Original Article

Pre-School Age Children's Perceptions on Perpendicularity through Drawing

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Abstract

Background: In recent decades, both researchers from the fields of psychology and educational field, highlight the importance of material space in the development and learning concepts. They attempt to investigate and introduce concepts associated with both the space and with forms of representation of it. They research the abilities of children to understand and use these representations.
Aim: to investigate the ability of preschool children to understand the meaning of verticality. Specifically, the research based on the theory of double coding, verbal and iconic. Each child was asked to paint a pine tree in three points of the mountain (on the top of the mountain, on a hillside with small slope, on a hillside with big slope) and the path to follow if pine nuts fall from the tree.
Results: Respondents are 31 preschool children (4-6 years), 16 girls and 15 boys. The results from both the verbal and the iconic analysis showed that the majority of children, regardless of gender, who were asked to reconstruct the tree on top of the mountain, designed vertically, and when asked to design the slopes placed it almost perpendicularly onto the corresponding line of the mountainside. This confirms the theory Piaget's according to which children under seven years old are unable to represent the space and tend to make this mistake because they do not understand the concept of vertical, influenced by local characteristics (hillsides). Indeed the majority of children seem to draw in the same way, the route of the pine falls.

Key - words: Preschool education, representation of space, double coding, vertical axes

Introduction

During the first development stage, children are passive in their explorations. By touching different parts of a shape, they get different haptic perceptions. Gradually children become aware of the actions, the involving operations, and subsequently acquire a global perception of the shape. The inability of young children to draw a copy indicates that the coordination of actions lies on the conceptual development of space. At that stage, children's copies of geometrical shapes initially represent the topological characteristics, despite those shapes not looking all that different from each other. The inaccuracies in the drawing can be attributed to the motor challenges children face, yet this explanation is not shared by Piaget and Inhelder (Richmond, 1986; Piaget & Inhelder, 1997; Torres και Ash, 2007).

At the stage of symbolic intelligence (second stage; 2-6 years) there is a gradual differentiation in the Euclidean shapes; the square and the rectangle is accurately reproduced, whereas the angle and the inclination take longer to develop. These challenges are overcome only at the stage of concrete operations (third stage, 6-12 years) (Piaget & Inhelder, 1997).

Projective relationships are formed once the shape is not viewed separately but examined in relation to a point. At a very young age, children are aware of a straight line but are incapable of aligning objects, they rather tend to form a curved line. This is not a perception issue. They realise that the line is not straight, yet they cannot draw it differently. Children see objects in a two-dimensional frame of reference. This indicates an innate tendency, a potentiality to organise objects in a two-dimensional or three-dimensional frame of reference. The realisation and perception of space does not begin with such an organisation, but rather the frame itself is the result of the development of Euclidean space (Piaget & Inhelder, 1997, McLeod, 2015).

Contrary to Piaget, who maintains that cognitive structures provide the basis of development, Vygotsky believed that knowledge occurs first in a social context before being integrated in the cognitive structures of the individual, and therefore emphasized the pivotal role of social element in development (Feldman & Fowler, 1997 Bodrova & Leong, 2005). Vygotsky's two fundamental notions of his theory is the Zone of Proximal Development, according to which the skills developed by a child are mastered with the help of more knowledgeable individuals and the notion of scaffolding, that is the appropriate arrangement and organisation of the child's experiences during the learning process (Vygotsky, 1931; DeVries, 2000; Shaffer & Kipp, 2014).

Science Education in pre-school years

According to the bibliography, there is an apparent interest in Science Education during pre-school years (Gelman 1998 Johnson 1998 Ravanis & Bagakis 1998). This type of education constitutes an intricate process, as well as an organised and complex effort on the part of toddlers to transition "from undifferentiated observation to actual studying of the natural world" (Tzimogiannis, 2002; Osborne et al., 2003). Science Education in pre-school years differs from the other levels of education (Ravanis et al., 2004) since it aims at the development of exploratory learning skills through observation and experimentation (Unal et al., 2010), as opposed to the mere transmission of knowledge (Alabay 2009, Unal et al., 2010).

According to Chalufour & Worth (2003), delving in Science Education benefits pre-school age children immensely, as it exploits the toddlers' innate curiosity and their motivation to learn and explore the world that surrounds them, leading them to scientific literacy in kindergarten.

The concept of perpendicularity

The perpendicular is a straight line defined by each spatial point and the centre of the Earth. The scientific concept of space is determined by three concepts: a) the concept of topological space (the relationships of proximity, separation, order and continuity of the elements), b) the concept of projective space (projective straight line, perspective, projection of shadows, correlation of perspectives, imaginary sections and developments of surfaces) and c) the concept of Euclidean space (parallels, similarities and the proportions of shapes, horizontal, vertical, coordinate system) (Piaget & Inhelder, 1997).

Aim

Aim of this research is to investigate the ability of preschool children to understand the meaning of verticality. Specifically, the research based on the theory of double coding, verbal and iconic. Each child was asked to paint a pine tree in three points of the mountain (on the top of the mountain, on a hillside with small slope, on a hillside with big slope) and the path to follow if pine nuts fall from the tree.

Methodology

Target group and Sample

The target group of the research consisted of pre-school children aged 4-6, attending nursery centres in the area of Attiki. The sample of this qualitative study was one of convenience, comprising 31 pre-school children, 16 girls and 15 boys of middle socioeconomic class attending two nursery centres in the Prefecture of Attiki.

