Mapping the interactions between young children while approaching the natural phenomenon of clouds creation

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ABSTRACT

In this research paper, the dynamic of preschoolers' interactions during the approach of basic science concepts in kindergarten is designated, based on the "socio-cultural, historical approach". The procedures through which young children communicate and cooperate in order to structure their explanatory schemes and the contextual factors that mediate in this process are explored through a multilayer qualitative analysis. The research sample consisted of sixteen (16) pre-school children (four to six years old) from one state kindergarten in Greece. Data were collected through expanded, open type, semi-structured conversations between children pairs of the sample and one of the researchers. In this paper, data from three (3) conversations in which six (6) children participated in pairs are presented. The results of the study indicated different types of substantial interactions between the children couples and led to the detection of ways that preschooler's conceptions shaped and were shaped while concepts from the natural world were commonly approached. From the research results, can be concluded that through a "conversational approach", organized in couples, we can foster and enhance science thinking and learning in early childhood.

KEYWORDS

Socio-cultural, historical approach, preschoolers' interactions, explanatory schemes, conversational approach, science thinking and learning in early childhood

RÉSUMÉ

Dans cet article, est présentée la dynamique des interactions des enfants d'âge préscolaire pendant l'approche des concepts scientifiques élémentaires à la maternelle, sur la base de « l'approche socio-culturelle, historique ». Les modalités à travers lesquels les jeunes enfants communiquent et coopèrent afin de structurer leurs schèmes explicatifs et les facteurs contextuels qui interviennent dans ce processus sont explorés à travers une analyse qualitative multicouche. L'échantillon de l'étude est composée de seize (16) enfants d'âge préscolaire (âgés de quatre à six ans) d'une école maternelle en Grèce. Les données ont été recueillies dans le cadre élargi, de type ouvert, semi-structurés conversations entre paires d'enfants de l'échantillon et l'un des chercheurs. Dans cet article, sont présentées les données de trois (3) conversations dans lesquelles six (6) enfants ont participé à paires. Les résultats de l'étude indiquent différents types d'interactions importantes entre les enfants et les couples et ils ont conduit à la détection de façons que les conceptions des enfants d'âge préscolaire ont façonnées et elles ont façonné tandis que les concepts de la nature ont été fréquemment abordés. D'après les résultats de la recherche, peut être conclu que par une « approche

conversationnelle », organisé dans les couples, nous pouvons encourager et développer la réflexion et l'apprentissage des sciences dans la petite enfance.

MOTS-CLÉS
Approche socio-culturelle, historique, interactions entre les enfants d'âge préscolaire, systèmes explicatifs, approche conversationnelle, réflexion et apprentissage des sciences dans la petite enfance

THEORETICAL FRAMEWORK

The study of young children's understanding of the natural world and natural science concepts has been a focus point on the epistemological, psychological and didactical field for approximately three decades (Ravanis et al., 2013). Therefore, a substantial body of theoretical and empirical research literature has been developed concerning the approach and explanation of children's thinking and learning about nature and science. In addition, many relevant educational programs and teaching interventions have been designed advancing the emergence of science, especially, in Early Childhood Education (Ravanis, 1998). Within this framework, emphasis has been successively given on a wide range of theoretical backgrounds, conceptual tools and methodological principles. An analysis of these diverse studies and projects aspects can lead to a classification into three theoretical distinct groups (Ravanis & Bagakis, 1998). Firstly, "to those based on empiricist ideas of learning", secondly, "to those arising from the Piagetian paradigm, and, finally, to those which combines both post- Piagetian and Vygotskian views of learning in a socio-cognitive or a sociocultural perspective" (Ravanis et al., 2013).

According to the first framework, which is based on the empiricist perspective, the classified research studies and, mostly, the educational approaches are mainly focused on the assembling of new data as the basis of cognition development. In the context of this theorizing, learning is considered, mainly, a process of knowledge transportation from source knowledge, usually a teacher, to the one who is learning. Thus, a presentation of knowledge is considered an adequate mean for leading to understanding. Regarding science knowledge, in order to become better accessible and perceived through presentation, science concepts are simplified and parceled.

The second framework consists of a research studies plurality and several educational extensions based on the Piagetian theorization (Piaget, 1929, 1975). According to this perspective, the development of cognition is considered an individual process of active construction. During a constant interdependence with their environment young children construct their knowledge and also their conceptions about natural world concepts and phenomena. As many studies have underlined, these initial conceptions are, frequently, alternative and untutored (Driver, Guesne & Tiberghien, 1985; Weil- Barais, 2001; Boilevin, 2013). Nevertheless, they can be reshaped into ideas more compatible with the science education models. The encouraging and supportive role of the adult can enhance this conceptual change movement within a pedagogically appropriate and equipped environment (Kamii & De Vries, 1978; Inagaki, 1992).

