.

Research Question 3: What is the nature of the relation between family environment and socio-behavioral performance?

3.1. To what extent do family environment variables predict problem behaviors and social skills exhibited by boys?

Problem Behavior

Initial inspection of correlation analyses indicated significant negative relation between problem behavior and Cohesion (-0.41 , $p = 0.002$) for boys (see Table 4). Namely, teacher-

ratings of problem behaviors were significantly higher for boys living in family contexts characterized by lower levels of Cohesion.

Table 4. Correlations of Family Environment Scales (FES) Scales with Problem Behavior and Social Skills Scale Scores

Item	Problem Behaviors		Social Skills	
	Boys <i>n</i> = 58	Girls <i>n</i> = 26	Boys <i>n</i> = 58	Girls <i>n</i> = 26
1. Cohesion	-0.41**	-0.05	0.33*	0.04
2. Expressiveness	-0.20	-0.07	0.13	0.02
3. Conflict	0.14	-0.13	-0.15	0.25
4. Independence	-0.18	-0.14	0.12	-0.00
5. Achievement Orientation	0.21	-0.06	-0.18	0.28
6. Intellectual-Cultural Orientation	0.10	0.09	-0.37**	-0.36
7. Active-Recreational Orientation	-0.15	-0.38	0.16	0.45*
8. Moral-Religious Emphasis	0.05	-0.10	-0.09	-0.07
9. Organization	-0.18	0.17	0.17	-0.16
10. Control	0.26*	-0.15	-0.34**	0.14

* $p < .05$, ** $p < .01$.

Results of a stepwise regression analysis examining family environment variables related to problem behaviors exhibited by boys indicated only one variable – Cohesion – was a statistically significant predictor of problem behaviors as measured by teacher ratings (see Table 5). Cohesion accounted for 17% of variance in problem behavior scores, $F(1, 57) = 11.08$, $p = .0015$, with Pearson correlation coefficients indicating an inverse relation between Cohesion and problem behavior. Children in families with higher levels of Cohesion had lower levels of problem behaviors according to their teachers than children in families with lower levels of Cohesion.

Table 5. Results of Stepwise Regression Analyses of Family Environment Subscales Scores on Problem Behaviors and Social Skills Scores: Boys and Girls

Gender	Criterion Variable	Step	Variable	Partial R^2	Model R^2	C(p)	<i>F</i> Value	<i>p</i> Value
Boys	Problem Behavior	1	Cohesion	0.1652	0.1652	0.0775	11.08	0.0015
	Social Skills	1	Intellectual-Cultural Orientation	0.1345	0.1345	12.91	8.70	0.0046
Girls	Problem Behavior	2	Cohesion	0.1688	0.3033	1.86	13.33	0.0006
			No variables entered the model					
	Social Skills	1	Active-Recreational Orientation	0.2043	0.2043	11.70	6.16	0.0205
		2	Intellectual-Cultural Orientation	0.2650	0.4692	2.48	11.48	0.0025

Social Skills

Initial inspection of correlation analyses indicated significant negative relations between social skills and Intellectual-Cultural Orientation ($-0.37, p = .0046$) and social skills and Control ($-0.34, p = .0090$) for boys. Also, there was a statically positive relation between social skills and Cohesion ($0.33, p = .0090$) for boys. Namely, teacher-ratings of social skills were significantly higher for boys living in family contexts characterized by lower levels of Intellectual-Cultural Orientation and Control (i.e., the degree to which the family has rules and procedures) as well as higher levels of Cohesion.

When examining the 10 family environment variables in a stepwise regression, two variables - Intellectual-Cultural Orientation and Cohesion – were statistically significant predictors of social skills as measured by teacher ratings, $F(2, 57) = 11.97, p < 0.0001$, accounting for 30% of the variance in social skills. Intellectual-Cultural Orientation accounted for 13% of variance in social skills scores, $F(1, 57) = 8.70, p = .0046$, and Cohesion accounted for an additional 17% of variance, $F(1, 57) = 13.33, p = .0006$ for boys. Pearson correlation coefficients indicated (a) an inverse relation between Intellectual-Cultural Orientation and social skills (-0.37) and (b) a positive relation between Cohesion and social skills (0.33). Boys in families with lower Intellectual-Cultural Orientation and higher levels of Cohesion had higher levels of social skills according to their teachers than children in families with higher Intellectual-Cultural Orientation and lower Cohesion scores.

3.2. To what extent do family environment variables predict problem behaviors and social skills exhibited by girls?

Problem Behavior

Initial inspection of correlation analyses indicated no statistically significant relations between problem behavior and any of the family environment variables. Correlation coefficients ranged from -0.38 (Active-Recreational Orientation, the extent to which the family participates in social and recreational activities [e.g., *Friends often come over for dinner or to visit.*] Scored if T.) to -0.05 (Cohesion) for girls (see Table 4).

Results of a stepwise regression analysis examining family environment variables related to problem behaviors exhibited by girls also indicated none of the family environment variables were statistically significant predictors of problem behaviors for girls as measured by teacher ratings (see Table 5).

Social Skills

Initial inspection of correlation analyses indicated significant positive relation between social skills and Active-Recreational Orientation ($0.45, p = .0205$) for girls. Namely, teacher-ratings of social skills were significantly higher for girls living in family contexts characterized by higher levels of Active-Recreational Orientation.

When examining the 10 family environment variables in a stepwise regression, two variables – Active-Recreational Orientation and Intellectual-Cultural Orientation – were statistically significant predictors of girls' social skills as measured by teacher ratings, $F(2, 25) = 10.17, p = 0.0007$, accounting for 47% of the variance in social skills. Active-Recreational Orientation accounted for 20% of variance in social skills scores, $F(1, 57) = 6.16, p = .0205$, and Intellectual-Cultural Orientation accounted for an additional 27% of

variance, $F(1, 57) = 11.48, p = .0025$. Pearson correlation coefficients indicated (a) a positive relation between Active-Recreational Orientation and social skills (0.45) and (b) an inverse relation between Intellectual-Cultural Orientation and social skills (-0.36) for girls. Girls in families with lower Intellectual-Cultural Orientation and higher levels of Active-Recreational Orientation had higher levels of social skills according to their teachers than girls in families with higher Intellectual-Cultural Orientation and lower Active-Recreational Orientation scores.

DISCUSSION

As we continue to support students who have risk factors for negative school and post school outcomes within a prevention framework, looking to family characteristics may provide needed information for assisting students at the earliest possible juncture when they are exhibiting soft signs of EBD in the primary grades when behaviors are more malleable and responsive to interventions (Walker et al., 2004). Our goals were to see if family environment influenced behavioral patterns at school compared to similar work in other contexts (Rana & Malhotra, 2005) and with other age groups for students in the US (Lucia & Breslau, 2006). First, we examined the extent to which young elementary-age boys and girls vary in their behavior problems and social skills from their teachers' perspectives. In our sample of 84 students in kindergarten, first, and second grades identified via systematic screening tools as showing soft signs of EBD, we found teachers perceived girls as having higher levels of problem behavior than boys. This finding suggests that in order for girls to be rated as meeting criteria for behavioral concern, they must exhibit behaviors to a greater degree than identified boys. Evidence would support this finding. For example, girls with EBD are more verbally than physically aggressive (Rana & Malhotra, 2005; Walker et al., 2004) resulting in fewer girls being identified with behavioral concerns (Cullinan, Osborne, & Epstein, 2004). Further, Rice, Merves, and Srsic (2008) found school-based professionals interpreted behavior problems of girls to be "less visible and more intense" and described girls as "acting more intensely when they are physical" (p. 560). In terms of social skills, however, there were no significant differences between the skill-sets as rated by teachers.

Second, we examined the degree to which children's family environments varied for girls and boys from their parents' perspectives. For students, there were no differences in the family environmental characteristics as rated by parents, indicating the home environments for students in this sample were similar. This is not surprising given that students were from seven schools located within close proximity, predominately White, and all having soft signs of EBD according to systematic screening tools. Further, a study examining the larger sample ($n = 134$) in terms of academic and socio-behavioral skill sets and patterns of change over time suggested that while individual differences were present, students in both locales were collectively similar in the early elementary grades (Lane et al., 2010).

Third, we examined the nature of the relation between family environment and socio-behavioral performance. The finding that boys with higher family Cohesion had fewer problem behaviors in school is consistent with findings of Rana and Malhotra (2005). Cohesion was also an important predictor of internalizing and attention difficulties for children in the Lucia and Breslau (2006) study; however, their findings were not examined

for differences by gender. This is an important question for future researchers to address. Boys' social skills, as rated by teachers, were positively associated with family cohesion. Families who help and support one another, have time for each other, and have feelings of togetherness had boys with higher teacher rated social skills. Results suggest family cohesion may serve as a protective factor for boys with soft signs of EBD. However, it is very important not to draw any causal conclusions from this descriptive study (Shavelson & Towne, 2002). Additional inquiry will be needed to examine causal relations and subsequently inform intervention efforts.

For young girls, there were no family characteristics associated with behavior problems that served as associated risk or protective factors for this sample. This finding was not consistent with findings of Rana and Malhotra (2005) with adolescent girls where families with high Expressiveness and Organization had girls with lower risk. It may be that expressiveness and organization serve as protective factors for girls as they get older when peer groups become more influential and girls with limited social skills may be rejected by peers or join deviant peer groups (Miller, Loeber, & Hipwell, 2010). Thus, girls with expressive families may learn communication skills that serve to buffer the risk related to peer rejection. In this sample, we found associations between families who were Active-Recreational orientated and girls who were rated as having more social skills. This finding suggests that socially-based activities are associated with improved social skills for young girls.

Interestingly, an Intellectual-Cultural Orientation was related to lower rates of social skills for both girls and boys. The items constituting this subscale tend to be individually oriented as opposed to the social environment of the items of the Active-Recreational subscale. This may suggest students benefit more in terms of building social skills when families offer opportunities for engaging in group social activities as opposed to individual solitary pursuits. Some evidence may be found in the research on the disappearance of play in pre-kindergarten classrooms (Nicolopou, 2010). This work posits that play is an important developmental practice where children have opportunities for cognitive development and social competencies (e.g., "cooperation, self-regulation, and interpersonal understanding"; p. 2). As many pre-kindergarten programs take on a stronger academic orientation, the presence of play in these settings is decreasing (Nicolopou, 2010). It may be that families who have higher Intellectual-Cultural Orientation look for early school experiences that are academically oriented rather than those that emphasize social skills acquisition. Although tentative, these findings raise interesting questions about the kinds of experiences that foster young children's positive behavior skills.

Limitations and Future Directions

As with all studies, there are limitations warranting consideration. First, although a widely used instrument in measuring family characteristics, the FES has less than optimal reliability (Boyd, Gullone, Needleman, & Burt, 1997). Although the third edition includes updated normative data, the reliability estimates remain below the generally acceptable level of .70 with only five of the 10 subscales meeting the acceptability criteria (Cohesion, Conflict, Intellectual-Cultural Orientation, Moral-Religious Orientation, Organization; Moos & Moos, 2002). When the reliability of a given measurement is limited, all findings –

including those here – must be interpreted with caution. Despite these issues with internal consistency, the FES is frequently used in research and there are few other instruments available for use. We encourage future research teams to consider developing more psychometrically rigorous instruments to assess comparable family context variables. One suggestion is to consider working within the current funding structure offered by the Institute of Education Sciences, focusing on Goal 5 measurement grants designed especially to support inquiry in to measures.

Second, the limited number of girls ($n = 26$) involved in this study raises concerns regarding the generalization of these findings. Before drawing definitive conclusions from this study, we encourage additional inquiry to confirm these findings before using this information to inform intervention efforts (Shavelson & Towne, 2002).

Third, due to the overall small sample size ($N = 84$) and the limited demographic data collected on teachers (e.g., years of experience, training in applied behavior analytics and classroom management, etc.) and parents (e.g., socio-economic status, parenting style), we were limited in the types of analyses and questions to be addressed. For example, some teachers rated more than one student in their classes; yet, we did not have sufficient sample size to address the nested nature of the data collected in this descriptive study. We encourage other research teams to explore other variables such as those noted here that may moderate or mediate the relation between family environment and socio-behavioral performance in the school setting.

Despite these limitations, we are cautiously optimistic about the findings of this study as we feel this information holds potential promise for clarifying and strengthening the importance of family factors when supporting students within the context of three-tiered models of prevention and the potential for augmenting schoolwide models with parent supports (Reinke, Splett, Robeson, & Offutt, 2009). Understanding risk and protective factors beyond those most frequently looked at (e.g. academic achievement) may provide school personnel with nuanced information that can help in decision making about strategies likely to be effective with particular children and families.

CONCLUSION

Family characteristics offer information for schools in planning supports for young students showing soft signs of EBD. Within a conceptual framework of risk and protective factors, schools can capitalize on family factors that provide protections for students with behavioral risk factors. Within school-based prevention models, parent supports and training can be offered as foundational activities that focus on the factors that offer protection for students such reducing coercive parenting styles that inhibit cohesive families, and increasing opportunities for and engaging families in school-sponsored active recreational activities (e.g., festivals, sporting activities, clubs). Further, it may be that risk, while stable through the elementary years (Lucia & Breslau, 2006), shifts as students enter adolescents. Therefore, monitoring social and behavior skill sets as students' progress into adolescents remains important for delivering interventions at the earliest onset of soft signs of EBD (Lane, Parks, Kalberg, & Carter, 2007). This paper offers an examination of the family characteristics of

students identified in the primary grades to aid in prevention and intervention efforts within schoolwide prevention models.

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Chapter 6

EVALUATION OF A TACTILE TRAINING FOR HANDWRITING ACQUISITION IN FRENCH KINDERGARTEN CHILDREN: A PILOT STUDY

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ABSTRACT

Handwriting is a complex activity involving perceptivo-motor, cognitive and linguistic skills. Handwriting acquisition is a slow and difficult process which requires several years of formal training for a correct mastering. In this context, we argued that there is a crucial interest in proposing new assessment methods to improve handwriting acquisition. Most of the scholar trainings for handwriting only utilize sensory visual and auditory abilities of young children (5-6 years old). Recently, we have shown that manual tactile exploration efficiently improves classical trainings in reading, handwriting, and geometry. The present work is a continuation of these studies, and aims at elaborating new trainings for handwriting acquisition. Importantly, we hypothesized that proposing exercises which aim at developing proactive motor strategies improve handwriting acquisition. Particularly we designed new handwriting exercises based on the use of a tactile tablet. This training included videos in which the writing production of each cursive letter is presented to the child. We found that this tactile training significantly improves the writing fluency in French preschoolers. Thus, in the line of our earlier studies, this pilot study tends to show that training exercises using tactile devices can be helpful for the acquisition of handwriting in kindergarten children.

Keywords: Handwriting acquisition; haptic; tactile interface

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INTRODUCTION

Handwriting is an essential cultural skill in our societies. Writing is the basis for a variety of productions, both at a scholar and at a professional level. However, its acquisition is a complex task which requires the coordination of cognitive, perceptive, motor, attentional and linguistic skills. Because handwriting influences other writing skills, like transcription and composing [Berninger et al., 1997; Bourdin & Fayol, 1994, 2000; Fayol & Miret, 2005; Graham, 1990; Jones & Christensen, 1999], and because handwriting problems do not disappear without specific intervention [Smits-Engelsman & van Galen, 1997], investigating teaching programs and their efficiency is of crucial interest. The goal of these interventions is to enable the child to acquire fast and legible handwriting, in order to make available attentional resources, which can be used for high writing processes [Kellogg, 2001; Olive, Favart, Beauvais, & Beauvais, 2009]. A large part of fundamental scholar teaching methods only mobilize visual and auditory sensory skills in 5-6 years old children. Researches performed in our laboratory in the past years have shown that adding haptic exploration to classic scholar trainings for reading, writing and geometry acquisition can improve their efficiency [Gentaz, 2009; Bara & Gentaz, 2011]. Following these results, we sought to elaborate new helpful pedagogical tools for the acquisition of handwriting which can be used by teachers in the classroom.

In adults, handwriting is a costless task in terms of attention and cognitive resources, due to the fact that the neuro-motor processes involved are widely automated. Working memory resources are indeed limited [Gavens & Camos, 2006], and the automation of handwriting thus frees up resources which can be used for linguistic aspects of writing. Moreover, handwriting is a complex activity involving perceptivo-motor, cognitive and linguistic skills, which requires years of practice before it is mastered completely [Blöte & Hamstra-Bletz, 1991; Viviani, 1994; Chartrel & Vinter, 2004; Vinter & Zesiger, 2007]. Writing can be studied at three different levels, depending on the size of units to be considered: letters, words, or texts [Vinter & Zesiger, 2008]. In our laboratory, we are essentially interested in the analysis of letters production, allowing the study of perceptive and motor aspects of writing. The study of words production gives insights into orthographic processes, while the study of texts production gives information about the processes involved in the elaboration and organization of a written text. These three levels are inter-dependant and influence each other. For instance, several studies pointed out the cognitive cost of the grapho-motor process and the interferences it induces on the construction and generation of texts. For example, it is easier for children to recall information and produce sentences orally than by writing [Bourdin & Fayol, 2000]. Likewise, text quality is higher when children dictate their production to someone else than when they write it themselves [Graham, 1990]. There is also a direct relationship between single letters writing and text production [Graham, Harris, & Fink, 2000].