Research tool: The research tools in this study were drawing and an interview with each child in order to determine the reasons they drew in their own specific way. Drawing is a "language", a medium through which children express their thoughts that would otherwise remain unknown or partially grasped by educators (Barrett, 1983; Kress, 1997; Anning & Ring, 2004; Rose, Jolley & Burkitt, 2006).

Interview: Complementary to the drawings, during the non rigidly structured interview the children's comments and answers were collected. All children were asked the following core question: "If we cut a pine cone or an apple, which course is it going to follow and where is it going to fall onto?" Furthermore, there was a broader discussion, a dialogue between researcher and child, where additional clarifications were asked as to the position of the trunk (Kvale 1996).

Procedure: The study was conducted in March-April 2015 and lasted 15 days. Access to two nursery centres was asked and permission to collect data was granted to me. The whole procedure of drawing and interviewing lasted 10 to 15 minutes for each child. Initially, each child was approached and given all relevant materials, drawing paper and markers. Then s/he was asked to draw a tree with a pine cone, placing it on a mountain, in three different positions (A peak, B small angle slope, C big angle slope). Each child was asked the following question: "If we cut the pine cone with a pair of scissors, where would it fall, what would its course be?" Each answer was recorded and coded by the researcher in relation to the drawing. After 15 minutes, the children's drawings were collected and additional verbal explanations about them, ensuring through the discussion between the children and the researcher, were recorded. Data collection in both nursery centres was performed by the researcher herself, in the creative occupation classrooms.

Analysis

The positioning of the tree on the mountain (vertically or horizontally) was analysed according to Piaget's theory on child's conception of space (Piaget & Inhelder, 1956) and on Science Education, as well as according to Paivio's Dual Coding Theory (1971, 1986), whereas the fall trajectory of the pine cone and the answers provided were analysed through the Constant Comparative Method (Glasser, 1965).

The children's drawings and answers were coded and categorised, allowing the researcher to group them in specific categories, presented in the following chapter. The content analysis was conducted according to two axes of reference. Firstly, two criteria were taken into consideration (the tree's trunk and the pine cone's trajectory) in relation to the concept of perpendicularity. Secondly, the children's drawings were compared against the explanations provided during the interviews.

Ethics and code of conduct

Prior to the research, parents whose children were involved in it were informed as to the aim and the manner of conducting it, to ensure their consent.

Results

The following categories revealed from the data content analysis.

1. Virtual and verbal analysis results

2. The sense of perspective

3. The pine orbit compared with the trunk of the tree

4. Comparison of visual and verbal works

Virtual and verbal analysis results

Respondents were 31 pre-school children, 16 girls and 15 boys. The researcher analyzed the data (paintings and children's responses) according to the "Dual Coding Theory". Both the verbal and the virtual analyses indicates that, most of those kids which are called to represent the tree at point A (top) design it vertically, and when they asked to design the tree at points B and C (slopes) then the children place the tree almost vertically onto the corresponding line of the mountainside. Indeed, the majority of children seem to draw in the same way the pines' path that will fall. The images (2,3) below shows the above.

In figure 2 the little girl painted the tree at point A and pine nuts fall "down here," as the child said. At point B, painted the tree and the pine nuts to fall at that point that looks on the picture, because the girl answered «the trunk of the tree is so,". Finally, at point C the child painted the third tree with the pine cone falls almost in the center of the mountain because the girl said again “So goes the tree”. When the girl asked why the tree is 'crooked', the child pondered and simply replied that "because it is on the mountain".

In figure 3 at point A, the little girl painted the tree and the pine nuts to fall slightly below that. At point B, the child painted again a tree in line with the hillside and pine nuts to fall slightly below without knowing why the tree leaning. Finally, at point C, she designed in the same way a tree and an apple to fall slightly below this, responding that “the apple cannot fall on the other side of the tree” but without knowing why. Only 2 children, a girl (Figure 4) and a boy answered correctly on the position of the tree and the trajectory of the pine at the three points. Below are the draws of the girl, which was corrected after the exhortation.

In figure 4 at point A the little girl painted the tree and the pine that will fall properly. At point B painted a similar tree and the pine nut to fall just below the top of the mountain. When the girl asked “why the pine falls there?” she changed her mind saying it should fall to the point B instead of point A. At point C, the girl drew the third tree and the pine nut falling near the tree. Then, the question was the same as before and the girl showed the point B again, as the point that eventually the pine will fall instead of point A. Table 1 briefly shows the results of virtual analysis of children's drawings.

Table 1. presents the virtual analysis results from drawings of preschool children.