Within the range of the socio-cognitive and sociocultural framework, classified research studies and educational projects are based on the extended theoretical work of Vygotsky (1962, 1978) but also utilize basic concepts of post- Piagetian perspective (Doise & Mugny, 1984). In this two associated approaches, cognition is accounted for a social activity and also a social construction based on the processes of "co- construction" and "mediation". Thus, it is remarked that through ongoing interpersonal interactions with others and through the use of cultural tools and sings, the individual gains the development of "higher mental

processes" and the formation of "higher mental models" (Vygotsky, 1987, 1997, 1998; Robbins, 2007). Nevertheless, as Rogoff suggested (1998), there is a distinction between these two approaches which is evident, mainly, at research field. This distinction concerns the definition of the relationship between the individual and his social environment. According to Rogoff, within a socio-cognitive perspective, emphasis is given at the individual and social factors are added "as external influences". However, within a sociocultural perspective, individual and social context is considered as completely inter-depended concepts. As Fleer and Robbins also argued (2003) about the two perspectives, on one hand, a more "individualistic and static" situation is observed while on the other hand, a more "dynamic and inter-depended activity" is remarked.

During the last decade, the need for a more holistic, naturalistic and substantive approach of young children's learning and thinking in science, has put into the center of attention the sociocultural, historical perspective (Lemke, 2001; Fleer, 2002a, 2002b; Robbins, 2005, 2007, 2009; Hedegaard & Fleer, 2008; Hedegaard, 2009; Larsson, 2013). Avoiding the typical research and educational practices, there is an attempt to detect new and also multiple insights into preschoolers understanding of natural phenomena and science concepts. Therefore, rethinking the methods of approaching young children's thought, several researchers, especially in the field of Early Childhood Science Education, focus not only on the individual and his interpersonal interactions but also at his "dialectic interdependence" with his context (Ravanis, Christidou & Hatzinikita, 2013; Delserieys, Jégou & Givry, 2014). This tendency is also slowly reflected in the educational practices and policies of few countries including Australia, New Zealand and United Kingdom (Anning, Cullen & Fleer, 2004).

Although educational efforts of sociocultural, historical perspective are limited, the research literature is steadily growing. In several studies sociocultural and historical views can be observed apart from the theoretical field, to the methodological framework also. Within this perspective, data gathering and analysis encompass elements like children's dialogues and common meaning- making conversations, interactions and play, drawings and gestures, use of objects, materials, symbols and tools. These elements refer not only to the individual and his social practices but also to his broader learning and thinking context. Thus, more extensive results and also, more authentic conclusions can be gained.

Likewise, in the present study we organized an alternative trace procedure in order to gain a better access to preschooler's understanding about the natural phenomenon of clouds creation. Our goal was to map young children's interactions while approaching the natural phenomenon and also to detect some contextual influences in their thinking. Thus, the research questions that we posed were *how do preschoolers structure and develop their explanatory schemes, moving from interpersonal to personal level* and *which are the traceable contextual factors that mediate in this process?*

METHODOLOGICAL FRAMEWORK

Sample

The sample of the study consisted of sixteen (16) pre-school children (four to six years old) from one state kindergarten of an urban area in Greece. None of the children had previously any formal instruction or involvement in discussions or tasks concerning the specific topic. Data were collected through expanded, open type, semi–structured conversations between children pairs of the sample and one of the researchers. In this paper, data from three (3) conversations in which six (6) children participated in pairs are presented.

Design

The theme of the study was the social and individual construction of the preschoolers' knowledge about the natural phenomenon of clouds. Our focus was on tracing their initial ideas about clouds creation. During the conversations in which they participated, children had the opportunity and were encouraged to talk to each other, making interactions and cooperating. They were also urged, through opened type questions, to make links with their everyday knowledge. Moreover, they were supported on making references to their sources of knowledge. Children had also the chance to draw and mark down their ideas throughout the conversations. A large piece of paper, meant for common use, was given to them.

Data collection and analysis

Data collection was made by video-taping and field notes during and afterwards the trace procedure. Observations were made based on Rogoff's "three foci of analysis" (personal, interpersonal and contextual focus) (Rogoff, 1995, 1998). A qualitative discourse microanalysis of preschoolers conversations were used so as to define the children's explanatory schemes. Through a comparative analysis of these explanatory schemes we also attempted to trace children's interchanges in order to map their interactions.

RESULTS

Focusing on the first research question, in Tables 1, 2 and 3 we, firstly, present the individuals' explanatory schemes based on their ideas about clouds' creation. Secondly, we attempt a parallel consideration of these explanatory schemes for each pair of children. The results rose from the conversations in which children were engaged trying to approach and acquire common meaning of the natural phenomenon.