The learning of handwriting begins in pre-school at the age of five. Children progressively learn to write their name in capitals, script and cursive letters, to copy simple words, and to write letters on a line and subsequently between two lines. The first training exercises consist in copying letters from models, a task which is very similar to drawing. In

the initial steps of writing acquisition, children build visual and motor representations of each letter which subsequently guide motor production [Bara & Gentaz, 2007, 2010; Zesiger, 1995]. For example, it has been shown that first, third and fifth-grade Japanese children better recalled pseudologographic or foreign letters when learned by writing rather than by looking only [Naka, 1998]. Reinforcing the link between perceptive and motor skills would improve letters memorisation and may also contribute to the understanding of the alphabetic system in young children [Longcamp, Zerbato-Poudou & Velay, 2005].

Writing acquisition is also intimately related to the acquisition of reading [Dehaene, Dehaene-Lambert, Gentaz, Sprenger-Charolles, & Huron, 2011]. The initial steps of both reading and writing acquisition are based on common knowledge and processes, such as the knowledge of the alphabetic system. Multisensory teaching methods are based on the strong relationship between writing and reading and hypothesize that reinforcing this link would enhance reading skills in children [Gentaz, 2009]. In other words, the features relating to the motor programs (evaluated for example by the writing speed of single letters) would be related to the features of written texts generation, thus underlying the importance for children to acquire a fluent and automatic writing (i.e. rapid, without pauses, and with the minimum pen strokes). In the following, we will examine the development of letters writing during acquisition in children, the two main causes of progression, and the contribution of haptic and tactile interfaces and multisensory trainings in handwriting acquisition.

THE DEVELOPMENT OF LETTERS HANDWRITING

Letters writing is controlled by the rules of motor production [Goodnow, Friedman, Bernbaum & Lehman, 1973]. Young children generally use the same rules of motor production to write their first letters as those used in drawing. Drawing production rules influence writing, and writing acquisition subsequently changes these rules. In French, young children do not spontaneously use the correct anti-clockwise rotation sense for the production of cursive letters, most likely because this gesture imposes strong motor constraints. Indeed, it is only by the age of 3-4 that children can produce circles in both senses with each hand [Lurçat, 1974]. This particular skill would be a pre-requisite for handwriting acquisition, but changing certain rules such as the sense of rotation is a difficult task which requires an intensive training for young children.

As writing acquisition progresses, both quantitative (speed, size) and qualitative differences arise. This is due not only to training, but also to the maturation of the motor system which allows children to execute fine motor movements. The evolution of handwriting with age concerns both static (form, size, spatial organization of letters, etc) and kinematic aspects (total writing time, speed, etc). Between the ages of 7 and 10, a global progression of static and dynamic indexes is observed, in particular with a progressive decrease in letter size, in total writing time, and in the number and duration of pauses during writing. The intra-individual variability also tends to decrease. In parallel, a strong increase in writing speed is observed. Beyond 10 years old, changes become minor and mostly reflect an increase in movement automation and in writing fluency.

FACTORS OF PROGRESSION

In cognitive psychology, two modes of movement control are classically considered: A closed-loop control (retroactive) and an open-loop control (proactive) [Zesiger, 1995]. In the first mode, a motor track stored in long-term memory drives the starting of movement, which is then adjusted in real time thanks to sensori-motor feedbacks. This mode of control thus applies to movements long enough to allow such modifications (i.e., greater than 100 ms). In contrast, the open-loop control mode applies to very rapid movements, and suggests that movements are entirely driven by automated programs without any reference to sensory signs. In reality, the mode of control of movements is never exclusive but integrates both motor feedbacks and programs, whose respective contribution depends on the movement to be executed and on the executor expertise [Desmurget & Grafton, 2000, Zesiger, 1995].

In the first steps of acquisition, the mode of movement control would be essentially retroactive. During writing, children use the sensory (visual and kinesthetic) feedbacks generated by their own movements [Zesiger, 1995]. As learning progresses, the automation of movement increases, and the mode of movement control would become primarily proactive: Children do not use sensory feedbacks anymore but essentially motor programs. Thus, the changes in both static and kinematic aspects of writing observed during acquisition would be due to a switch from retroactive to proactive control strategy.

The absence of visual feedback during handwriting has greater consequences in younger children than in older children or in adults. In the absence of visual feedback, the duration of movement and the "dysfluency" (i.e. number of acceleration and deceleration peaks) increase [Chartrel & Vinter, 2006]. The most important differences between "with" and "without feedback" are observed in 8 and 9 years old children. In the absence of visual feedback, children tend to maximize kinesthetic information to increase letter size. These feedbacks may contribute to the building of internal representations of movements.

The size of the motor program unit seems to evolve during writing acquisition. Using a sentence copy task, Prêteur & Telleria-Jauregui (1986) analyzed the evolution of the number of sequences written without looking at the model in first-grade children. They found that the size of units that children transcribed without looking at the model increased over the year. At the beginning, children only copied isolated letters without the model, while at the end of the year they became able to copy words. The acquisition of handwriting would thus correlate with an increase in the size of motor program units.

To sum up, the quality and speed of handwriting thus increase progressively with age, but quality tends to reach a steady-state level beyond 3rd-grade. Handwriting acquisition involves (i) the elaboration of more and more sophisticated motor programs, (ii) a progressive shift from a retroactive to a proactive control of movements, and (iii) an increase in the size of motor program units.

HOW CHILDREN LEARN TO WRITE LETTERS

The aim of intervention methods for handwriting teaching is to help in the automation of motor movements by proposing different kind of specific exercises [Bara, Gentaz, & Colé, 2004]. Certain graphic activities, such as circles and downstrokes drawing, seem to efficiently

prepare children to further handwriting acquisition. Indeed, the quality of the letters produced by kindergarten children who received this type of training is significantly improved in comparison to a control group [Smits-Engelman, Niemeijer, & van Galen, 2001]. A main objective in handwriting teaching is to show how to reproduce letters according to a "model". Children must be able to perceive not only the shape of the model, but also the deviation of their own production relative to the model. Self-instruction methods for handwriting acquisition are based upon a systematic evaluation of his/her productions after each exercise: Each letter or pair of letters is produced several times and the child has to choose the best productions [Jongmans, Linthorst-Bakker, Westenberg, & Smits-Engelman, 2003]. This type of training seems to improve especially the quality of handwriting, but not kinematics of handwriting movement.

A visual presentation of letters combined with verbal instructions for their production seems to improve handwriting quality in children more efficiently than visual presentation alone [Kirk, 1981; Berninger et al., 1997]. These results suggest that the ability of children to perceive letter form is crucial for the development of handwriting. The perception and memorisation of letter form would constitute the first steps in handwriting acquisition. More recently, we have shown in our laboratory that the visuo-haptic exploration of relief letters in handwriting trainings significantly improves the identification of letters and the quality of handwritten letters in 5-6 years old children when compared to visual training [Bara & Gentaz, 2011].

THE CONTRIBUTION OF A VISUO-HAPTIC INTERFACE IN HANDWRITING ACQUISITION

In a previous study, we used an original visuo-haptic–kinesthetic training program with a record-and-playback technique to improve handwriting in first-grade children [Palluel-Germain et al., 2007]. Unlike traditional interfaces providing visual and auditory information, haptic interfaces generate mechanical signals that stimulate human kinesthetic and touch channels [for a review see Hayward et al., 2004]. Thus, as a promising technological development, haptic interface guidance has been widely used for handwriting learning. For example, Henmi et al. (1998) designed a Japanese calligraphy system using a record-and-playback strategy: The authors recorded positions and forces applied by a human teacher and displayed them to the students. We can notice that this training technique is different from the haptic guidances-control in force in which the force felt by the user at time t does the same as the force existing for the theoretical trajectory at the same time [Bluteau et al., 2008; Srimathveeravalli et al., 2005].

We have developed an original ergonomic visuo-haptic interface named Telemaque [Hennion, Gentaz, Gouagout & Bara, 2005]. The basic device is a force-feedback programmable pen. This interface is used to teach children how to reproduce a letter according to a standard that is not only static (correct shape) but also dynamic (rules of motor production). The kinematics applied to Telemaque was built according to the rules of motor production described by Lacquaniti, Terzuolo, and Viviani (1983): (1) There is a proportional and direct relationship, called isochrony, between the trajectory length and movement velocity (whatever the size of a letter, the time taken to write it remains constant); (2)

Handwritten letters keep their spatial characteristics even if the size of the letter changes (the shape remains the same whatever the size); (3) Shape determines the movement dynamic, called the two-thirds power law. We propose to use this interface for improving handwriting in young children. As said before, we have shown that incorporating the visuo-haptic and haptic exploration of letters in a training designed to develop children's understanding of the alphabetic principle makes easier the connections between the orthographic representation of letters and the phonological representation of the corresponding sounds, thus improving the decoding skills of young children. Thus, we assumed that a multisensory training using Telemaque could be suitable for the acquisition of handwriting. More precisely, this program could effectively act on problems of handwriting distortion, including incorrect letter forms, disconnected letters, wavy lines, lack of loops, touched-up letters, irregular letter shapes, and incorrect size proportions among letters. To test this assumption we have tested kindergarten children to show that incorporating such device in learning may increase the fluency of handwriting production of cursive letters in children.

Forty-two 5 year-old children were assigned to an intervention involving either Telemaque (experimental training; VH group) or not (control training; C group). First in a pre-training session we asked them to copy six cursive letters (*a, b, f, i, l, s*) on a digital tablet (Wacom®). Then we have calculated for each letter production the mean movement velocity, the number of velocity peaks and the number of breaks during execution. Indeed, the main temporal and spatial features that differentiate the handwriting process of poor writers from proficient writers include movement velocity, pauses at greater frequencies and a lack of continuity and fluency. Then in the training session, two equivalent groups of children were formed and followed during six weeks (one letter per week) a learning intervention in which a specific letter was trained. In each session, they were asked to perform four exercises: two basic exercises (to colour the target letter and to make a 4-piece jigsaw puzzle that represented the target letter) and two exercises specific to each intervention (control vs. visuohaptic intervention).

In the visuohaptic intervention, children were asked to hold a pen attached to a force-feedback arm (Phantom®) and were seated in front of a table upon which the letters generated by the visuo-haptic interface were displayed on a horizontal computer screen. Then each child performed two exercises generated by Telemaque: The circuit game and the dynamical tracing of letters. The circuit game was focused on the correct order of a letter production. In this exercise, a letter appeared with two borders representing a road on the computer screen. Children were asked to draw a line between the two borders. Importantly, a force generated by Telemaque attracted the pen on the correct direction if the child veered off the correct trajectory or did not produce the letter in a correct order. This force was progressively reduced during the exercise. In the dynamical tracing of letter, children held the pen, a letter appeared on the video screen and the pen moved “alone”. The dynamical font was used here to drive the pen at the right place in the right time in a natural way: The movement generated by Telemaque followed the basic principles of writing production i.e., isochrony principle and the two-thirds power law. In the Control intervention, children were first asked to copy the target letter ten times on a sheet of paper. In the second exercise, children had to type on text software a sentence in which the target letter appeared frequently.

The results indicated that the fluency of handwriting production was improved after the Visuohaptic intervention. The average velocity improved after intervention, the movements exhibited less velocity peaks and children lifted the pen less often during the execution.

Consequently, movements executed after a training involving Telemaque were more fluent. We conclude that the use of Telemaque may help the motor system to incorporate the basic rules of motor production and therefore leads children to use proactive strategy to control handwriting movements.

THE CONTRIBUTION OF TACTILE INTERFACES IN HANDWRITING ACQUISITION: A PILOT STUDY

Despite their obvious contribution in handwriting acquisition, haptic interfaces cannot be widely used by teachers in schools due to their elevated cost. Thus, we decided to elaborate new visuo-haptic trainings based on touchpad technology. The device consisted in a horizontal computer screen on which children directly perform writing exercises with a special pen. Furthermore, the exercises we have developed include videos showing how to trace each letter. An important point is that our exercises can be adapted to the individual skills and scholar level of each child. Finally, our system enables to record the kinematics of children movements for a subsequent analysis. We thus generated writing exercises similar to those used with the Telemaque haptic interface [Palluel-Germain et al., 2007], and evaluated the contribution of these ecological tactile trainings in handwriting acquisition in kindergarten children.

METHOD

Participants

Forty-nine kindergarten children from Grenoble suburban schools were separated in two groups which were equivalent in terms of pre-training handwriting performances. The first group of 29 children (16 boys; $M_{age} = 5.5$, $SD_{age} = 0.17$) was trained with the haptic device. We will refer to this group as the Trained group. The second group of 20 children (9 boys; $M_{age} = 5.58$, $SD_{age} = 0.25$) performed the same exercises on a paper sheet, i.e. without tutorial videos. This group also used the computer for interactive games, so that both groups spent an equivalent time on the computer. This group will be referred to as the Control group.

The present study was conducted in accordance with the Declaration of Helsinki. It was approved by the laboratory LPNC ethics committee. It was conducted with the understanding and written consent of each child's parent and in accordance with the ethics convention between the academic organization (LPNC-CNRS) and educational organizations.

Apparatus and Procedure

The tactile device was a Wacom Cintiq© tablet (Figure 1). It was inserted in a wood board placed on the table, so that the working surface remains smooth. Children were seated comfortably in front of the table.

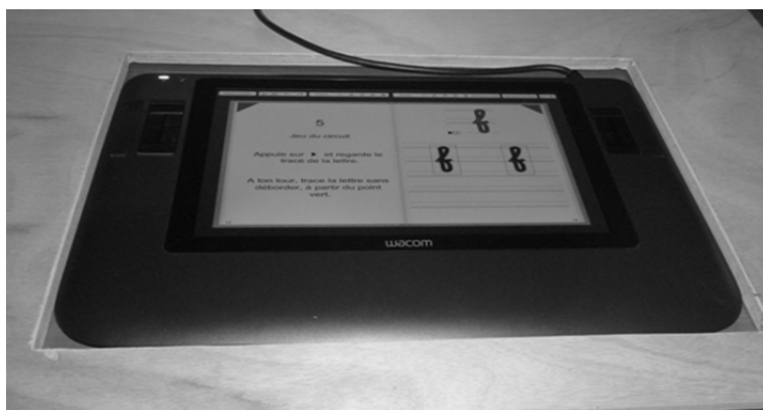


Figure 1. View of the tactile interface.

The virtual exercise books were generated with the freeware Didapages© (<http://www.didasystem.com/>). Two types of copy exercises were generated. In the first exercise, an underlying model with a thick letter was presented, and children have to reproduce the letter without extending beyond the underlying model (Figure 2A). In the second exercise, the target letter was shown and children have to reproduce it just after its presentation without an underlying model (Figure 2B). In the two exercises, videos showing the how to correctly perform the exercise were presented, and the starting point for writing was provided (Figure 2). For each trained letter, the two exercises were proposed consecutively.

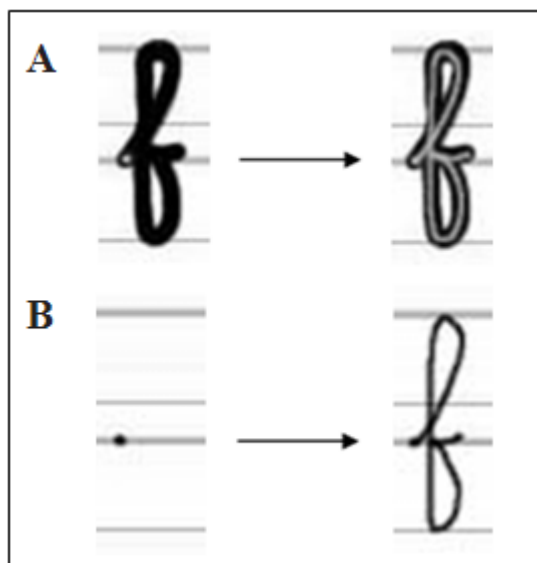


Figure 2. Two types of exercises performed by children. (A) The child has to reproduce the letter from the starting point (grey), without extending from the underlying model (thick black letter). (B) The child has to reproduce the letter from the starting point, without underlying model.

The trained letters were chosen in agreement with the teachers: e, f, m, n, p. The children received six training sessions, with one session per week.