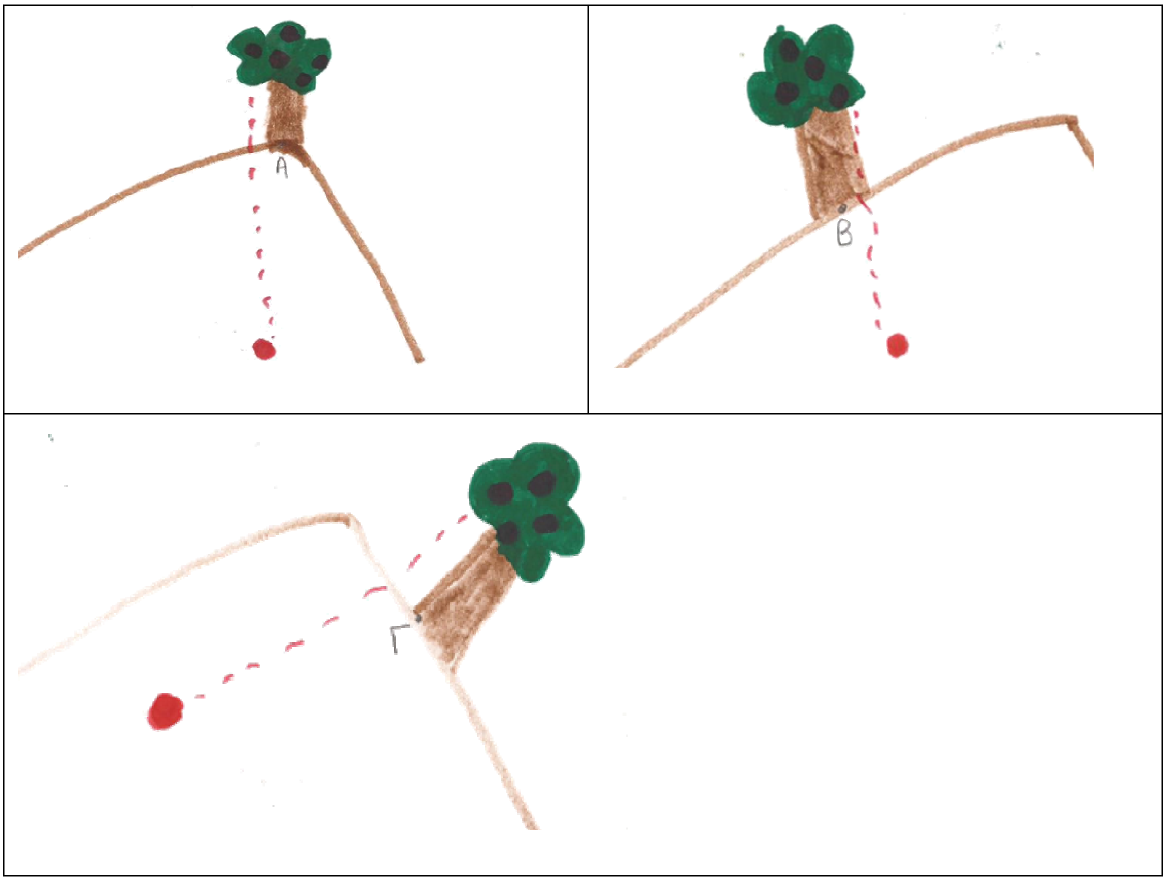

Figure 2. Representation of the tree mountain (peak, big slope, small slope) and the pines' fall.