Pre- and Post Tests

Children were individually assessed in order to measure their handwriting performances immediately before, a few days after, and two months after the end of the training session. Children handwriting was evaluated on the basis of a random dictation of both trained and non-trained letters. The dictations were performed on a paper sheet placed on a Wacom© Intuos 3 A5 USB graphic tablet and with a ball-point pen (Intuos Ink Pen, Wacom©). In this measuring system, the positions of the pen were sampled at a frequency of 50 Hz and at a spatial resolution of about 0.1 mm. Each test lasted approximately 15 minutes. Each letter was then analyzed using software developed in our laboratory [Bluteau, Hillairet de Boisferon, & Gentaz, 2010; Jolly, Huron, Albaret, & Gentaz, 2010]. This software calculates ten kinematic parameters which reflect the fluency of writing: (1) 'nb strokes' corresponds to the number of pen strokes which constitute the letter; (2) 'in-air time' corresponds to the total time (in seconds) during which the pen is not in contact with the tablet; (3) 'nb peaks' corresponds to the number of velocity peaks. The measure of this parameter requires prior filtration of raw data with an order 3 Butterworth filter at a seizure frequency of 8 Hz (Butterworth, 1930); (4) 'nb static moments' corresponds to the number of static moments, i.e. periods during which the distance is null; (5) 'nb slow mvts' corresponds to the number of slow movements, i.e. groups of static moments of under 150 ms, between which the distance is less than 0.1 cm; (6) 'nb pauses' corresponds to the number of pauses, i.e. periods of over 150 ms during which the distance is null; (7) 'length' corresponds to the total length of the track in cm; (8) 'time' corresponds to the total writing time in sec; (9) 'speed' is the mean speed in cm/sec (length/time ratio), and (10) 'pressure' corresponds to the mean downward pressure of the pen on the tablet.

Mean values and standard deviations were calculated for each letter and each parameter for the two control groups. A Student test was used to compare the results between the groups before training, and ANOVAs were used to compare the results between groups before and after training. For each kinematic parameters, we conducted a one-way ANOVA with the parameter as within-subject factor, and the group (control or trained) as dependent variable.

RESULTS

We first checked that the handwritten productions of the two groups were equivalent before training. A Student test comparison of their respective productions showed no significant differences between the two groups in the various kinematic parameters for the five trained letters (all $p > .05$, data not shown).

In Figure 3 are shown samples of letters produced by children from both groups before and after training. The progression of writing before and after training was then evaluated for the two groups as follows. For each kinematic parameter, the difference between the pre-test and post-test mean values was calculated for each trained letter, and compared between the two groups by a one-way ANOVA with the parameter as within-subject factor and the group as dependent variable. In order to improve the legibility of the manuscript, the results of the statistical analyses related to the effects of training on the kinematic parameters of children

handwritten productions have been reported in Table 1 (effects observed immediately after the end of training) and Table 2 (effects observed 2 months after the end of training).

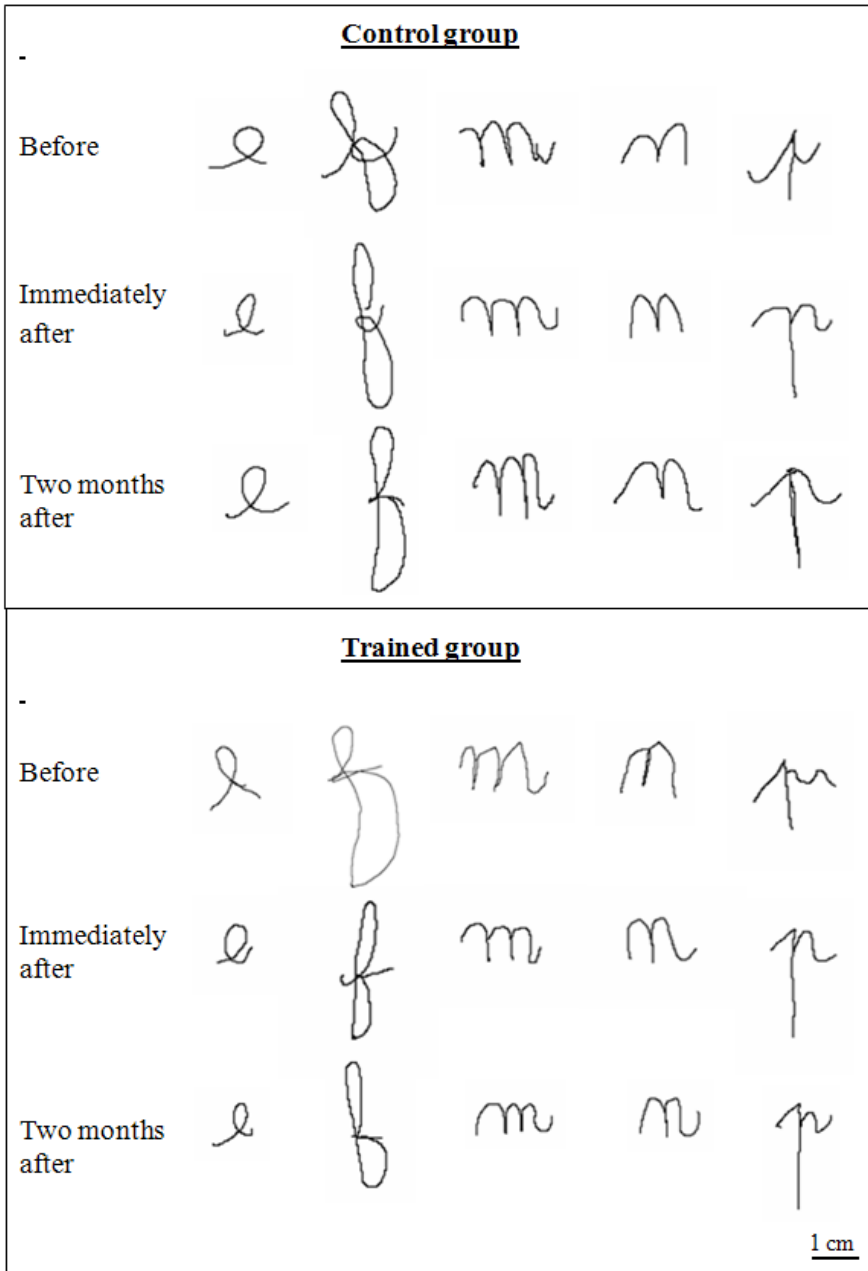


Figure 3. Examples of letters produced by five different randomly chosen children from the control and the trained group. The letters shown here were produced before (top), immediately after (middle), or two months after the end of training (bottom).

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Table 1. Summary of the main results of ANOVAs related to the effects of training on the kinematic parameters of children handwritten productions observed immediately after the end of training

	Control group		Trained group		F(1, 8)	p	η^2_p
	M	SD	M	SD			
In-air time (sec)	-0.01	0.3	-0.55	0.29	8.59	.02	.52
Total time (sec)	0.38	0.67	-0.77	0.4	10.88	.01	.58
Speed (cm/sec)	-0.11	0.08	0.34	0.2	21.45	< .002	.73
Nb static moments	-3.92	1.28	-5.77	1.26	5.33	< .05	.4
Pressure	326.43	46.12	242.55	40.23	9.39	< .02	.54

As shown in Table 1, significant differences between the control and the trained groups ($p < .05$) were observed immediately after the end of training for five parameters: The 'in-air' time, the total writing time, the mean speed, the number of static moments, and the mean pressure. For instance, a significant decrease in the 'in-air' time was observed in the group of children trained with the tactile interface but not in the control. Likewise, a decrease in the total writing time was observed in the trained group whereas this parameter tended to increase in the control group. The mean speed was increased in the trained group whereas it tended to decrease in the control group. Moreover, a greater decrease in the number of static moments was observed for the trained group compared to the control group. Inversely, a significantly lower increase in the mean pressure was observed for the trained group compared to the control group.

Table 2. Summary of the main results of ANOVAs related to the effects of training on the kinematic parameters of children handwritten productions observed two months after the end of training

	Control group		Trained group		F(1, 8)	p	η^2_p
	M	SD	M	SD			
In-air time (sec)	1.72	1.08	0.07	0.27	11.01	.01	.58
Distance (cm)	0.11	0.26	-1.92	0.78	30.38	< .001	.79

Interestingly, we also observed a persistence of progress for some kinematic parameters two months after the end of training in the trained group. As shown in Table 2, the 'in-air' time did not change in trained children while it increased in the control group. In addition, a decrease in the distance (i.e. letters' size) was observed for the trained group whereas this parameter was slightly increased in the control group.

CONCLUSION

In the present study, we evaluated the effects of virtual training exercises based on the use of touchpad on the acquisition of five cursive letters handwriting in kindergarten children. Altogether, our results reveal a greater improvement in writing fluency in children trained

with the tactile interface in comparison to children trained with conventional exercises (i.e. on paper). In particular, the decrease in the 'in-air' time and in the number of static moments clearly reflects an increased fluency in writing. It is also worth noting that the total time and the mean speed inversely evolve in the two groups after training. For instance, the total writing time increased in the control group while it clearly decreases in the trained group. Likewise, the mean writing speed decreases in the control group whereas it increases in the trained group. Since the written productions were equivalent for the two groups before training, our results thus clearly show that training with the tactile device has a beneficial effect on the acquisition of cursive letters handwriting in kindergarten children. The present results are in the line of our previous results, which show an improved fluency of handwriting production in children after the Visuohaptic Telemaque intervention [Palluel-Germain et al., 2007]. We propose that the use of our tactile device, similarly to Telemaque, may help the motor system to incorporate the basic rules of motor production.

How can we explain the observed effects of training with the tactile interface on handwriting acquisition? Following our initial hypothesis, we propose that these effects are due to the dynamic component of the exercises, i.e. the videos showing how to trace each letter. Indeed, the main difference between the exercises performed by the two groups was the videos. In the classroom, teachers can only show a limited number of times how to trace a letter, and when children perform training exercises on a paper sheet, they usually have only a static model of the letter to trace. In addition, the black board where teachers show how to trace a letter is sometimes far from the children, whereas the videos we proposed are within a working distance from the children, thus attracting their attention. However, it is also possible that the attractiveness of the computer merely favoured a greater active participation of children in the proposed writing task, resulting in better handwritten productions. This hypothesis seems unlikely since the post-training dictation task used to evaluate children handwriting was performed on a paper sheet. In addition, children from the control group also spent an equivalent time on the computer with interactive games. However, in order to totally exclude the possibility that the beneficial effects observed are due to the attractiveness of the device, it would be important in a future study that children from the control group also perform training exercises on the tactile device, but without videos.

The technology used here for handwriting training is of particular interest since it is affordable for schools and teachers. However, it requires the use of a computer and thus some computer skills from the teachers. The recent development and wide spread of touchpad devices offers a new support for handwriting training exercises. It would be interesting to develop this type of training on such devices, which are even more affordable for schools and of easier use for teachers.

It would also be interesting to test the effects of tactile training exercises on the acquisition of number writing. In particular, kindergarten children usually experience a normal period of mirror writing during the acquisition of both letters and numbers writing [Cornell, 1985; Della Sala & Cubelli, 2007; Schott, 1999, 2007; Pegado, Nakamura, Cohen, & Dehaene, 2011], and it may be interesting to evaluate the contribution of exercises including demo videos on the production of mirror numbers. Finally, testing whether trainings with a tactile interface could be beneficial to older children presenting dysgraphic troubles would also be relevant [Jolly et al., 2010; Huron, 2011].

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Chapter 7

**ASSESSING PERSONALITY TRAITS IN THE YOUNG
CHILD FOR INDIVIDUALIZED PLANNING
FOR SOCIAL-EMOTIONAL SKILLS
IN THE KINDERGARTEN CLASSROOM**

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ABSTRACT

The kindergarten years are important in giving children a basic foundation for social and academic skills. Kindergarten teachers are finding that children entering this year have increasingly challenging behaviors that inhibit their ability to learn and interact with their peers and adults appropriately. Innate personality traits identified during the preschool years can help teachers to intervene and modify instruction in order to help children with challenging behaviors better socialize with their classmates and learn the necessary academic skills during this important year. The following chapter summarizes and reviews research about the M5-35 Preschool Personality Scale which has been used to identify innate personality characteristics in young children, particularly preschoolers (Grist, Socha, & McCord, 2012). The chapter will focus on several studies that have been conducted in the area of the preschool personality.

Once traits have been identified, teachers can use the information to intervene with children with challenging behaviors in the classroom. Activities and routines can be modified according to personality traits in order to ease challenging behaviors.

INTRODUCTION

The growing demands of kindergarten with high stakes testing, No Child Left Behind and now Race to the Top are increasing pressure on administrators, teachers and young children who begin kindergarten each year. The demands for academic skills in the kindergarten year press the need for children to come to school ready to learn.

Children need to be ready socially and emotionally to have a good foundation for learning. Kindergarten teachers have a unique opportunity to begin working with children in the early years to either strengthen social-emotional skills already learned by a child or to work with children that may be experiencing issues with social-emotional issues.

Personality assessment is one way to start the process to get know children in the classroom individually. The next step is to help children that may be having issues with challenging behaviors in the classroom by looking through the lens of personality traits and to begin individualizing intervention for a child with challenging behaviors.

INDIVIDUAL DIFFERENCES

Many researchers agree that children do in fact have individual differences which are manifested in the behaviors they exhibit (Buss & Plomin, 1984; Diener, 2000; Shiner & Caspi, 2003;). Over the last 5 to 10 years, the topic of challenging behaviors has become popular among early childhood educators, particularly as more children seem to have these issues in the classroom. Often challenging behaviors are ameliorated by strategies that are used to stop the behavior at the moment rather than changing the behavior the child will exhibit in a similar situation the next time. Research addressing personality traits in young children may be the key in helping early childhood providers develop plans and create strategies that are more comprehensive in nature in reducing a child's challenging behavior.

FIVE-FACTOR PERSONALITY THEORY IN PRESCHOOLERS

When looking at the historical perspective of how preschool personality has been viewed in the past, theories of temperament have been applied to traits of children in the early years. Early theorist used temperamental traits to describe young children and older children and adults were described as having personality characteristics (Buss & Plomin, 1975; Strelau, 1987; Thomas & Chess, 1977). Adult personality has a strong foundation in the Five Factor Theory (FFT) and this theory has been applied to adolescents and elementary children (Goldberg, 2001; Costa & McCrae, 1995). Researchers now are using the FFT as a way to explain preschool traits and characteristics. The FFT has been described as subsuming temperamental traits rather than temperament and personality coexisting or personality developing after temperament in individual children (De Pauw, Mervielde, & Van Leeuwen, 2009; Digman, 1990; Grist, & McCord, 2010; Mervielde, & De Fruyt, 2002).

The Five Factor Theory of personality consists of 5 core personality traits which consist of the following: Extraversion, Agreeableness, Conscientiousness, Neuroticism and Openness. Each of these scales are typically described within the context of adults, adolescents and elementary children but when we start to describe these behaviors in preschool children, we start to see some differences due to their age.

Extraversion and introversion can be seen on a continuum in young children. A child who exhibits many of the characteristics of extroversion can be described as a young child who radiates joy, is always on the go, has fun, laughs aloud, and likes to amuse his/her friends. A

child who is introverted or has more of these characteristics will be less likely to show joy, laugh aloud and less willing to amuse his/her friends. Those children who show many of the traits of Agreeableness can be described as easy to satisfy, telling the truth, doing what is asked of him/her, and thinking before acting. Moreover, a young child who shows characteristics of low Agreeableness will be more likely to insult and get back at others, mess things up and be more demanding as well as be more likely to break the rules and figure out how to get around the rules.

The young child who has many of the Conscientious traits will complete tasks successfully, solve complex problems, try to excel at what he/she does, work hard, understand things, help others, start tasks easily, be able to see the consequences of things and finish what he/she starts. Young children who are low in Conscientiousness will have difficulty completing tasks and finishing what they start. They are less interested in helping others, and often do not see the consequences of their behavior.

Children in the early years who are high in Neuroticism will exhibit traits in the following ways: worry about things, will be afraid of many things, become overwhelmed by events, have difficulty relaxing most of the time, get upset easily, get stressed out easily, and have difficulty adapting to new situations.

Children who score low in Neuroticism will be less likely to get stressed out and upset easily over situations. This child characteristically will be more relaxed and can adapt to new situations easily, they are also less likely to become overwhelmed by events and worry about things.

Openness is characterized in young children has having a vivid imagination, interested in many things, and likes to begin new things while children who are low in this trait will have more narrow interest and have difficulty beginning new things. (Grist, Socha, & McCord, 2012). (See Table 1.)

Grist, Socha, and McCord (2012) researched 621 preschooler's traits and found preschoolers traits to be valid and reliable for the FFT of traits for Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness. This study was designed to produce a short reliable and valid personality measure for preschool children based on the FFT. Teachers completed the 90 item questionnaire for each child who spent a substantial amount of time in their care.

Exploratory and confirmatory factor analyses were the procedures used in this study to determine scale refinement. These researchers began with a 90 item preschool personality scale and found 35 of the items to be reliable for each of the FFT traits mentioned above. The 35 item questionnaire resulted in an improvement in discriminate validity over the 90 item questionnaire (Grist, Socha, & McCord, 2012).

Other researchers, Deal et al. (2007) studied personality in preschool children initially using a long form of the Inventory of Children's Individual Differences form (ICID) developed by Halverson et al. (2003). The goal of the study was to develop a shorter form consisting of 45 items. The research consisted of taking the ICID which was a 108 item inventory and developing a shorter version of the instrument with only 50 items while still maintaining the same levels of validity and reliability. Descriptions from 903 parents about their children were collected and a majority of the participants were mothers from the middleclass.

Table 1. M5-PS-35 Personality Traits and Descriptions

Trait	Description
Extraversion	Radiates joy, always on the go, has fun, laughs aloud, likes to amuse his/her friends
Introversion	Less likely to show joy, slower in movement, less likely to laugh aloud, less likely to amuse his/her friends
Agreeableness	Easy to satisfy, tells the truth, does what is asked of he/she, thinks before acting
Low Agreeableness	More likely to insult and get back at others, mess things up and be more demanding, breaks the rules, figures out how to get around the rules
Conscientiousness	Completes tasks successfully, solves complex problems, excels at what he/she does, works hard, understands things, likes to help others, starts tasks easily, sees the consequences of things, finishes what he or she starts
Low Conscientiousness	Difficulty completing tasks, less interested in helping others, difficulty in finishing what he/she starts, often does not see the consequences of his/her behavior
Neuroticism	Worries about things, afraid of many things, becomes overwhelmed by new events, difficulty relaxing, gets stressed out easily, difficulty adapting to new situations
Low Neuroticism	Relaxed, adapts easily to new situations, less likely to become overwhelmed by new events, worries little, not afraid of much, less likely to get upset
Openness	Vivid imagination, interested in many things, likes to begin new things and activities
Low Openness	Less likely to be interested in new things and trying new things and activities

Grist, Socha, & McCord, 2012.

One study consisted of parental free descriptions in which the FFT framework was the underlying premise (Mervielde & De Fruyt, 2002). In this study, 9,000 free descriptions were collected from parents based on their children. These descriptions led to development of the Hierarchical Personality Inventory for children (HiPIC). The HiPIC is a taxonomy which assesses 18 facets that are organized into 5 higher order dimensions: Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness. Within each higher order dimension, there are several facets (i.e. Openness is related to the sub dimension of imagination and benevolence is strongly related to the higher level deminsion of Agreeableness).

Using the HiPIC, the measure created by Mervielde and De Fruyt (2002) De Pauw, Mervielde, and Van Leeuwen (2009) researched how the traits of the FFT related to problem behaviors in early childhood. 443 preschool children were used to evaluate the relationship between three temperament models, the five-factor model and how the traits from all of these models related to young children's behavior problems. Traits reflected by temperament models included: Thomas and Chess (1977); Buss and Plomin, (1975); and the Rothbart Model (Rothbart & Bates, 2006). The FFT used in this research was Mervielde and De Fruyt, (2002). Finally, problematic behaviors were assessed with the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2000). Joint factor analysis was the procedure used resulting in six factors. Four of the factors resembled factors in the five factor theory and a sixth factor which was labeled Activity was a sub domain of one of the five factors: Extraversion. Problem related scores on the CBCL were then regressed onto groups of scales corresponding to the three temperament models, the FFT Model and the newly produced six-factor model.

The combination of the six-factor scales increased the variance to a significant level for all of the scales.

Assessment in the area of preschool personality facilitates teachers and parents in the ability to be able to individualize intervention when working with children with challenging behaviors. Viewing challenging behaviors through the lens of personality based on the framework of the Five Factor Theory can be one of the first steps in prevention for a teacher or provider working with children in the classroom.

CHALLENGING BEHAVIORS IN THE KINDERGARTEN CLASSROOM

While young children grow and change rapidly, personality based intervention can help teachers to formulate planning and instructional strategies with a solid foundation rather than trying interventions that may be trial and error, as personality can be one stable factor in the equation. The method of trial and error can be detrimental to the child, teacher and other children in the classroom when it does not work as it is often time consuming and tiresome for everyone involved. In the process, the child that is the target of the intervention as well as the other children in the classroom can begin to pick up behaviors that may be unwanted.

There is a growing body of research showing that traits play a part in maladaptive behavior in children and adolescents. Traits found in the FFT seem to provide stability and can be the basis of etiology in some childhood disorders. A model proposed by Mervielde et al. (2005, 2006), maintains that Neuroticism/Emotionality and Extraversion are the major correlates of internalizing challenging behaviors. Agreeableness and Conscientiousness are correlated with externalizing challenging behavior.

When looking more specifically at the traits of the five factor theory and how they apply to behavior in general, researchers agree that Neuroticism can be a predictor of Internalizing behaviors in individuals which can become an issue in a classroom setting (Clark, Watson, & Mineka, 1994; De Pauw & Mervielde, 2010). Those individuals who score high on anxiety and fearfulness which are sub facets of Neuroticism are often the individuals with Anxiety disorder. However, there are many children and adults without disorders that may tend to score higher such as anxiety and fearfulness and it may not necessarily be maladaptive or lead to a challenging behavior but is needed on a daily basis in order for that individual to stay motivated and regulated to some degree. Low Agreeableness and Low Conscientiousness have been correlated to Externalizing behaviors which can lead to characteristics of ADHD, and proactive and reactive antisocial behavior (De Pauw & Mervielde, 2010). Traits that are present in early childhood can manifest into challenging behaviors if not redirected and can continue into full blown psychopathology in adulthood or sooner. The importance of intervening in the early childhood years by teachers and parents is one way to redirect how a child interacts with others and responds to the environment in positive ways.

PERSONALITY TRAITS AND THE KINDERGARTEN EXPERIENCE

The school experience is often the first time that a child may be recognized as having challenging behaviors. Parents may not have experienced their child as having challenging

behaviors until the first few weeks of school. More specifically, kindergarten can be the first time that a child has had to follow rules and a routine. Thus, the environment can be more difficult for a child which can contribute to the challenging behavior. Kindergarten is also important for setting a solid foundation in social-emotional skills in order to be academically successfully, socially accepted and in the future productive adults (Olweus, 1991; Reid, 1993; Dishion, French, & Patterson, 1995).

The growing demands of kindergarten are evident across the country as No Child Left Behind has been in place as well as high stakes testing. Where kindergarten use to be a place of learning social skills through child-centered activities, it is now a place where children are expected to learn more information, faster, all while sitting for longer periods of time (Abbot, 2011; Curwood, 2007; Hatch, 2002; Moore, 2012). With these circumstances in play, some children will not have the social-emotional abilities to cope. It takes extra effort on the part of teachers and school administration to provide support for each child to have a successful first school year. Early childhood personality can facilitate the first steps of developing intervention for a child with challenging behaviors. If we know that a child has high or low traits in one domain we can begin to develop strategies for a child to facilitate their transition to positive outcomes.

Extraversion. A child who has high traits in the domain of Extraversion will be a child that will be likely to exhibit some positive characteristics such as radiating joy, having fun, and laughing aloud (See Table 1 for other traits). Young children who are high in Extraversion may be easy to engage and may never meet a stranger but may have some difficulties knowing when it is time to work and listen to directions. A child with this type of behavior may also have difficulty knowing how to have boundaries with friends. It may be important for this child to have a classroom routine and physical boundaries as well as emotional boundaries. Many of these traits can be used in a positive manner in a classroom by allowing the child to complete activities successfully that will involve high energy and activity such as gross motor games: obstacle courses, group games, playground games, etc. Young children who score low in extraversion tend to have a lower activity level, are not as generally as joyful, not interested in amusing their friends and may be the child that does not get noticed in the classroom because behavior is internalized. This child will benefit from one-on-one activities with the teacher, or peers or small group activities in order to become more engaged socially with the other children. Cooperative learning with peers to solve set learning problems can help all children but particularly children who have traits low in extraversion. Children who exhibit this type of behavior may also get along better in the classroom when there is not as much noise or stimulation.

Agreeableness. While Agreeableness is an incomparable trait, children who score very high on this scale can have some issues in the kindergarten classroom. Children high in Agreeableness work well with adults who are authority figures such as parents and teachers, however, children with these characteristics can be easily lead by peers and can be the victims of bullying. It is essential in the kindergarten classroom for the teacher to keep a watchful eye on children who have high Agreeableness traits so that they are not taken advantage of or pushed around by other children with stronger personality traits. It may also be necessary to teach a child, who is high in Agreeableness to not do everything that all adults say to do, particularly those adults that the child does not know. Group time activities such as teaching children which adults are safe such as parents and grandparents is a good strategy. Using

puppets to deliver the information about who is not safe such as strangers is another useful strategy to help children understand this concept.

Children who are low in Agreeableness will do best if they are able to develop the rules and help determine what rules are important. Children who are low in Agreeableness have a harder time when they are told what to do and do not have choices. Choices are important for all young children in the kindergarten classroom. Children low in Agreeableness will need to be successful at tasks and activities so that they will be engaged in the classroom and engaged in the entire classroom's success rather than just their own. It is important to get these children at the beginning of the school year tied into the community of the classroom. They will need to have responsibility for jobs in the classroom in which they can take pride in and complete well. The more engaged the child is with low Agreeableness, the less likely this child is to mess up things for other children physically and emotionally. It may also benefit this child to see how it affects peers and other adults in the room when this child is insulting or tries to get back at others. Social stories and books with this theme or content may be useful in getting the message across to the child who is low in Agreeableness.

Conscientiousness. Children who exhibit traits high in Conscientiousness are typically the children that every teacher wants in his/her classroom. Children that score high in Conscientiousness can have issues in the kindergarten classroom as they can become too focused on completing tasks, needing to finish what they have started, wanting to help and seeing the consequences for things that can happen not only for themselves but for others. Children with these traits will often need guidance from adults to know when it is time to take a break from a task to do something else. Kindergarten classrooms are busy and the children will often transition from one activity to the next and will not have time to complete a task such as an art project. A child may need permission to come back to a project and finish it later. Children who have traits high in Agreeableness may also have a tendency to observe and let their peers know the consequences of actions. These children can sometimes seem like the "Little Teacher." While children with this characteristic can sometimes be helpful, they can also be frustrating while dealing with a child who is breaking the rules. This can be handled by talking with the child about their concern for others and how important this is but that it is the teacher's job to help other children when they are breaking the rules. Redirecting the child's energy by asking them to create a book about what rules the class has to follow or drawing a picture can help with this issue.

Children who score low in Conscientiousness may benefit from having step-by-step pictures for some of the tasks in the kindergarten classroom to help him/her complete tasks. The idea is that the pictures will not be necessary or needed for the entire year but until the child is able to start having some success completing tasks. Children who score low in Conscientiousness can also benefit from being paired with a peer who may be able to model appropriate skills in completing tasks and how to start tasks. A teacher or adult model will be able to facilitate how to start a task by using self-talk so the child will begin to learn how to start a task and so the child can begin to learn what might come first. Children who have difficulty starting tasks may not know what comes first or how to sequence. If children have difficulty sequencing socially, they may have difficulty sequencing academically. It will be helpful to begin modeling this behavior for children who score low in this area. Story books about consequences of behavior may also help the child that does not seem to understand the consequences of their behavior.

Another strategy that may help with behavior is when having group time with the children is to discuss the the consequences of behavior of specific behavior. Have the children talk about what happens when they hit another child, climb high on a shelf or touch a hot oven. It really depends on the behavior as to what is targeted for discussion in the group. A teacher will also need to know the children well enough to know what the group can handle as far as how a discussion is structured.

Neuroticism. Children who score high in Neuroticism will need help with learning to adapt to new situations which can be done by being introduced to new activities slowly, using social stories, visual schedules, visual routines and calendars posted in the classroom. These strategies can all help a child to see what will happen next. Teachers and peers can help the child by pointing out the schedule or routine so that the child can be reminded of the next activity. All of these strategies will help a child who has traits high in Neuroticism to know what is going to happen next and prepare for activities and situations. Carrying the schedule of the classroom on a key ring so that it can be checked until committed to memory can help a child know what is coming next is another strategy. The child can check the schedule own their own without having to ask an adult. Children who are high in traits in Neuroticism such as worrying and have difficulty relaxing can be taught to relax at times when they are not worried. Children can be taught to breathe deeply by using the Turtle Technique (Lentini, Vaughn, & Fox, 2005). This technique teaches children to recognize feelings, breathe and calm down, and think of a solution before reacting. If there is a schedule or activity change, the teacher can begin to talk to the class about the change several days before the change will take place for example, if the class will be going on a field trip. If a change is unexpected, the teacher can talk about the change as soon as he/she is aware of the change. For example, if it rains and the class is unable to go outside and this is a favorite activity of the child. Preparation and prevention can go a long way in changing a behavior from challenging to appropriate (Joseph & Strain, 2010).

Children who score low in Neuroticism will be less likely to worry and to become upset easily. Children with this trait are able to adapt easily to situations, are rarely overwhelmed by events, and are fairly relaxed. In the kindergarten classroom, this child may be one that is easily ignored. Whereas, most of these traits are respectable in most students, this child in the kindergarten classroom may be lost.

Other issues for children who score low on this trait include: difficulty with exhibiting enough energy to engage in tasks or other activities. In other words, the child may be too relaxed to become engaged with the classroom activities and routines and not notice changes that occur within the schedule or routine. Strategies that can help a child to engage with their environment and others are having the child working with peers one-on-one on projects and activities. Children can also engage in the classroom through visual schedules or physical activity. Music is one way to engage children in group activities through dancing, exercise, and song. Physical activity in general may facilitate engagement in the kindergarten classroom.

Openness. Openness traits are characterized by a child who likes to start new things, is interested in new things and has a vivid imagination. Children who have traits high in this area will volunteer for new activities in the classroom and will tend to be interested in all activities. He/she will also have a vivid imagination that can be seen in art, play and music. The child who scores high in this trait is often the child that can lead other children who have some difficulty getting started in tasks.

Table 2. Strategies based on Personality Traits

Trait	Strategies
Extraversion	Reminders to Work and Listen: a timer to remember to keep working; visual pictures of an ear to listen or a physical reminder of pointing to an ear to remind a child to listen. Classroom Routine: Schedules; visual and auditory reminders such as bells, music, pictures and objects; Physical Boundaries: Carpet squares or tape to stay in the physical space during group time; showing the child with your hand or a picture of a hand to keep their hands to themselves; High Energy Activities: Outside gross motor activities- running games, obstacle courses, swinging, sliding, etc. Inside games: inside obstacle course, pushing heavy boxes, dancing, jumping jacks, singing to music
Introversion	Engagement with Others: One-on-one activities with peers or other adults; provide opportunities for participation in games and activities that are non threatening and fun; cooperative learning to solve set problems; opportunities to practice entering or joining groups children (modeling by peers or teachers is great for this); Classroom Environment: Provide a calm place in the classroom for children to regroup; remember that noise and light can be too much for some children on a continual basis so it is important to have times of the day that are quiet and calm for all the children beside naptime;
High Agreeableness	Group Time: Teach children about what adults are safe and what adults are not safe; teaching children how to be assertive with peers and still be respectful; communicating respectfully to others;
Low Agreeableness	Classroom Environment: Include children in involvement of the rules and consequences if the rules are broken; provide choices of activities where possible as well as centers; help children solve issues by asking the child to think of ways that may help the problem and providing feedback and suggestions on what the child has stated; give opportunities for the child to complete jobs in the classroom; Engagement with Others: Using social stories to start the conversation about how the child's behavior may make other feel; reading story books about social emotional issues can also begin the conversation with the child
High Conscientiousness	Boundaries: Give verbal boundaries to let the child know that they can come back to a task rather than finishing it; redirecting children when telling other children what to do by having the child draw a picture about the rules or creating a book about the rule can be helpful for the classroom and the child
Low Conscientiousness	Classroom Environment: Provide step-by-step pictures for tasks to help complete tasks; pairing the child with a peer for modeling to help with completing a task as well as how to complete the task; teachers or other adults working with the child can use self talk and talk about how to start a task and which part of the task comes first; story books and social stories about consequences to specific behavior choices will help the child to see what will happen or what the outcome will be if a specific choice is made; Group Time: discuss consequences of different behaviors with the children as a group and have the children provide the consequences;
High Neuroticism	Classroom Environment: Introduce new activities slowly with social stories, story books, pictures and picture schedules; teaching relaxation techniques such as breathing, the Turtle Technique; providing a calm, soft area in the classroom where a child can go to regroup; having discussions about schedule changes as soon as a change is known about in the schedule

Table 2. (Continued)

Trait	Strategies
Low Neuroticism	Engaging with others: Working with peers or small groups on projects so the child can stay engaged; Classroom Environment: Visual prompts, schedules and pictures can help a child to engage; providing music activities with dance, exercise and song can also provide engagement in activity
High Openness	Classroom Environment: Pair with peers who have difficulty starting tasks, do not seem to be interested in anything or who have difficulty with sequencing
Low Openness	Classroom Environment: Pair with peers or small groups of children to complete projects or activities; provide opportunities to try a variety of different activities in the classroom to find specific interests; pair with peers and adults to help extend imagination

This child may overshadow other children who seem to have narrow interests and do not volunteer for new activities. This child will be eager to engage in the activity possibly pushing others out of the way. The child who scores high in Openness can be helpful by completing jobs in the classroom and creating new and special projects.

The child who scores low in Openness will be less likely to try new activities and will be less interested in things. This child will have more limited interest and working with peers one-on-one or in small groups in the classroom will help to extend ideas and provide a model of how to work with others and new materials which can be useful. (See Table 2).