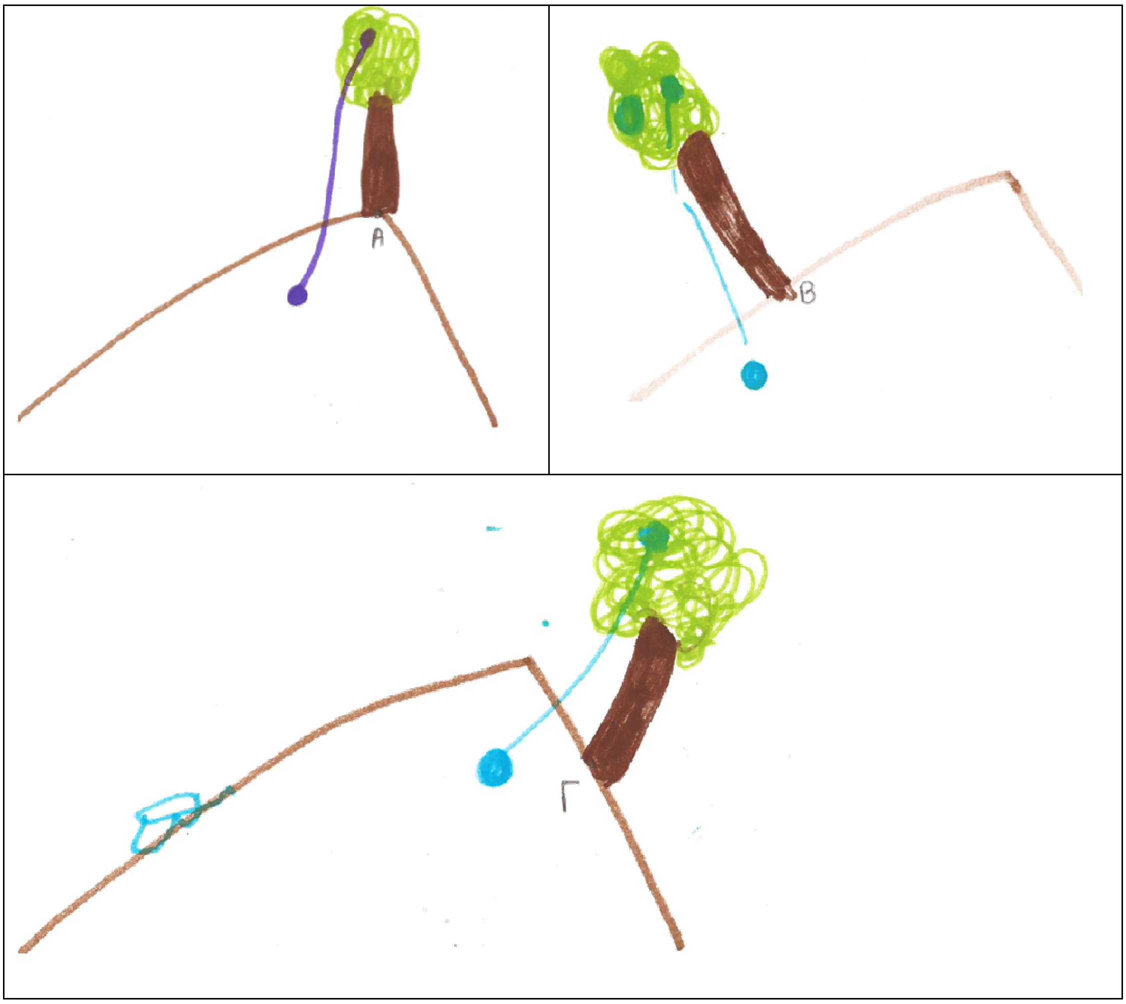

Figure 3. Representation of the tree mountain (peak, small and big slope) and the pines' fall.

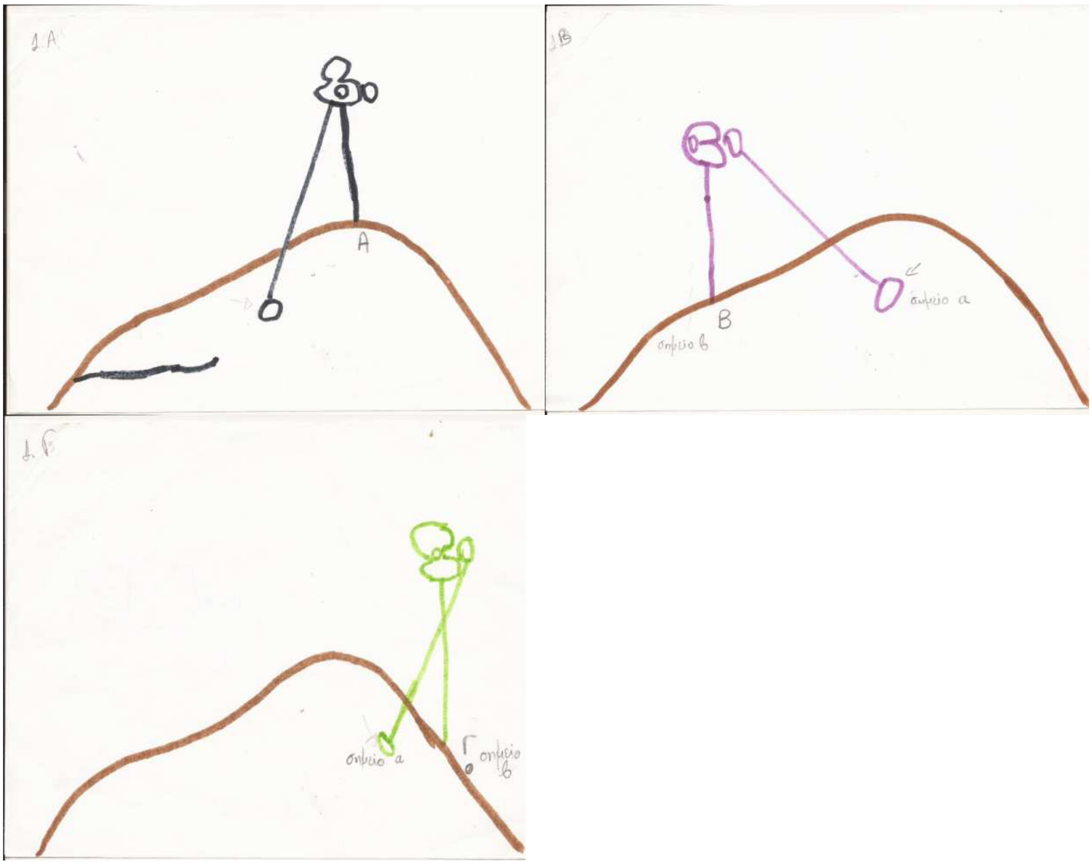

Figure 4. Proper design of the tree and the falling pine

Table 1. Virtual analysis results from drawings of preschool children.

A/A	SEX	TOP	SLOPE	SLOPE	TOP (Pine orbit)	SLOPE (Pine orbit)	SLOPE (Pine orbit)
1	**Girl**	*Right*	*Right*	*Right*	*Wrong*	*Right after the intervention*	*Right after the intervention*
2	**Girl**	*Right*	*Wrong*	*Wrong*	*Wrong*	*Wrong*	*Wrong*
3	**Boy**	*Right*	*Wrong*	*Wrong*	*Right*	*Wrong*	*Wrong*
4	**Girl**	*Right*	*Wrong*	*Right without perspective*	*Wrong*	*Wrong*	*Wrong*
5	**Girl**	*Right*	*Wrong*	*Wrong*	*Right*	*Wrong*	*Wrong*
6	**Boy**	*Right*	*Wrong*	*Wrong*	*Right*	*Wrong*	*Right*
7	**Boy**	*Right*	*Wrong*	*Wrong*	*Right*	*Wrong*	*Wrong*
8	**Boy**	*Right*	*Wrong*	*Wrong*	*Right*	*Wrong*	*Wrong*
9	**Boy**	*Right*	*Wrong*	*Wrong*	*Wrong*	*Wrong*	*Wrong*
10	**Boy**	*Right*	*Wrong*	*Wrong*	*Wrong*	*Wrong*	*Wrong*
11	**Boy**	*Right*	*Wrong*	*Wrong*	*Wrong*	*Wrong*	*Wrong*