CONCLUSION

In part, personality traits can begin to help teachers build individualized programs for intervening in challenging behaviors in the kindergarten classroom. Peers can be a part of the program in helping a child to learn appropriate social skills as well as adults such as teachers and other providers that work with the child. Social-emotional competence is one of the key components to adjustment in one of the first school experiences whether it is in preschool or kindergarten. Nevertheless, the academic rigor in kindergarten continues to rise each year with demands placed on teachers to have students perform to a certain standard (Parker & Neuharth-Pritchett, 2006.)

Traditionally, kindergarten has been a year for children to learn social skills and for a home-school connection to be made that will set a pattern that will last for many years to come in the child's school career (Jeynes, 2006). When children come into a setting that is high pressure for teachers and in turn for the children, it can create a situation where the children will not be ready academically or socially. It will be important for teachers and other caregivers to know the children in their care.

Personality assessment can be the first step in individual planning for a child with social emotional issues. By knowing what the child's basic personality traits are, a teacher or parent can facilitate the transition and adaptation into the kindergarten classroom by changing the environment or activities for the child.

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Chapter 8

AN EXPLORATION OF MEANING IN YOUNG CHILDREN'S IMAGES AND DESIGNS

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ABSTRACT

This chapter describes an integrated art and early literacy project. Students in a teacher training program worked with young learners on visual and verbal responses to a picturebook. A design grid served as a template to encourage children to explore meaning making in compartmentalized spaces. Using a qualitative, interpretative analysis, a subset of drawings was chosen to demonstrate how young children: (1) express thoughts through their choice of design elements and symbols, and (2) apply compositional strategies to construct meaning. The point of interest was not on the performance level the children achieved in their artwork, but rather on how meaning and understanding can be mediated through image-making that encourages the inclusion of patterns and designs.

The results showed young artists demonstrating divergent thinking as they applied shapes, colors, symbols and metaphors for relating similarities between the elements of a visual design and objects in the real world. While each child invented his or her own way of representing ideas and events, the evidence showed that children configured their drawings in a purposeful manner, weaving principles of selection and arrangement into unique graphic designs full of meaning. These children readily combined component parts to create the whole message as they actively constructed understandings of their worlds through their choice of designs and pictorial units.

INTRODUCTION

Children discover multiple ways of making meaning while drawing. The following depiction of two children's experiences with image making occurred after a reader response activity that asked kindergartens to use a template to design their own quilt.

Morgan drew hearts and flowers around the borders and then drew shooting stars on the large square in the middle of the quilt, imitating the image in the picturebook. She wrote her

name in the same position on the quilt as Abigail, a character in the story. Morgan's spoken words communicated her thoughts, "I like the girl Abby and the hearts and stars. I like the whole picture. It is pretty."

Michael drew small American flags around the borders and then drew fireworks shooting into the night sky in the center of his quilt. His verbal expression provided information not available in the picture, "I'm making polka-dots in the night sky ... red, white, and blue for America's birthday. And I used all the colors that I like."

These vignettes demonstrate two very different types of responses and compositional strategies. Morgan explored existing images and folk art symbols and arranged these items on the page according to the same orientation as the model. She chose to reproduce the pictorial material and the spatial arrangement found in *The Quilt Story* (Johnston, 1985), a picturebook with illustrations by Tomie dePaola. In constructing her artwork, Morgan learned about the basics of design while replicating an existing model of artistic expression, differentiated only by the substitution of her name for Abigail's name. Michael also showed interest in emulating the artist's ideas, but he freely produced variations and exhibited new ideas. Using his ability to generate mental images, Michael connected the vision of shooting stars and exploding fireworks in his mind and infused patriotic symbols to create a theme-based image. He used a centering strategy to organize all the fireworks around the large interior area of the quilt. Although Michael may have been influenced by the graphic images produced by the illustrator, he readily branched out and applied "polka-dots" in an unconventional way and in a new context. In the process he engaged his imagination and produced a novel idea, an "out of the box" thinking moment.

This glimpse into children's design making and the talk that accompanies it provides educators with a practical and accessible way to observe how young artists use images to convey meaning. Although very different drawings were produced, Morgan and Michael identified and captured the elements of their experience that helped them classify and order it. Both children experienced the beginnings of visual thinking and aesthetic sensibility through their choice of organizing principles, symbols, and meaning making behaviors. Clearly, explorations with artistic design can stimulate children's abilities to think, feel, and imagine, and when coupled with dialogue, adults can open pathways for understanding children's communicative intentions.

THEORETICAL BACKGROUND

The literature in child art contains an abundance of children's portrayals of people, houses, animals, and aspects of nature in their early drawings (DiLeo, 1983; Gardner, 1980; Strauss, 2007). While a picture can be a decorative pattern or a realistic depiction of a scene or event, most studies of children's drawings contain a strong focus on life-like images of people and objects (Cox, 2005). The traditional view of pictorial realism as the ultimate goal of art has resulted in fewer studies on such factors as children's organizational characteristics, visual order and pattern-making. Two examples of studies on nonrepresentational aspects of drawings include Kellogg's (1969) work with children's search for order and balance in their graphic work and Golomb's (2004) research on children's compositional development in drawing. Although many years exist between these two studies, both researchers view

pattern-making and design work as a category of artistic expression that warrants further study.

Many practitioners appreciate children's pattern-making and designing as aesthetically pleasing products (Kolbe, 2000), but in the context of schooling, children's drawings are not usually valued on the same level as other literacy or language-based activities (Kress, 1997). Views are changing and the early childhood field is supporting a multiple literacies perspective that recognizes art, music, dance, and drama as modes of representation and communication that play an important role in the development of children's thinking (Dyson, 2002; Rowe, 2003; Wright, 2010). Within this paradigm, researchers and practitioners are adopting a more inclusive path, one that does not privilege written language above all other symbol systems in instructional practices (Kress and van Leeuwen, 1996) and one that does not position one form of art above another.

The theoretical context for this project is the social semiotic perspective as presented in the writings of (Kress, 2010; Mavers, 2011). Language, whether written or spoken, is a subset of communication that often occurs in a social setting. Drawing, when viewed as a semiotic activity, is a form of social practice in which children explore ideas through their image making. The meanings that children construct are influenced by what they see in picturebooks and popular culture, sometimes as a solitary act, but more often from a social context that contains opportunities for interactions with peers (Hopperstad, 2008). The discipline of semiotics sets the stage for thinking about the link between the arts and literacy (Cowan and Albers, 2006) and for a multimodal approach that combines drawing with other modes of representation to enrich meaning (Kress, 2003; 2010).

CONTEXT OF THE PROJECT

This article describes an integrated art and early literacy project. The authors explore patterns and designs, a specialized art genre, to better understand how drawing, as a multimodal way of knowing, shapes children's thinking. This study was specifically designed to address whether a drawing template could influence how children arrange lines and shapes, not just to create meaning in a pictorial sense, but to infuse order, symmetry and balance. We wanted lots of spaces for children to discover serious ideas as well as create fun or whimsical designs. Our goal was to gain insight into children's visual compositional strategies and conceptual thoughts.

For practical purposes, the chosen layout needed to be a familiar one that would sustain the child's sense of appreciation and enjoyment in making patterns. By replicating the format that appeared in *The Quilt Story*, children could playfully investigate the same ten compartments, comprised of one large center area surrounded by five smaller panels and four corner squares. This organizational system affords children the opportunity to utilize the large space to display their "big ideas" and the marginal spaces to post their ancillary thoughts or supporting details. This format might also reveal children's attempts to unify the composition.

METHOD AND ANALYSIS

Students in our undergraduate teacher training program were given an assignment to observe and document children's experiences with patterns and pictorial spaces. This particular field-based project limited the scope to art and literacy and provided a manageable forum for prospective teachers to view children's designing capabilities and visual thinking skills. A theme of quilts was chosen to stimulate children's interest in creating designs. *The Quilt Story* was selected because the text was suitable for the age group and the illustrations contained an array of visual symbols and design elements. The aesthetically pleasing patterns invited young viewers to discover lines, shapes, and colors in the eye-catching designs.

As students worked within their assigned classroom, they took time to observe children's production of images, designs, and symbols and to dialogue with children as they drew, wrote, and talked about their artwork. Two research questions guided the study: (1) How do children express meaning through their choice of design elements and symbols? (2) How do children use compositional strategies to construct meaning? The point of interest was not on the performance level the children achieved in their artwork, but rather on how meaning and understanding can be mediated through designs.

For the duration of this research project, each pre-service teacher worked with two to three children during a small group read-aloud session. After showing the cover page and announcing the title and author, practicum students provided an introduction to the activity, "We're going to read about Abigail's beloved patchwork quilt." The story was introduced with a short picture walk. Illustrations were used to provide a quick synopsis of the story line and to expose children to pattern-rich vocabulary such as dots, stripes, checks, and zigzags. When the quilt appeared on the first few pages, the pre-service teacher asked the children to look for symbols, such as hearts, stars, doves, flowers, etc. that evoke feelings of happiness, safety, and warmth.

Pre-service teachers conducted the read-aloud activity and led a brief post discussion of the story by selecting a set of questions from one or more of the following three categories: (1) What did the mother make for Abigail? Why was it so special? Has your parent (or grandparent) ever made you something special? (2) How did the quilt make the little girl feel safe? What makes you feel safe? (3) Which symbols do you remember seeing on the quilt? What do these symbols mean to you? The length of the question and answer session was dependent on the children's attention span, but in all instances, the objective was to reinforce children's understanding of the images and symbols that appeared in the picturebook.

Following the post discussion, the children were asked to think about designing their own quilt. The template was distributed and children were prompted to draw in the available spaces. The directions for the drawing task were deliberately left open-ended and did not specify who or what should be in the drawing or where it might take place. After each individual was finished with her drawing, a second prompt was given, "Can you write about your design? Please describe your quilt." The pre-service teacher observed closely and took notes on drawing and writing behaviors. The final step was to prompt the children with an opportunity to expand their thinking, "Is there anything else you would like to tell me about your design?" These oral responses were recorded by the pre-service teacher.

In the phase of data analysis, the children's drawings, writings, and verbal expressions were analyzed with the support of the pre-service teacher's field notes and reflective

comments from their journal entries. This qualitative study was situated within an interpretative paradigm, one in which “researchers focus on the meanings people ascribe to their experiences and phenomena” (Mukherji and Albon, 2010, p. 28). Our first step was to determine if features in the drawings could be classified as an example of a spatial compositional strategy, such as centering, side-by-side positioning, or alignment of items along the diagonal or horizontal-vertical axes. The symbols in a children's drawings were examined next, if any, and then in terms of their relations to the other objects in the template to derive information with regard to the research questions. When analyzing the data, the researchers identified nine children whose respective work of art was determined to contain strong aesthetic properties and examples of interesting form, design, and composition. A commentary was included to help readers gain knowledge of the visual meaning-making systems found in children's designs.

DESIGNS FROM THE CLASSROOM

The nine examples came from a set of 150 drawings produced by children from 4- to 7-year-olds. An entry from Sarah's portfolio, a student in our teacher training program, was chosen to demonstrate the nature of design elements and symbols in a young child's artwork. In addition to focusing on the first research question, the excerpt also reveals new learnings that occurred for this pre-service teacher.

All of the children in my small group copied some of the designs from the picturebook. They drew hearts and flowers and one youngster included a shooting star and a checkered pattern. These items suggested that the illustrations in the story influence children's choices. I also noticed how these three participants took ideas from their own lives and combined these images in their quilt designs. The children's written responses helped me to see a range of developmental levels and to better understand their artwork.

I was amazed by what 5-year-old Kylie attempted to write: “I drew on my quilt a dream catcher.” Without this printed information, I would not have known that her mandala-like form was drawn to represent a dream catcher (see Figure 1). When Kylie reread her sentence, I saw how she used the letters ‘gen cahr’ to spell dream catcher. Her invented spelling was so clever and kind of made sense. The content of her ‘talk time’ was just as informative. I listened as Kylie described her illustration, “I writed a daddy deer and mommy deer, a dream catcher and a heart, flower, heart, flower.” Although she confused ‘writed’ for drew, this verbal inventory or labeling of objects provided a childlike annotation to her finished project.

Later that morning, I talked with Kylie at the math center. I had a moment to ask her about the drawing and whether she had a dream catcher at home. She told me that her mom had hung a dream catcher above her bed and that it looked like a spider web. Kylie seemed intent on explaining its function. She elaborated, “It traps bad dreams in the web, like a spider traps bugs. And then you can dream about deer drinking water and flowers growing. And happy hearts and singing birds.”

Sarah did a commendable job of explaining Kylie's experience with both the visual and verbal mode in her repetition of ‘heart, flower, heart, flower, ...’ and demonstrating Kylie's sense of awareness of patterning. Although it is well known that ideas tend to flow readily while a participant is actively engaged in drawing, Sarah's excerpt provides evidence of a

young artist's thought processes at work after the completion of the drawing event. When prompted, a child's ideas can continue to flourish beyond the parameters of the 'draw and write' activity. Kylie's reference to singing birds, an object not depicted in her drawing, still exists in her mind's eye, enabling communication with herself and others, and opening paths for future encounters with symbols.

What Sarah didn't fully realize, however, was that children often use writing and 'talk time' to tell a story, and the elements of story structure – setting, characters, plot -- frequently make their appearance in follow-up narratives. But the nature of this activity prompt was different. Kylie and other children's perceptions of this task may have been affected by the expectations set by the pre-service teachers, and the level of help and support that was provided. Participants had been encouraged to write and tell about their respective design. The outcome was a proliferation of visual symbols, designs, and descriptive comments about the images, and rarely included the typical narratives that often accompany a prompt such as, "Draw your favorite part of the story." On the surface, this assignment provided Sarah with the unique opportunity to learn about Kylie's dream catcher, but at a deeper level of meaning, the drawing illustrates how Kylie uses positive images to ward off her fears. The picture and accompanying talk, as a totality, is a metaphorical message that connotes protection, warmth, and beauty.

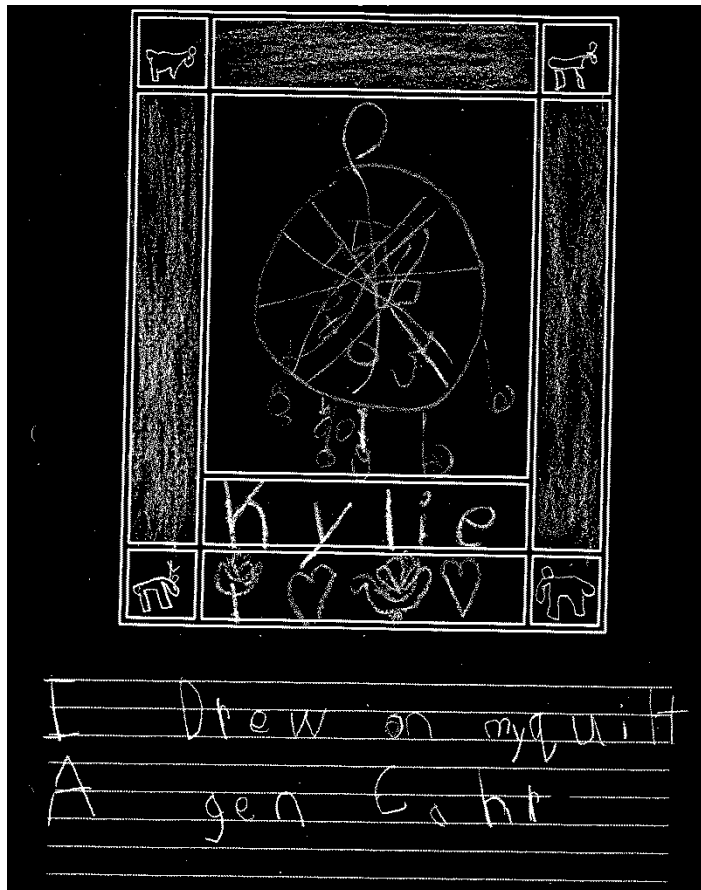


Figure 1.

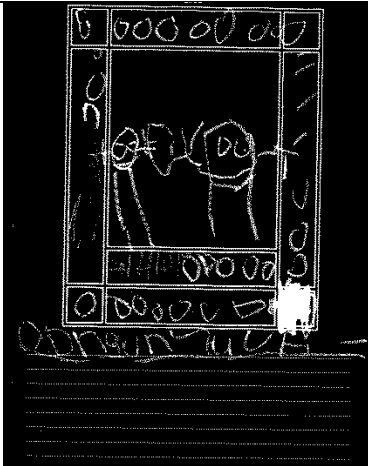


Figure 2.

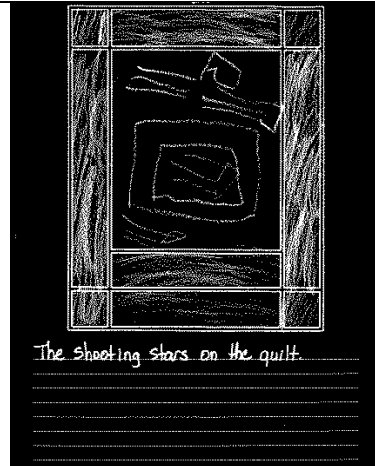


Figure 5.

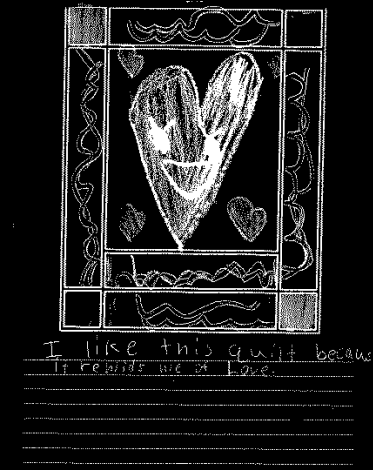


Figure 3.

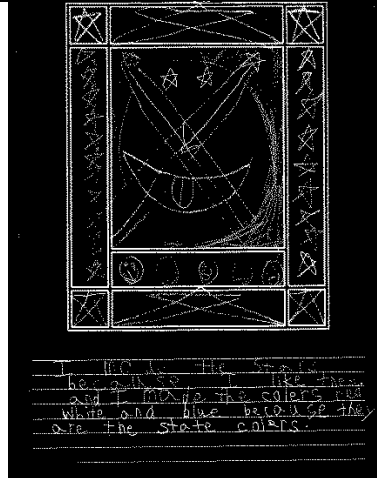


Figure 6.

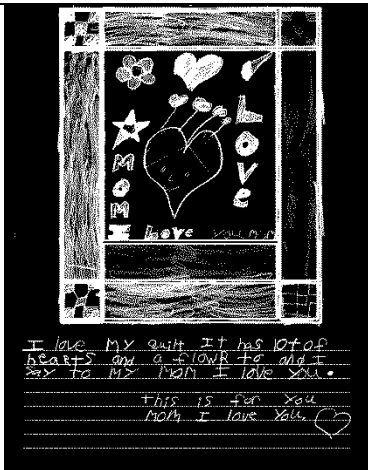


Figure 4.

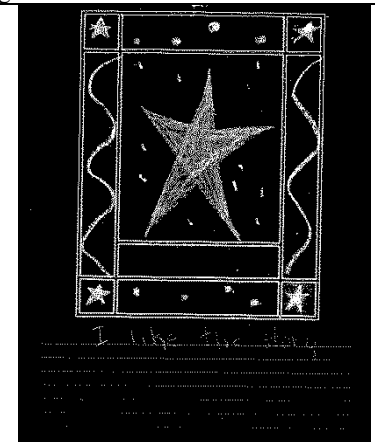


Figure 7.

Six additional drawings were selected to serve as examples of children's design work which typify the compositional strategies and types of symbols children use to construct meaning. Although the larger collection of drawings also contained entries characterized by color filled spaces or the delineation of multiple symbols, this small subset featured heart or star motifs, the most frequently used symbols in this set of children's drawings. The 2 x 3 display table organizes the entries by age, gender, and thematic variables. The first column displays artwork with the heart theme that was created by girls. The second column displays the star theme that was produced by boys. The top row was done by 4-year-old children in Pre-K, the middle row by 5-year-old children in kindergarten, and the bottom row by 6-year-old children in first grade. The following commentary provides information on the organizational framework and the content of the children's work.

Heart Theme

The first image depicts a child presenting a heart shaped object to her mother (see Figure 2). The figures are drawn standing on a horizontal alignment across the bottom edge of the center space. Rendering heart shaped objects is difficult for most 4-year-olds. In an older child, these partially closed figures take on the defining curves and angular lines of the heart. The surrounding panels contain a series of circular shapes with some interspersing of horizontal, vertical and diagonal lines. The writing is primarily a series of mock letters that appear on the top line of the area designated for written responses. When the child entered the 'telling' phase of the activity, the figures were identified as a mother and daughter. This child's dominant composing media is visual, i.e., picture-making, but her verbal expression provides an important detail.

A simplified, personified heart with a joyful expression fills the largest space (see Figure 3). Four unadorned, smaller hearts appear, one in each corner of this center space. This 5-year-old produced a well formed heart shape; indicators of early symmetrical thinking are evident. The compositional structure could be the result of the child's intuitive awareness of an axis. Several figures are arranged in a pattern along the left diagonal and include an orange box, a purple heart, a red heart, a purple heart, and the lower orange box. The same chaining of elements appears along the right diagonal, but the hearts are pink and the corner boxes are yellow. The surrounding panels feature ribbon-like lines of green, blue, and pink which encircle the heart. The child has produced a clear written message, "I like this quilt because it reminds me of love." This response confirms her understanding of heart symbols.

In this more advanced drawing by a 6-year-old, the largest heart is positioned near the lower center (see Figure 4). Four symbols -- a five-pointed star, flower, heart and shooting star -- are drawn as separate entities; these same symbols appear in the picturebook. The personified heart looks like an inflated balloon. Four smaller hearts are positioned along an invisible slope, and are attached to the large heart's periphery by red lines. Although decorative in nature, hints of functionality may be present. One pre-service teacher offered the following speculative comment, "The smaller hearts appear as antennae that are seeking contact with the outside world, and open to receiving vibrations of love." The message, albeit on an unconscious level, may have something to do with reaching out and making connections or it may simply indicate a child's interest in decorative detail or rhythmic repetition of an element. The poetic form of the written sentences clearly communicates the

child's understanding of the heart symbol and her desire to present this work to her mother. The heart icon in the lower right hand side of the text adds a finishing touch that is both decorative and communicative.

Star Theme

This young artist used a closed shape as the tip and three trailing lines for the tail to portray four shooting stars in the center space (see Figure 5). One of the stars was bounded by a double lined frame. The child's verbal contribution revealed his reason for framing this object. He told the adult, "That's what a star looks like from my bedroom." The 4-year-old had attempted to depict a falling star from the perspective of being in his house and looking outward through the window. Some awareness of symmetry is present in the blue colored panels spanning the top and bottom margins. The left and right panels were colored using a vertical movement of the pencil while the remaining top and bottom panels were filled in using a horizontal direction of movement. The pre-service teacher wrote the child's dictation, "The shooting stars on the quilt."

A five-year-old presented this star-studded image of the moon in the center position (see Figure 6). Star shaped eyes and a protruding tongue are unique facial features and add a playful, mischievous trait to the drawing. The shading around the perimeter of the moon provides contrast between lightness and darkness and produces a brightly shining effect. The three lines that stream from the two stars placed in the upper corners of this center space show a strong awareness of the diagonal axes. The intersection occurs at the nose and provides balance between the eyes and the large mouth. The margins contain much evidence of symmetry and repetition of stars and other faces of the moon. This young artist uses an alternating pattern of red and blue throughout the composition; these colors appear prominently on top of the quilt in the picturebook. The child's written message points to an association of these colors with the state in which he lives, but perhaps he fell short in his attempt to connect the red, white, and blue colors to the American flag, a national symbol denoting patriotism, strength, and protection.

The last artwork displays a well developed sense of design (see Figure 7). This child's precisely drawn lines of the green star stand out from the softened, orange background and command the viewer's attention. The surrounding short green lines appear as distant twinkling stars and provide texture and a sense of prominence to the star. The composition has strong evidence of symmetry. The side margins contain wavy lines and provide a contrast in shape to the small purple circles on the upper and lower panels; all 10 components are filled with color. Pre-service teachers who viewed this image responded to the abstract features on the basis of perceived analogies to elements of real-world experiences. They wondered whether this young artist might be communicating a desire for peace in the dark hours of the night. Overall, it is an aesthetically pleasing artistic form that depicts a centric composition within a well-balanced picture. The child's written message, "I like the story," seems to call out to all who gaze to reply, "I like the design!"

DISCUSSION

Many children started this activity by making abstract designs – both symmetrical and asymmetrical. Some youngsters were occupied over a long period of time with a single problem, such as changing one shape into another, a hexagon into a star, for example – or building related patterns of increasing size. Others made only representational pictures, rather than patterns. As a whole, the template worked well as a tool for exploring representational and decorative art within compartmentalized spaces. The children were receptive to engaging in pattern-making, in effect, to create their own quilt design. Although we realized it may have been difficult for some participants to compartmentalize their thinking in this way, we were pleasantly surprised by the outpouring of designs and the many ways that children combined patterns and pictorial units. Much of the work produced by these young artists had strong dominant centers, surrounded by marginal elements. The large space was consistently used to display the child’s main idea or point of interest (see Figures 1-7 and 9). The panels contained an assortment of decorative images; the lower panel was often used by the child to write his name, and it appeared in the same space as Abigail’s name, one of the characters in the story.

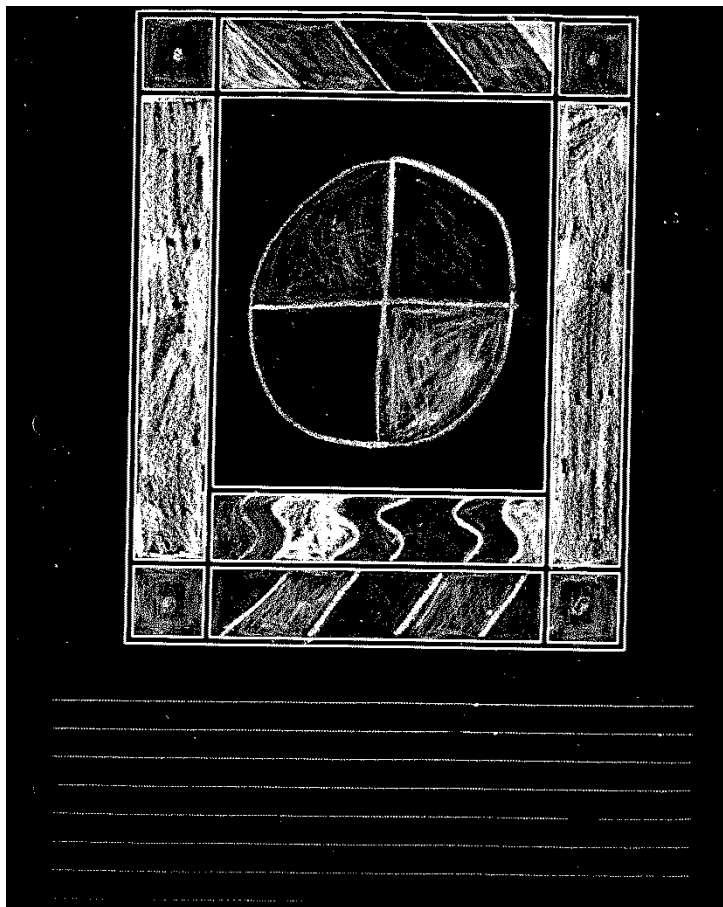


Figure 8.

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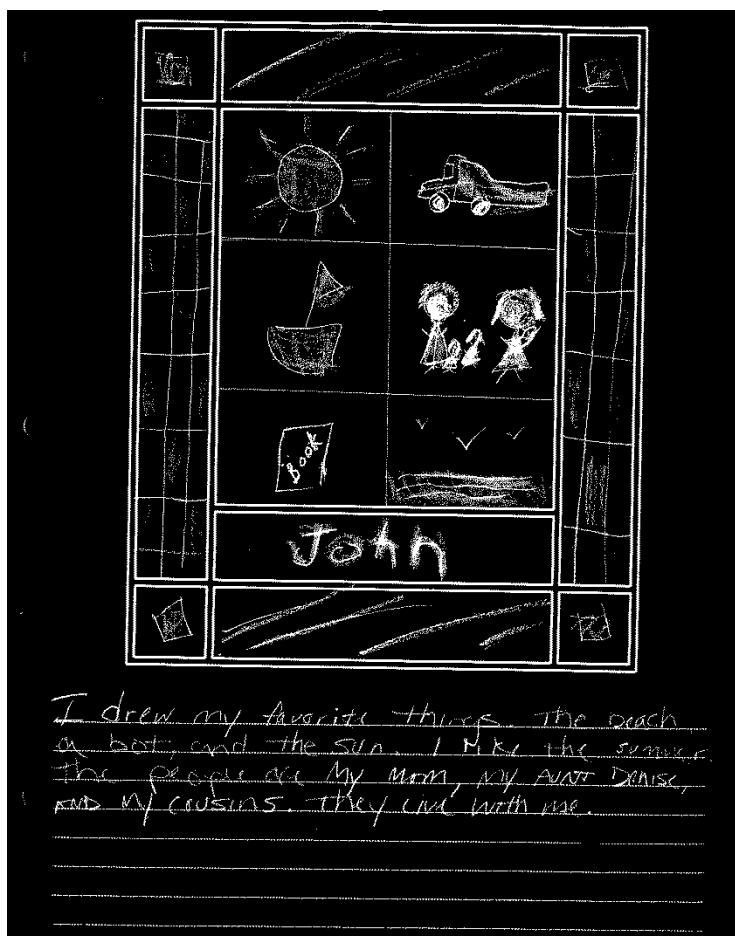


Figure 9.

Principles of composition can be helpful in describing children's drawings. Golomb (2004) states, "the primary function of composition is to arrange the elements of line, form, space, and color in a manner that indicates to the viewer what the work is about" (p. 169). One organizational framework that was present in this set of drawings was the side by side alignment of figures along a horizontal baseline (see Figure 2). Another strategy consisted of two diagonal axes that cross the center of the picture plane (see Figures 3 and 6). Other children used a centering strategy and organized their elements around a pictorial center (see Figures 4, 5, and 7). This center point principle was also at work in the following design produced by a 6-year-old girl (see Figure 8). These findings echo those of Golomb (2004) who found that children tend to align elements in gridlike fashion along the major structural axes of the picture or around a pictorial center.

The participants were also quite adept at using symbols to communicate personal perspectives, and in the process, these children produced their own innovative and communicative work. Most participants seemed capable of understanding pictorial symbols and language terms for abstract concepts such as happiness, safety and protection (see Figure 1). Kylie used the gentle image of a family of deer drinking water to convey a sense of beauty and peace in the world. Clearly, children are capable of evoking meaning through their visual

designs, although for some, it may be on the basis of unconsciously perceived analogies to elements of real-world experience.

By the age of six or seven, children's drawings become quite complex, varied, and symbolically advanced. Frequently occurring symbols – not associated with the picturebook used in this study – but freely generated by the children included music notes, sports balls, smiley faces, horseshoes, rainbows, and religious or holiday symbols. Children at the upper end of this age range were able to choose a theme and use pictorial symbols intentionally in communicative ways. John's beach theme in the following example accurately depicts this capacity (see Figure 9). He incorporates his favorite memories – bright sun, sailboats, seagulls, summer readings and the people he enjoys spending time with at the beach.

The illustrations that children see in picturebooks are influential models for their own drawings. Children are able to absorb information from the pictorial contexts in which they work and to assimilate and transform new ideas through their drawings. Young children often combine these available symbols with their own realities and make connections with symbols about love, warmth, and security. For example, one 5-year-old girl drew a 'shooting heart' that appeared to be moving across a pink colored skyline. Then she placed four heart shaped flowers along the baseline and promptly announced, "Love is everywhere." The result is a truly unique piece of artwork that captures the child's current level of metaphoric thought and design capability.

CONCLUSION

This study provides insight into how children make discoveries, invent, and engage in a good deal of playful activity as they produce images, designs, and symbols in compartmentalized drawing spaces. The evidence shows that the way children configure their drawing is purposeful; it is related to an intention to show the significant features and to communicate. Children seem to rely on structural principles as they shape and order their experience. The organizing framework, whether diagonal axes or centering, acts as a structural skeleton around which the conceptual work is built. While some children draw to replicate objects in the world, others seek to extend the meaning that objects hold for them. When children are going through the process of including or excluding symbols, such as a heart, star, or combination of available images from the picturebook, and when they are simultaneously dealing with encoding and decoding intentions in their drawings, they are building a conceptual base. Young artists are also using metaphors as lenses for seeing similarities between the elements of a visual design and objects in a real world.

Beyond this strong interest in using pictures as symbols and making meaning, children also engage in embellishing and adorning figures, and in selecting colors and shapes as ornaments. Children use shapes and colors freely and succeed at organizing these elements in compartmentalized spaces in an expressive way. It's quite possible that cognitive growth occurs as children determine what gets chosen, what gets integrated into the design, and how. All of these factors influence the transformative action undertaken by a child, who is by nature, intent on making meaning. Additional research will be needed in order to comprehend the meaning and value that image making has on individual children's lives.

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Chapter 9

FIRST AID TRAINING IN KINDERGARTEN: A REVIEW OF THE LITERATURE AND REFLECTIONS FROM PRACTICAL EXPERIENCE IN TWO COUNTRIES

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ABSTRACT

Purpose of the study: An emergency situation can occur at any time, often out of reach of experienced medical personnel. Everybody should be prepared for helping others in acute emergency situations like accidents or acute illnesses. Therefore first aid training should be given to the whole public including children. The aim of the present review is to present existing knowledge on first aid training in the kindergarten from the scientific literature and the author's own experience in the field. Materials and methods: A literature search was conducted in databases for scientific journals (Pubmed/Medline, CINAHL), the Internet and reference lists of books and articles. Relevant scientific articles, recommendations and other publications were reviewed. In addition own experience with first aid training in the kindergarten is presented and discussed. Results and conclusion: There are just a few studies on first aid in the kindergarten and primary school. A Norwegian study on kindergarten children shows that even young children are able to learn and perform basic first aid. Knowledge about first aid training in the kindergarten is lacking and more work needs to be done. Longitudinal follow up studies are needed to learn more about the effect of teaching first aid to children on helping behaviour of the course participants as adults. Nevertheless the actual evidence and own experience allow the conclusion that first aid training in the kindergarten is worth the

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effort and does not just lead to increased knowledge about first aid but also to more social and empathic behaviour in general.