12	**Girl**	*Right*	*Wrong*	*Right without perspective*	*Wrong*	*Wrong*	*Wrong*
13	**Girl**	*Right*	*Wrong*	*Right without perspective*	*Wrong*	*Wrong*	*Right*
14	**Girl**	*Right*	*Wrong*	*Wrong*	*Right με παρέμβαση*	*Wrong*	*Wrong*
15	**Girl**	*Right*	*Wrong*	*Wrong*	*Wrong*	*Wrong*	*Wrong*
16	**Boy**	*Right*	*Wrong*	*Wrong*	*Right*	*Right*	*Right*
17	**Girl**	*Right*	*Wrong*	*Wrong*	*Right*	*Wrong*	*Wrong*
18	**Girl**	*Right*	*Wrong*	*Wrong*	*Right*	*Wrong*	*Wrong*
19	**Girl**	*Right*	*Wrong*	*Wrong*	*Right*	*Wrong*	*Wrong*
20	**Girl**	*Right*	*Wrong*	*Wrong*	*Right*	*Wrong*	*Wrong*
21	**Boy**	*Right*	*Wrong*	*Wrong*	*Right*	*Wrong*	*Wrong*
22	**Girl**	*Right*	*Wrong*	*Wrong*	*Right*	*Wrong*	*Wrong*
23	**Girl**	*Right*	*Wrong*	*Wrong*	*Right*	*Wrong*	*Right*
24	**Girl**	*Right*	*Wrong*	*Wrong*	*Right*	*Wrong*	*Wrong*
25	**Boy**	*Right*	*Wrong*	*Wrong*	*Right*	*Wrong*	*Wrong*

26	**Girl**	*Right*	*Wrong*	*Wrong*	*Wrong*	*Wrong*	*Wrong*
27	**Boy**	*Right*	*Wrong*	*Wrong*	*Right*	*Wrong*	*Wrong*
28	**Boy**	*Right*	*Right*	*Right*	*Right*	*Right*	*Right*
29	**Boy**	*Right*	*Wrong*	*Wrong*	*Right*	*Wrong*	*Wrong*
30	**Boy**	*Right*	*Wrong*	*Wrong*	*Right*	*Wrong*	*Wrong*
31	**Boy**	*Right*	*Wrong*	*Wrong*	*Wrong*	*Wrong*	*Wrong*

Table 1 briefly shows the results of virtual analysis of children's drawings.

Sense of Perspective

In almost all the children's drawings the tree on the mountainside not shown with an extension of the trunk (perspective) but projected at the same level around an axis or point, which indicates that the preschool child has not yet developed a sense of perspective . This can be seen from the drawings of children surveyed where in many cases depicted trees on the mountain to be at right angles to the side of the mountain and in many cases, while they made perpendicular to the base of the mountain, there was no extension of the trunk (Figure 5).

Specifically, the results of children's drawings analysis shows that all children painted the tree right on top of the mountain. Only a girl and a boy painted correctly the tree on the slopes of the mountain, and three other girls painted correctly the tree on the slope steep but without extension of the trunk to the mountain (the tree seems to hover).

The pine orbit compared with the trunk of the tree

Regarding the orbit of pine, 19 children, 11 boys and 8 girls painted the right path pine falling from the tree on the mountain top (Figure 2, 3). One of the girls surveyed painted properly the path pine to position A after intervention (Figure 6).

In figure 6 all, the little girl asked to paint on top of the mountain a tree. After, she drew the pine nut and in the question “were the nut will fall if we cut it and what path will do?” she drew the line at the right next to the mountain. Then she asked "Oh, it will stop next to the mountain, not on the mountain?" So the child made a second thought and drew the second line just under the tree and on the mountain.

In Figure 8, the boy painted tree and pine nuts fall to the base of the mountain by answering: "That goes down." Therefore, verbal and virtual analysis of the fall of pine indicates that children are unable to understand the meaning of verticality, and compared with the design of trees in different positions, there is no significant variation. At A position the correct answer for the tree is 31 and for the pine fall is 20. At B position, the correct answer for the tree is 2 and 3 for the pine nuts. At position C, the correct answer for the tree is 4 and for pine nuts 6. Considering the above, we cannot conclude whether the perception of verticality can be seen more easily on the bodies that move (like this drop of pine) and less for static (as the tree).

The rest 11 children painted the right path pine falling from the tree at the top of the mountain.

Figure 5. Design of the tree on the mountainside

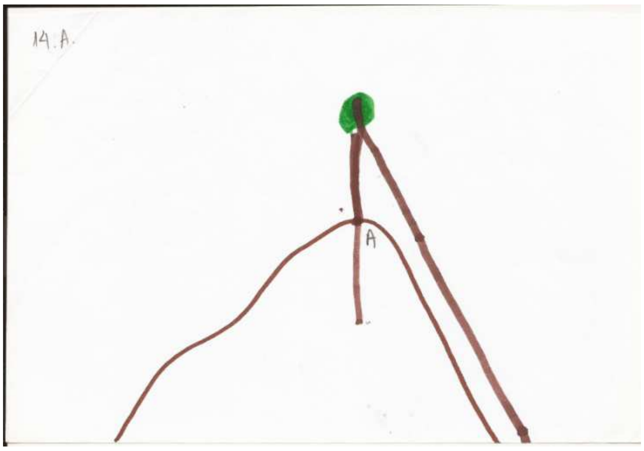

Figure 6. **The pine orbit after intervention.**

Figure 7. Orange orbit design - The girl here did not answer anything.

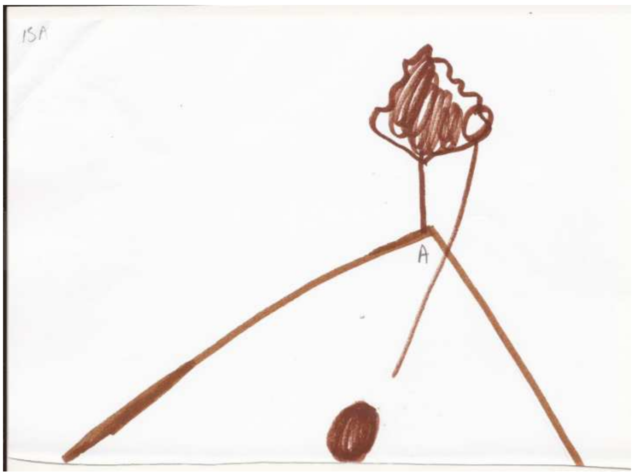

Figure 8. **Pine orbit design**

Comparison of graphic and verbal works

Examining the graphic works (paintings) and the verbal works (responses to the comments and questions of the investigator) of children reveals the following observations.

Children respond according to what they draw either it is right or wrong. For the positions B and C, 25 of the 31 children tried to give their own explanations for why the pine nut falls to the point that they did or why the tree is crooked. So there were answers that justify the position of the tree (Figures 9, 10) or the path of the pine (Figures 11, 12)

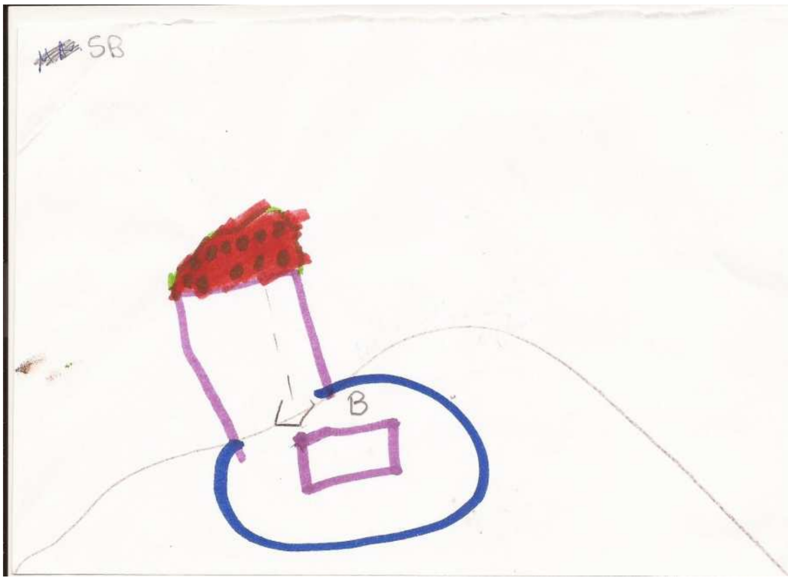

Figure 9. Tree trunk design and explanation - To the he second point the child painted the tree in line with the hillside because the mountain is crooked.

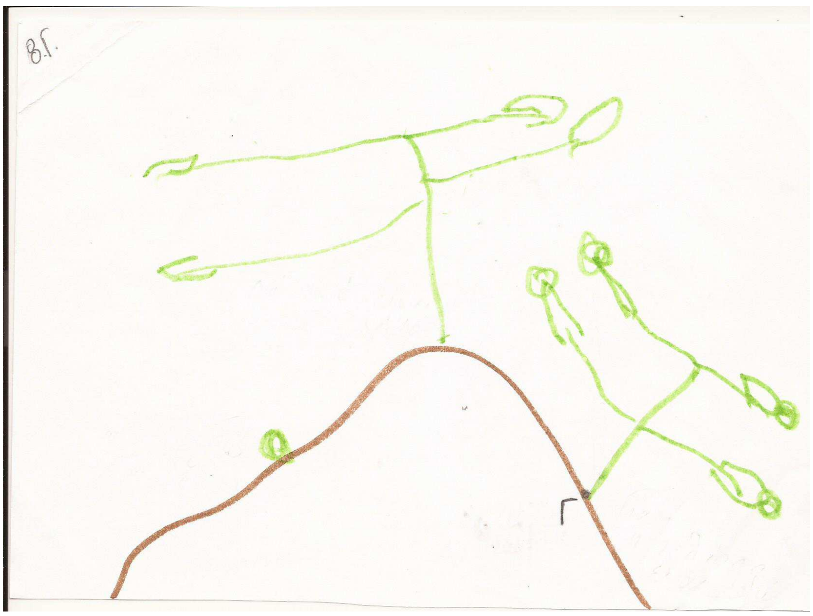

Figure 10. **Tree trunk design and explanation - In the question "why the tree leans?" the child answered "The dot is here and not at the top."**