INTRODUCTION

Everybody can be affected by acute life-threatening situations or oneself can be in need for first aid given by others. Medical emergencies can occur at any time, anywhere. After activation of the Emergency Medical Service (EMS) it takes at least some minutes before professional paramedics or emergency physicians arrive at the scene of an accident or medical emergency. In many cases measures undertaken by laypersons in these crucial minutes before arrival of Emergency Medical Service personnel can save lives. Laypersons are an important factor for saving lives in emergency situations. Sometimes children are the only witnesses of an emergency situation. Therefore first aid training should be given to the whole public including children [1,2]. The aim of the present review is to present existing knowledge on first aid training in the kindergarten and primary school from the scientific literature and the author's own experience in the field.

MATERIALS AND METHODS

A literature search was conducted in databases for scientific journals (Pubmed/Medline, CINAHL), the Internet and reference lists of books and articles. Keywords used were "first aid", "children", "kindergarten", "teaching", "training" and "pre-school". Relevant scientific articles, recommendations and other publications were reviewed. All articles where children have been taught first aid or have been active in providing first aid were included. Articles that dealt with first aid given to children were excluded. In addition own experiences with first aid training in the kindergarten are presented and discussed. The experiences in teaching first aid and measures to implement first aid training in daily life in two kindergartens from Germany and Norway are described. Based on the review and own experiences recommendations for implementation of first aid training in the kindergarten are given and the need for further research in the field described.

RESULTS FROM THE REVIEW OF THE LITERATURE

Need for First Aid Training of the Public and First Aid Training in Public Schools

It is widely accepted that first aid skills are important for everybody and that first aid training should be widespread and aim to include a great proportion of the public. Eisenburger and Safar have stated that Life-Supporting First-Aid (LSFA) should be part of basic health education and all persons from the age of 10 should learn LSFA-skills including Basic Life-Support (BLS) and cardiopulmonary resuscitation (CPR) [3]. A relationship between the level of first aid training and the quality of first aid measures provided has been

shown in several studies [4,5,6]. Therefore first aid training for the public is an important topic in public health. But training practical first aid measures alone is not sufficient to increase the helping rate in emergencies [6]. The motivation to use previously learned first aid skills is crucial. One solution could be first aid courses that include strategies to overcome inhibitors of emergency helping behaviour [6]. This underlines the fact that first aid is more than just practical skills and that empathy and the attitude towards helping others are paramount.

Children as First Aid Providers

Many examples that children are capable of adequately responding to an emergency situation, providing first aid and saving lives can be found in the media. In most cases recognizing the need for help and calling for help or contacting the EMS or fire brigade is enough to give sufficient first aid and to save a life in many cases. Primary school children are able to learn and provide first aid and life supporting first aid measures. Therefore first aid training should be part of the regular school curriculum [7-13]. A first aid course with 5 lessons lead to a significant increase in both - first aid knowledge and skills in 6-7-year-old children attending the first year of primary school. After the course the children were able to provide basic first aid to an unconscious patient including establishment of the recovery position, opening of the airway and calling the EMS [9]. First aid training must include both theory and practice. Lubrano et al. [11] have shown that practical training for 8-11-year-old primary school children is superior to theoretical training only. Austrian school children in the first and second year showed the ability to use a semi-automatic defibrillator after one week of training in Life Supporting First Aid (LSFA) by medical students and emergency physicians [14]. Young children can learn and provide life saving first aid but they are unfortunately not able to provide sufficient cardiopulmonary resuscitation (CPR). 9-12-year-old children can learn and provide the correct rate and correct hand position of chest compressions but do not perform chest compressions as well as adults [12]. This suggests that CPR can be taught to older school children but that helping behaviour and other first aid measures are of greater importance in teaching first aid to children under the age of 12.

In conclusion there is evidence in the scientific literature to recommend first aid training for school children starting from primary school.

What about Kindergarten Children and First Aid?

Little is known about first aid training in the kindergarten. To our knowledge there are established some projects for teaching first aid to kindergarten children in different countries as e.g. Germany, Norway and Turkey, but these are not yet implemented nationwide. Unfortunately at present there are no specific recommendations from the international scientific organizations dealing with resuscitation and first aid (e.g. the European Resuscitation Council, American Heart Association) on what or how to teach first aid to children in kindergarten and primary school.

So far there are just some reports in the media and the scientific literature including pilot studies on kindergarten children and first aid. Scientific studies, which were found in our

literature search, were mostly about adults providing first aid to children. One study from Poland investigated the kindergarten teachers' preparation to provide first aid. The participants from that study ranked their first aid knowledge at grade 3 on a scale from 1 to 5 [15]. Another study from Turkey concluded that primary school teachers do not have enough knowledge about first aid [16]. There was just one study on first aid in the kindergarten that could be retrieved from the literature search. This study was done by a group of the authors of this chapter. Main results from a previous study of our group in a Norwegian kindergarten were [17]:

- 4-5-year-old-children can learn and apply basic first aid
- Teaching first aid led to:
 - high motivation to help others and to provide first aid
 - more active helping behaviour
 - increased empathy
- Training first aid became a part of the daily life in the kindergarten
 - a poster displaying the five-finger rule for first aid was designed by the participating children
 - younger children (under four years of age) who did not participate in the first aid course were introduced to first aid by role plays and the five-finger rule poster by the children who had participated in the course.

The first aid measures taught in the course included assessment of consciousness, assessment of breathing (looking for signs of life), knowledge of the telephone number of the national EMS-service and being able to deliver needed information about the emergency situation, performance of the recovery position for unconscious victims and the correct airway management with opening of the airway. The results suggest that learning first aid in the kindergarten leads to including this topic as everyday life activity. First aid training in the kindergarten has in addition to acquiring first aid knowledge and skills led to positive changes in social responsibility and empathic behaviour in the children [14]. Chest compressions were not included in the curriculum. Most often-used first aid measures by laypersons are application of a dressing and positioning of the patient whereas CPR or clearing the airway by bystanders is not frequently required [5]. Therefore it seems appropriate to start with basic first aid measures for younger children and to introduce CPR/chest compressions at a later age. Eisenburger and Safar suggested the age of 10 for teaching CPR skills [3]. A recent systematic review on first aid provided by laypeople to trauma victims has concluded that first aid given to trauma victims has the potential to reduce these patients' mortality [18].

It has been demanded that learning first aid should therefore include both knowledge-transfer and motivation to give first aid [9]. This has been the case in the mentioned study from Norway [17]. First aid education in the kindergarten could probably lead to first aid as a normal activity of daily life and an increased motivation to apply first aid measures when needed.

More research in the field of first aid training for children including educational efforts in the kindergarten and working groups in order to establish consensus and guidelines for teaching first aid are needed.

EXPERIENCES FROM THE KINDERGARTEN WORLD IN GERMANY AND NORWAY

Experiences from a Kindergarten in Germany

The kindergarten in the town of Erftstadt-Lechenich (Städt.-Kita Lechenich-Süd) uses an integrative approach. The kindergarten has 3 groups with 20-25 children each and two integrative groups where 5 handicapped children are together with 10 other children. It aims to integrate handicapped children in a normal kindergarten and not to separate them from “normal” children. In the kindergarten Lechenich-Süd in Erftstadt-Lechenich/Germany a pilot-project started in 1994. The project was established by Georg Bollig who was a paramedic and medical student and Angela Bollig who was kindergarten teacher and the head of the kindergarten. The first aid training was given to both “normal” and handicapped children aged 5-6 years. The curriculum included the following themes:

- The body and its organs
- Assessment of consciousness, breathing and pulse
- Emergency call
- Use of bandages and plaster
- Check of the first aid kit
- A visit of an ambulance in the kindergarten
- A visit to the local hospital

Teaching was done by two certified paramedics and first aid instructors from a local Emergency Medical Service (Malteser Hilfsdienst) with support of a kindergarten teacher to ease contact with the children and to ensure a safe learning surrounding. Glove puppets were used to ease contact to the children. The glove puppets assisted in teaching and participated as advisors and peers for the learning children. During the course role plays, songs and working sheets were used as teaching aids.

Aims of the project were to introduce children to first aid, to provide them with first aid knowledge and first aid skills and to make them self confident to use their knowledge and skills in an emergency situation. Other aims were to reduce the children’s anxiety in contact with paramedics and the hospital. The course included 6 lessons. One lesson was done once a week.

Before the project started the personnel of the kindergarten was taught first aid in order to make them competent to answer the children’s questions and to be able to become a role model when real first aid would have to be provided in daily life in the kindergarten. In addition the parents were informed about the project and were invited to attend first aid classes, too.

After the first experiences with the course and positive feedback from the children, personnel and the parents in 1995 the next step was planned. All kindergarten teachers working in the kindergarten were invited to participate in an instructor course. This course aimed to make all kindergarten teachers to competent first aid providers and first aid instructors.

After the first pilot courses first aid has become a part of the regular teaching in the kindergarten. The glove puppets and teaching material adapted to the needs of kindergarten children were important to make first aid a popular activity among the children. The children included first aid in their daily role play activities. Parents stated that the children started to talk about first aid at home and that they wanted to check the parents' first aid kit at home and in the car.

Another finding was that the children became more attentive to the needs of others and attended to comfort children who were sad. In other words helping became a normal activity of everyday life in the kindergarten. So helping behaviour became natural.

Within the many years of experience with first aid in the kindergarten a first aid kit has been a normal accessory in the play corner. In addition to visiting the hospital children today visit a physicians and dentist's office in order to introduce them as parts of their normal life and to reduce the children's anxiety when meeting the health-care services.

Learning material in the kindergarten has been adapted over the years through participation of the children in cooperation with the kindergarten teachers. The children's interest and curiosity always improve the experience. First aid has become an important part of the educational work in the kindergarten.

From the kindergarten teachers point of view repetition of first aid training in school is necessary and should have be part of the school curriculum during the whole school education.

Experiences from a Kindergarten in Norway

The kindergarten „Hellemyren barnehage“ is a small kindergarten with 22 children in two groups. A pilot project with first aid teaching was started in the year 2010 by the physician Georg Bollig (specialist in anaesthesiology and acute medicine) and the kindergarten teachers Anne Grete Myklebust and Kristin Østringen. The pilot project led to a scientific article about first aid training in the kindergarten which gained public interest around the world [17]. The project itself is described above, more information can be obtained from the internet link to the article that can be downloaded free of charge [17].

After introduction of first aid as part of a study [17] the kindergarten teachers took responsibility to go on with first aid teaching in the kindergarten. The aim was to incorporate first aid training in the regular educational efforts of the kindergarten for the children from the age of four.

Teaching methods used were:

- a poster displaying the five-finger rule for first aid was designed by the participating children
- a weekly first aid repetition

Empathy and Social Learning as Effects of First Aid Training

There is a great demand for repetition of first aid. Repetition and the use of first aid in the children's daily role play has also led to "covered learning" [see also Lamer, 19]. Covered learning includes learning which is planned by the teachers and other learning which is not planned. There are definitely skills and knowledge children learn that are not part of the curriculum. Covered learning has often been associated with negative focus, e.g. in connection to mobbing in school. Our experiences show that it also has positive implications. The children show a more empathic behaviour and comfort each other if needed after first aid training. This underlines that first aid training improves helping behaviour in general. This has been recognized in both kindergartens in Germany and Norway. In addition the youngest children who did not attend the first aid course received informal training by the older children who participated in the course. This can be seen as an informal peer training through role play in daily kindergarten life. So the younger children learn from the older children who function as role model for helping behaviour. Probably this peer training has more impact on helping motivation than all course curricula can possibly have. Therefore this type of learning should be encouraged and enabled. A simple measure to make this happen is to provide a first aid kit which can be used in a play corner in the kindergarten. These effects of learning from other children have not been planned but just happened as positive effects after establishing first aid training in the kindergarten.

Empathy is an inborn skill, but it has to be developed during childhood [see 20]. During the first aid course the children learn that one child should call for help and another child should stay with the victim and try to comfort him. Experience from the next course in the Hellemøyren kindergarten provided by Østringen og Myklebust showed that repetition in daily role play is important for learning first aid and for the improvement towards a more empathic and helping behaviour. To comfort a crying child is not just learned in first aid, but practised in daily life. So first aid role plays in daily life are repetitions in first aid and learning of social behaviour. In addition to a regular first aid repetition once a week first aid is discussed after situations where first help was needed. This improves the learning through practice and reflection of real first aid situations. Lamer and Hoffman [19,21] have stated that learning social norms as to care for others need internalisation of the norms so that it can be part of oneself and can come from one's own personality. When a moral norm is internalized parents or other adults lose their motivational importance and the children have made the norm their own. This is similar to the aim of first aid training in the kindergarten. First aid shall be a normal day activity and not anything special to do. In addition to social learning the children seem to become more self-confident through training first aid. At present children under the age of four are included in the first aid training as spectators and participants e.g. to establish the recovery position. This leads to inclusion of all children and can strengthen learning for the small children from the other children as role models.

Skill Retention and Need for Retraining

It is well known from the literature that skill retention of basic life support skills significantly declines within 2 months after traditional AHA Heartsaver class as well as video self-training [22].

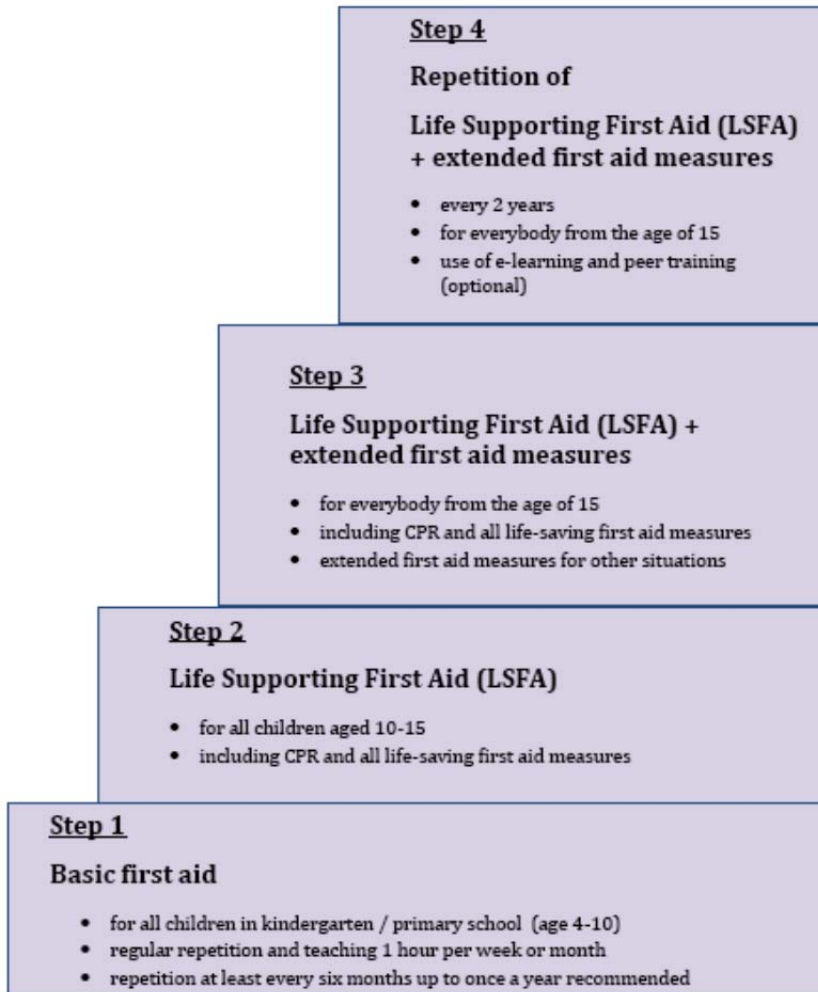


Figure 1. Four-Step-Model of First Aid Education.

Recommended intervals of refresher training for first aid, CPR and automated external has been recommended to be necessary between 7 and 17 months [23,24]. In a previous study it could be shown that skill retention tested 6 months after the course was significantly better for five out of six tested tasks compared to children with no course [9]. This shows that repetition of first aid knowledge and skills is needed but the necessary interval of repetition remains unclear. For practical reasons a first aid course every second month is not possible but a repetition must take place in-between 6-24 months after the initial first aid training. A simple measure introduced in the Hellemyren kindergarten in Bergen is the first aid poster at the wall [17]. This poster can help to remember in repetition sessions as well as in an acute situation. Used once a month it helps to raise awareness about the importance of giving first aid and needed algorithm of applying first aid. The poster serves the same purpose as first aid and CPR posters of the ERC displayed in hospitals or public places. Regular repetition of first aid knowledge and extension of the curriculum throughout the kindergarten and school years up to adulthood could probably lead to an improvement of the motivation to provide first aid

and as well to a better performance in a real emergency situation. Therefore a four-step model of lifelong first aid education is shown in Figure 1.