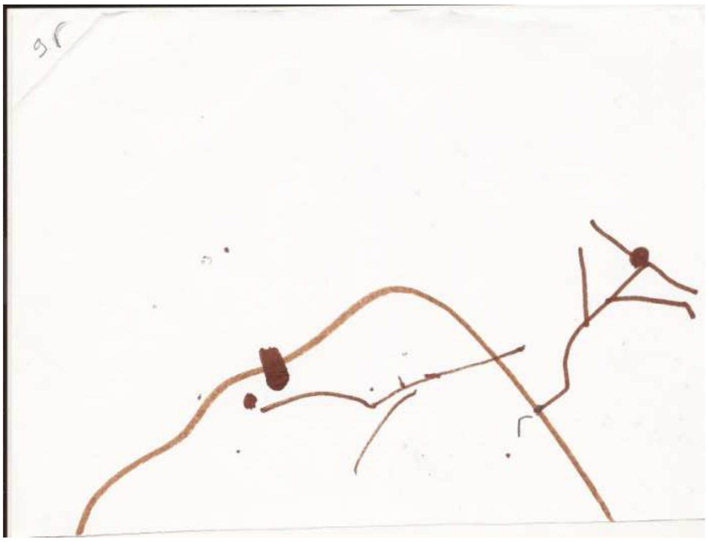

Figure 11. Fall pine design with explanation - The boy asked from the researcher "why the pine falls from the other side of the mountain?" and he replied "because there is no tree on the other side".

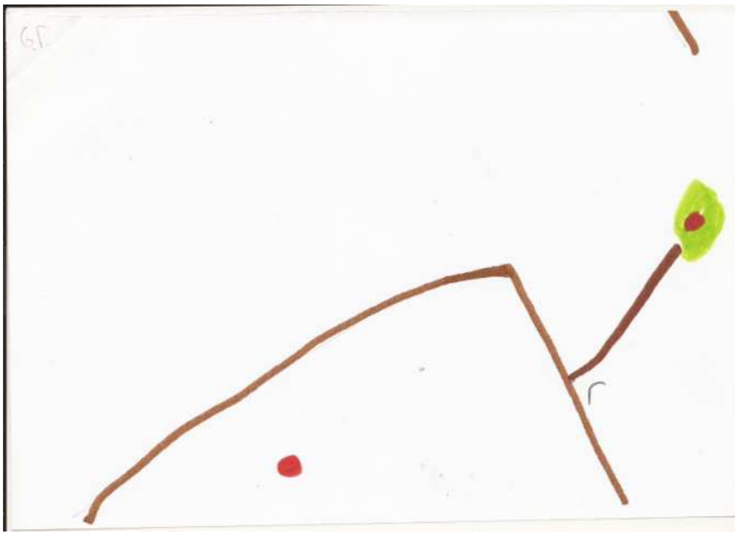

Figure 12. Drawing the apple fall and explanation - The child asked "why the apple falls on the other side?" and he responded "the apples are round and fall everywhere".

Discussion

The results of the analysis validate Piaget's theory according to which children under the age of seven are incapable of representing space and usually make an alignment mistake (aligning the tree onto the slope) since they fail to grasp the concept of perpendicularity (or the Euclidean Coordinate System), being influenced by the spatial characteristics already in place.

This conclusion was verified both by the trunk's drawings as well as the pine cone's trajectory.

As highlighted by Piaget and Inhelder (1997), pre-school children view objects in a two-dimensional frame of reference, which poses a difficulty in the development of the Euclidean space. This means that there is an innate tendency, a potentiality to organise objects in a two-dimensional or three-dimensional frame of reference.

It is evident that these children are in the stage of Preconceptual Thought (Piaget), more specifically in the Intuitive Thought stage, in which the child's basic skills lay on apparent conceptual aspects and not the more complex properties adults utilise.

By applying the Dual Coding theory, it becomes apparent that "it is better in education to use multiple codes of representing information than merely one (e.g. verbal coding). The conclusion drawn through a multitude of studies applying the combined use of two ways of representation is that the use of multiple representation codes enhances learning. According to the Dual Coding theory, combining two models (verbal and visual) and connecting their elements to previously acquired knowledge recorded in long-term memory, creates solid paths of information retrieval (meaning the child remembers more easily), which ultimately aids learning (Dimitriades, 2008).

The bibliography provides several research studies whose results perfectly support the Dual Coding theory, such as (Dimitriades, 2008) the experiment conducted by Nugent (1982), where better learning results were recorded when presentation of information combined "text and illustrations" or "sound (narration) and illustrations", that is when both the verbal and the visual channel were activated. On the contrary, learning results were poor when the same content was presented using text, sound, or illustrations separately. Another pertinent experiment was the one conducted by Levin, Bender and Lesgold (1976). A story was orally presented to a group of children in the following ways: a) one sentence at a time, b) the same sentence twice in a row and c) a sentence accompanied by an illustration. Recall tests results showed that retrieval of information was better achieved when text and illustrations were combined.

During the research conducted by Mayer and Anderson (1991), 102 adult college students were divided in three groups. Group 1 viewed an animation depicting the operation of a bicycle tire pump while listening to a verbal description, Group 2 listened only to the verbal description, Group 3 watched only the animation. Group 1 (animation and narration) performed better than the other two groups (Group 2: narration alone, Group 3: animation alone) whose results were similar.

In another research study combining text and illustrations, Mayer and Moreno (2000) state that "in three out of four different tests administered, students achieved better learning results through animation and narration combined than through narration alone" (Mayer & Anderson, 1991, Mayer and Anderson, 1992). The conclusion to be drawn is that combining multiple representation codes (multimedia) to present information leads to deeper learning than using solely one code (monomedia).

Consequently, in the study in question, it was deemed corroborative to have children express their thoughts through both processing channels (what they see and how they can explain what they see). Information received from both channels was complementary and aligning.

Educational practices

In order to facilitate children's transition through the stages of cognitive development and comprehension of the concepts studied, as well as to encourage the externalisation of children's internal representations of these concepts, various experiments are suggested.

One such experiment could be the following, conducted by Piaget and Inhelder (1997). Children were shown vases of coloured water and were asked to predict the spatial orientation of water level when the vase was tilted. To examine the perception of perpendicularity, a line of sinkers was fixed hanging in a similarly tilted empty vase.

Moreover, pre-school educators could introduce New Technologies by creating digital representations of the concepts of perpendicularity and verticality on a computer.

The socio-cognitive frame offers numerous possibilities for such activities. As proven by this experiment, in accordance with the cognitive stage of pre-school children, several constructive methods may be applied in class with the active participation of toddlers in activities directly related to nature, in an actual natural environment.

Recommendations for further research

Recommended further research would be the study of the perceptual ability of the same children as regards space and perpendicularity, through observation of the fall of a fruit from a tree or following various activities in the context of learning process. The aim would be to assess any changes in the perception of the topological characteristics through observation or learning activities. Furthermore, the same study could be extended to children of school age in order to determine the perception of perpendicularity and its spatial representation in different age groups in order to verify Piaget's theory.

References

Anning, A. & Ring, K. (2004). Making sense of children's drawings. London: Open University Press.

Alabay E. (2009). Analysis of science and nature corners in preschool institutions. (Example of Konya province). Procedia Social and Behavioral Sciences 1, 857–861.

Barrett, M. (1983). The study of children's drawings: Piagetian and experimental approaches. Early Child Development and Care, 12, 19-22.

Bodrova E. & Leong D. (2005). High Quality Preschool Programs: What Would Vygotsky Say? Early Education & Development. Volume 16, Number 4, October 2005.

Chalufour, I., & Worth, K. (2003). Discovering nature with young children. St. Paul, MN: Redleaf.

Dimitriades S. 2008. Theories of Learning & Educational Software. Aristotle University of Thessaloniki. Computer Science Department. Version 1.0.

DeVries R. (2000). Vygotsky, Piaget, and education: A reciprocal assimilation of theories and educational practices. New Ideas in Psychology, 18:187–213. http://www.sciencedirect.com/science/article/pii/S0732118X00000088

Feldman Dh & Fowler Rc. (1997). The nature(s) of developmental change: Piaget, Vygotsky, and the transition process. New Ideas in Psychology, 15:195–210

Gelman S. A. (1998), Concept development in preschool children, Dialogue on early childhood science, mathematics, and technology education, Washington, DC: project 2061, American Association for the Advancement of Science. http://www.project2061.org/publications/earlychild/online/context/gelman.htm

Kvale S (2006). Dominance Through Interviews and Dialogues *Qualitative Inquiry* 2006; 12; 480

Kress, G. 1997. Before writing: Rethinking the paths to literacy. New York: Routledge. London. SAGE

Levin, J.R., Bender, B.G., & Lesgold, A.M. (1976). Pictures, repetition, and young children's oral prose learning. AV Communication Review, 24, 367-380.

McLeod, S. A. (2015). Cognitive Psychology. Retrieved from www.simplypsychology.org/cognitive.html

Mayer, R. E., & Anderson, R. B. (1991). Animations need narrations: An experimental test of a dual-coding hypothesis. Journal of Educational Psychology, 83, 484-490.

Mayer, R. E. & Moreno, R. (2000). A coherence effect in multimedia learning: The case for minimizing irrelevant sounds in the design of multimedia instructional messages. Journal of Educational Psychology, 97, 117-125

Nugent, G. (1982). Pictures, audio, and print: Symbolic representation and effect on learning. Educational Communication and Technology Journal, 30, 163-174.

Pahl, K. (1999). Transformations: Meaning making in a nursery. Stoke on Trent: Trentham Books.

Piaget, J. (1977). Epistemology and psychology of functions. Dordrecht, Netherlands: D. Reidel Publishing Company

Piaget, J. and B. Inhelder (1997). A Child's Conception of Space (F. J. Langdon & J. L. Lunzer, Trans.). New York: Norton (Original work published 1948)

Ravanis, K. & Bagakis, G. (1998). Science Education in Kindergarten: Sociocognitive perspective. International Journal of Early Years Education, 6(3), pp. 315-327.

Ravanis, K., Koliopoulos, D. & Hadzigeorgiou, Y. (2004). What factors does friction depend on? A socio-cognitive teaching intervention with young children. International Journal of Science Education, 26(8), pp. 997-1007.

Richmond P. (1986). Introduction to the Piaget theory. Hypodomi Publ, Athens

Rose, S. , Jolley, R. & Burkitt, E. (2006). A Review of Children's, Teachers' and Parents' Influences on Children's Drawing Experience. *The International Journal of Art and Design Education*, *25*(3), 341-349

Shaffer D. & Kipp K. (2004). Developmental Psychology: Childhood and Adolescence. 9th Edition. John David Hague

Torres, J. and Ash, M. (2007). Cognitive development. In Encyclopedia of special education.

Ünal, M.P., Akman, B. & Gelbal. (2010). The adaptation of a scale for preschool teachers' attitudes towards science teaching. Procedia Social and Behavioral Sciences, 2, pp. 2881-2884

Vygotsky Ls. (1931). The genesis of higher mental functions. In: Wertsch JV (ed) The concept of activity in Soviet Psychology. Armonk, NY, Sharpe, 1981.