CONCLUSION

First aid training in the kindergarten is an important part of the educational efforts in the kindergarten. In addition to gaining knowledge about first aid and first aid skills it leads to improved social behaviour, empathy and better helping behaviour in general.

In the future we do need a worldwide consensus on first aid education starting in childhood and continuing as lifelong learning. The European Resuscitation Council has given recommendations for basic life support but there is a lack of European first aid guidelines and guidelines for how to teach first aid to children. In 2007 the Belgian Red Cross proposed European first aid guidelines which should be integrated together with the European Resuscitation Council guidelines in a European first aid manual [14]. Handley suggested the formation of a European Liaison Committee on First Aid [15]. We strongly recommend that the European Resuscitation Council should establish a European working group to make recommendations for basic life support and LSFA training for primary school children. All children should receive first aid training starting already in the kindergarten. Our observations show that also small children under four can profit from first aid training in the kindergarten.

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Chapter 10

THERMAL COMFORT AND AIR QUALITY IN OCCUPIED VENTILATED KINDERGARTEN SPACES

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ABSTRACT

In this paper the thermal comfort and air quality in occupied ventilated kindergarten spaces are evaluated. This review article includes previous results obtained in kindergartens in Mediterranean environment. In the study the natural and forced ventilation, cold environment used in Winter thermal conditions and warm environment used in Summer thermal conditions, are considered. In this paper the numerical and experimental analysis are presented in detail.

In the numerical simulation the building thermal response numerical model, that simulates the kindergarten thermal behaviour and the occupant's thermal response, is presented. In the numerical simulation all building and all internal spaces scheme details are considered.

In the experimental measurements the environmental variables and the subjective responses are used. In the experimental environmental measurements the air temperature, the air relative humidity, the mean radiant temperature, the air velocity and the carbon dioxide are considered. The carbon dioxide, using the tracer gas decreasing concentration, is used to evaluate the air exchange rate, the age of the air or the airflow rate. The adaptive thermal comfort model is developed in a Kindergarten, using subjective and experimental measurements, for cold environment used in Winter thermal conditions and warm environment used in Summer thermal conditions.

Different validations of the numerical model, using numerical values and experimental data, are made. The Summer thermal conditions and Winter thermal conditions, with and without surrounding buildings, are considered in the validation tests.

The numerical and experimental techniques, presented and applied in this paper, are used to increase the thermal comfort level and the air quality level, that the occupants are subjected. For warm environment used in Summer thermal conditions the shading devices and the underground spaces are used, while in the cold environment used in Winter thermal conditions the greenhouse is used.

Keywords: Numerical simulation, experimental measurements, building thermal behaviour, thermal comfort, air quality.

INTRODUCTION

In this review article the building thermal response, the thermal comfort and the indoor air quality, evaluated in kindergarten spaces, are presented. In this work the review of indoor environment comfort in Summer thermal conditions (Conceição et al., 2008A), the energy and thermal comfort in Winter thermal conditions (Conceição et al., 2008B), the indoor greenhouse in Winter thermal conditions (Conceição et al., 2008C), the passive solutions in Summer thermal conditions (Conceição et al., 2009), the passive and active strategies (Conceição and Lúcio, 2010) and the adaptive thermal comfort model applied in indoor ventilated spaces (Conceição et al., 2012), are presented.

A numerical model, that simulates the buildings thermal response and evaluates the occupants' thermal comfort and indoor air quality in transient conditions, is used in the kindergarten thermal response in Summer thermal conditions (see Conceição et al., 2008A).

In Conceição et al. (2008B) the obtained numerical values and the measured experimental data in Winter thermal conditions are compared, the indoor temperature evolution is used to identify potential indoor greenhouse spaces and the occupants' thermal comfort level is evaluated.

The numerical model, that simulates the building thermal response, is used in the application of an indoor greenhouse in the energy and thermal comfort performance in a kindergarten school building (see Conceição et al., 2008C). This numerical model is used to evaluate the kindergarten thermal behaviour and the occupants' thermal comfort levels. In the thermal comfort level the Predicted Mean Vote index and the Predicted Percentage of Dissatisfied people index are used. In the greenhouse implementation the connecting time and the airflow transport way are analysed in detail. In the transport way, from the greenhouse to the indoor cold spaces, the internal ducts system and the internal corridor space are considered.

In Conceição et al. (2008C), in Winter thermal conditions, the study is developed without and with kindergarten indoor greenhouse. In the kindergarten without indoor greenhouse the comparison of the numerical calculated values and the experimental measured data, the indoor temperature evolution, the viability of indoor greenhouse spaces and the indoor thermal comfort level, are analysed. In the kindergarten with indoor greenhouse the indoor temperature evolution and in the indoor thermal comfort level, are analysed.

A building thermal response numerical model is used in the energy and thermal comfort evaluation for different kindergarten passive solutions in Summer thermal conditions (see Conceição et al., 2009). This numerical model, in this study, is used in the evaluation of the building thermal behaviour (using the indoor temperature evolution) and the occupants' thermal comfort levels (using the Predicted Mean Vote index and the Predicted Percentage of Dissatisfied people index), applied in transient conditions.

In Conceição and Lúcio (2010) the building thermal response numerical model is used in the study of kindergarten thermal response, the occupants' thermal comfort and the indoor air quality, in transient conditions. The study is made with natural and forced ventilation,

respectively, for Winter thermal conditions and Summer thermal conditions. In the simulation a real occupation cycle, a passive strategy and an active strategy are implemented, in order to promote acceptable occupant's thermal comfort and indoor air quality conditions, with low energy consumption level.

Finally, in Conceição et al. (2012), the application of a developed adaptive thermal comfort model, in the evaluation of occupants' thermal comfort in ventilated kindergarten occupied spaces, is made. The study, conducted in real conditions, in Mediterranean environment, for cold environment used in Winter thermal conditions and warm environment used in Summer thermal conditions, is made.

METHODOLOGY

In this work a numerical software, that simulates the building thermal behaviour with complex topology and the surrounding buildings, that works in transient conditions, developed by the author in the last years, is used. The software is based on energy balance integral equations and mass balance integral equations. The energy balance integral equations are developed for

- the air inside the several compartments and ducts system;
- the different windows glasses;
- the interior bodies located inside the several spaces;
- the different layers of buildings main bodies and the ducts system.

The mass balance integral equations are developed for:

- the water vapour inside the several spaces;
- the water vapour inside the ducts system;
- the water vapour in the interior surfaces;
- the air contaminants inside the several spaces;
- the air contaminants inside the ducts system.

In the resolution of energy and mass balance integral equations system the Runge-Kutta-Fehlberg method with error control is used.

The model considers the conductive, convective, radiative and mass transfer phenomena:

- The conduction is verified inside the building main bodies and the ducts main bodies layers;
- The convection, verified between the surfaces and the environment, is done by the natural, forced and mixed convection;
- The radiation, verified inside and outside the building, is divided in short-wave and long-wave phenomena. In radiative calculus the shading effect caused by the surrounding surfaces and by the internal surfaces is also considered;
- The evaporation, that considers simultaneously the mass and heat transfer, is verified between the human body surfaces and the environment.

In order to evaluate the thermal comfort level the software considers the Predicted Mean Vote index and the Predicted Percentage of Dissatisfied people index (see Fanger (1970), ISO 7730 (2005) and ASHRAE 55 (2010)).

In the numerical simulation of the kindergarten school building, located in the South of Portugal, the 25 compartments, the 498 building main bodies and the 42 windows glasses, as well as all surrounding main buildings are considered. This building, located in Olhão, has:

- three classrooms, for 3, 4 and 5 years old children;
- spaces for offices;
- spaces for administrative;
- spaces for WC;
- spaces for teachers staff;
- spaces for non-teachers staff;
- spaces for meeting room.

Before applying the numerical model, is necessary to make sure validation tests. In the numerical model validation, indoor air temperature experimental data and numerical values obtained through the numerical model are compared. In the experimental tests the outdoor and indoor environmental variables are measured. The validations in a typical Summer thermal conditions day is presented in Conceição et al. (2008A) and the validations in a typical Winter thermal conditions day are presented in Conceição et al. (2008B). Conceição et al. (2008A) is divided in two parts. In the first one the results consider the surrounding buildings, while in the second one the results do not consider the surrounding buildings. In Conceição et al. (2008B) the results only consider the surrounding building situation.

In order to increase the internal air temperature, in Winter thermal conditions, an internal greenhouse is used. The viability of the introduction of an indoor greenhouse, in the present kindergarten, used to heat the internal cooled spaces, are analysed in Conceição et al. (2008B).

In Summer thermal conditions the internal direct solar radiation should be made. In Conceição et al. (2009) different shading solutions, based in passive strategies, are applied, namely:

- the introduction of a roof placed above the kindergarten;
- the horizontal shading devices placed above the windows level facing South;
- the external pyramidal opaque trees placed in front to the windows facing West and East.

These shading devices passive strategies are used to reduce the indoor temperature level and to increase the indoor thermal comfort level, in Summer thermal conditions. However, only the passive strategies cannot guarantee acceptable thermal conditions. The simultaneous introduction of passive strategies and active strategies, might be very important (see Conceição and Lúcio, 2010).

In Conceição and Lúcio (2010) the passive strategies of the kindergarten are divided in:

- multiple inclined aluminium shading devices placed above the transparent windows level and in front to the transparent door facing South, in the external environmental;
- removable inclined fabrics shading devices placed in front to the transparent windows facing East and horizontal fabrics shading devices placed above the transparent panel levels facing South, South-West and West, in the external environmental.

In the active strategies, in Winter thermal conditions and Summer thermal conditions, this study is made with natural and forced ventilation (see Conceição and Lúcio, 2010).

- In Winter thermal conditions the forced ventilation, from an internal greenhouse to heat the internal occupied cold spaces, is used however, in the other indoor spaces the natural ventilation is used.
- In Summer thermal conditions the forced ventilation from the cold external environment to the indoor spaces is used during the night and the forced ventilation from the stored cold air in the underground spaces is used during the day.

Finally, in order to evaluate the thermal comfort level that the occupants of this kindergarten are subjected, in this work an adaptive thermal comfort model is developed and used. In Conceição et al. (2012) three different trained groups of subjects are used in the development of the adaptive thermal comfort model. Each subject of each group expressed the thermal subjective response, in different kindergarten classrooms, for cold environment used in Winter thermal conditions and for warm environment used in Summer thermal conditions. In each experimental test the environmental experimental measurement is also made.

The natural ventilation verified in the indoor classrooms is evaluated using the tracer gas decreasing concentration method, while the verified forced airflow verified in the indoor playground is numerically calculated. The experimental measurements made in natural ventilation are made for different window states, from close state to open state (see Conceição et al., 2012).

In cold environment used in Winter thermal conditions the forced airflow is done from the greenhouse to the indoor playground. In warm environment used in Summer thermal conditions, the forced ventilation is done in the opposite direction (from the playground to the indoor greenhouse). The developed adaptive thermal comfort model is used to evaluate the thermal comfort level, while the carbon dioxide concentration released by the occupants is used to evaluate the air quality level evaluation (see Conceição et al., 2012).

RESULTS

In this review article, in accordance with the numerical and experimental obtained results, the occupant's thermal comfort and indoor air quality, verified in kindergarten spaces, are evaluated. The indoor environment comfort in Summer thermal conditions, the energy and thermal comfort in Winter thermal conditions, the indoor greenhouse in Winter thermal

conditions, the passive solutions in Summer thermal conditions, the passive and active strategies and the adaptive thermal comfort model, are evaluated.

In accordance with the numerically obtained results, the agreement between the numerical values and the experimental data is better when the introduction of the surrounding buildings is considered than when the introduction of the surrounding buildings is not considered (see Conceição et al., 2008A).

The validation of the numerical model, that considers the kindergarten school building and the surrounding buildings, in Winter thermal conditions, shows good agreement between the numerical values and the experimental data (see Conceição et al., 2008B).

In Conceição et al. (2008B) is verified that the classrooms with small window area turned North present the lowest indoor air temperature values and the hall with large windows area turned South and West present the highest indoor air temperature values. The warm air in the hall can be used to warm the classrooms with windows turned North. To transport this warm air, from the greenhouse (hall space) to the classrooms with windows turned North, internal ducts or internal corridor can be used.

In Winter thermal conditions, the classrooms with windows turned North are thermally uncomfortable and the classrooms with windows turned South are thermally comfortable (see Conceição et al., 2008B).

In another study, similar with the previous, with the objective to introduce the indoor greenhouse, the classrooms with windows turned North present the lowest indoor air temperature values, while the hall with windows turned South and West present the highest indoor air temperature values. The hall, applied as greenhouse, is used to warm the air to be used in the classrooms with windows turned North (see Conceição et al., 2008C).

In this study, using an internal ducts system or a corridor space to transport the warm air, from the greenhouse to the indoor coldest spaces, is recommended that the forced ventilation system in the greenhouse should be not connected before the 9 a.m. and should be disconnected after the 19 p.m. (see Conceição et al., 2008C).

In accordance with the obtained results, in Conceição et al., 2008C, is verified that one air renovation promotes highest thermal comfort conditions in the afternoon and two air renovations promote highest thermal conditions in the morning. When an indoor corridor space is used, to transport the warm airflow from the greenhouse to the cold classroom space, the thermal comfort levels verified in the North classrooms are lightly lower than when a ducts system is used, to transport the warm airflow from the greenhouse to the cold classroom space. The thermal comfort level in the corridor space is higher when the warm airflow is transported in the corridor space than when the warm airflow is transported in the ducts system. The thermal comfort level in the hall is higher when two air renovations are used than when one air renovations is used (see Conceição et al., 2008C).

The introduction of passive strategies, in Summer thermal conditions, can be used to increase the thermal comfort level that the occupants are subjected. The introduction of a new roof above the kindergarten, horizontal shading devices placed above the windows level, facing South, and external pyramidal opaque trees placed in front to the windows facing West and East, are numerically analysed (see Conceição et al., 2009). In accord to the obtained results, the shading device promoted by the new roof and the horizontal shading devices placed above the windows level are thermally efficient, because when this passive strategy can promote shading device the kindergarten is not simultaneously subjected to shading due to the surrounding buildings. Nevertheless the external pyramidal opaque trees are not

thermally efficient, because when the trees can promote shading device the kindergarten is subjected to shading due to the surrounding buildings.

When the kindergarten, the surrounding buildings, the horizontal shading devices placed above the windows level and the roof place above the kindergarten are considered (see Conceição et al., 2009) the thermal comfort level, in general, is acceptable. However, in some spaces, the thermal comfort level is not acceptable.

The simultaneous introduction of passive and active strategies, can be used to increase simultaneously the occupants' thermal comfort level and the indoor air quality. In Conceição and Lúcio (2010) the passive strategy developed guarantees a maximum solar radiation during Winter thermal conditions and guarantees a minimum solar radiation during Summer thermal conditions. In the active strategies, without forced ventilation, the indoor air quality is not acceptable, while with forced ventilation, in general, the indoor air quality is acceptable. In Winter thermal conditions, when the greenhouse to heat the air is used, is suggested that the forced ventilation should be not connected before the 10 a.m. In Summer thermal conditions the forced ventilation uses the cold air from the outdoor environment during the night and use the cold air from the underground space during the morning and afternoon in order to reduce the air temperature level. The combination of passive and active strategies developed in this work guarantees, in general, acceptable occupants' thermal comfort and indoor air quality conditions in the occupation spaces with low energy consumption level.

In Conceição et al. (2012) the obtained results can be used to define strategies for building ventilation, in order to obtain a good compromise between the indoor air quality and occupants' thermal comfort. The strategy considered in Winter thermal conditions considers the natural ventilation in the classrooms, with 50% of window open area, and forced ventilation from the hall (working as greenhouse) to the indoor playground, while the strategy considered in Summer thermal conditions considers natural ventilation in the classrooms, with 100% of window open area, and forced ventilation from the indoor playground (cold space) to the hall.

The developed adaptive Predicted Mean Vote index, made in Conceição et al. (2012), is based in a linear regression and is function of the indoor air temperature, indoor air relative humidity, indoor air velocity, indoor mean radiant temperature, clothing level, activity level and outdoor temperature. In accordance with the obtained results, in the warm environment used in Summer thermal conditions the adaptive Predicted Mean Vote index is lower than the Predicted Mean Vote index. In cold conditions (in Winter thermal conditions) the adaptive Predicted Mean Vote index is higher than Predicted Mean Vote index.

According to the adaptive thermal comfort model (see Conceição et al., 2012), in Winter conditions, the thermal comfort levels is acceptable, while in Summer conditions the thermal comfort level is near the acceptable limit. According to the obtained results the indoor air quality (see Conceição et al., 2012), in Summer thermal conditions is acceptable, while in Winter thermal conditions is near the acceptable limit.

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