In Table 1 we observe that the two children begun their conversation with a different framework. Each of them had a different conception about the basic constituent of clouds. Particularly, the first child (named A. because of his initial) seemed to correlate the phenomenon, in rotation, with concepts such as water, rain, sun, wind which are relevant to the scientific model of explanation. While A. was trying to make an utterance of his reflection he seemed to be quite certain about his ideas. This certainty can be probably traced back to his source of knowledge. That was a cartoon, designed to describe and explain basic natural phenomena to young children, which was frequently mentioned during the conversation *"From the rain. Really… I had seen… I had seen the clouds at "Cindy, the young scientist"*. Nevertheless, A. probably did not hold an adequate explanatory scheme. In an attempt to develop his reflection he failed to make a cause-effect interconnection in order to approach an explanation of the phenomenon. Therefore, based on Laurandeau and Pinard classification (1972) it can be deduced that although A.'s pre-causal reflection is quite relevant to the scientific model of explanation, this reflection is based on "phenomenistic" interconnections. Of special interest is the fact that A., in his attempt to interconnect his relevant information and knowledge on clouds creation, concluded in a "supernatural casualty" explanation for the phenomenon along with aspects of "artificial explanations" *"God makes them... from the rain… with glue", " When some water comes out it touches at the cotton and it creates the clouds".* When his interlocutor asked him to specify his ideas A. also correlated the phenomenon with wind. He concluded his reflection by repeating his initial idea that rain is the basic constituent of clouds.

TABLE 1
Parallel presentation of the explanatory schemes structure concerning the first pair of children

	The explanatory scheme of A.	**The explanatory scheme of N.**
Phase 1	He designates water as the basic constituent of clouds	He designates fume as the basic constituent of clouds
Phase 2	He designates rain as the process of clouds creation	He accepts the reflection of his interlocutor and designates water as the basic constituent of clouds and rain as the process of clouds creation
Phase 3		He adds the sun at his painting
Phase 4	He correlates the phenomenon with the sun	
Phase 5	He makes a stable correlation of the phenomenon with water and, in rotation, with other artificial or natural materials (glue, cream, sand, cotton) and he attributes it to supernatural casualty	He incorporates the explanation about the supernatural causality but he formulated his contrast about the correlation with artificial explanations (glue, cotton)
Phase 6		He repeats his initial idea by designating fume as the basic constituent of clouds with the combination of water
Phase 7		He calls his interlocutor to clarify/ illustrate his opinion about artificial explanations
Phase 8		He correlates the phenomenon with wind
Phase 9	He correlates the phenomenon with wind	
Phase 10	He repeats his initial idea designating rain as the process of clouds creation	

On the other hand, the second child, named N., begun the conversation by designating fume as the basic constituent of the clouds. Nevertheless, when A. referred to the cartoon, N. seemed to recognize it immediately and he exclaimed his appellation. Afterwards, it seemed that he incorporated the correlation that A. had just mentioned and he extended it *"I…Clouds are made from rain because when there are clouds it rains. There is no rain when there are white; there is when they are blue"*. Later, when A. extended his reflection by correlating the phenomenon with the sun *"It needs water and sun"* N. asked: "*Mrs., can I also draw a sun? And the teacher replied "If you want to… Do you agree with what A. says?"* and N. singed

positively. Following, N. also incorporated A.'s explanation about the supernatural causality but he formulated his contrast about the correlation with artificial explanations (glue, cotton) *"God does not do like that!"*. Consequently, N. repeated his initial idea and he designated fume as the basic constituent of the clouds with the combination of water *"I mean that clouds are made a little bit of water and a little bit of fume".* He also called his interlocutor to clarify and to illustrate his ideas about the artificial explanations *"(he is laughing...) What are you talking about?... Yes, but how can cotton come up there?".* Finally, although he firstly denied the correlation of the phenomenon with the wind he accepted it by saying *"A, a, a… fume comes up like this… (he blows). We blow it a lot… and after that wind does it. We cannot blow it and the wind does it".*

A comparative analysis of the explanatory schemes of the two children signifies that although there were no instances of cooperation there were some significant interactions between them. As we particularly observe, the first child named A., whose explanatory scheme was more relevant to the scientific explanation, shaped the meaning- making of the other individual. Despite the fact that A. was almost a year younger than N. he seemed a lot more confident about what he knew and said because of his source of knowledge (a cartoon). As described by Southerland et al. (2005), persuasiveness and rhetorical strategies had a strong affection to the meaning making of the two children. In parallel, the other individual, named N., through his doubting views of some ideas of A. also forced A. to extend his reflection by importing the concept of wind.

In Table 2 we observe that these two children also begun their conversation with a different framework. The girl, named G., immediately attributed the phenomenon to supernatural casualty *"Jesus makes the clouds"*. However, her interlocutor responded forthwith expressing his perplexity *"And I wonder…* (about what G. had just said)*"*. Afterwards, he, named T., designated water as the basic constituent of clouds and explained that clouds are water in a state of gas. When he was asked to express his opinion about G.'s idea he said that *"It is wrong"*. Following, G. gave another response based again to supernatural casualty *"God makes the clouds"*. Subsequently, she said that he makes them from ice introducing a parameter based on natural casualty. After that, T. developed his explanatory scheme which was relevant to the scientific explanation of the phenomenon declaring that he knew it by another cartoon named "*Mr. Little Drop. He teaches you a lot of things*". When G. was asked again about the creation of clouds she gave once more the previous answer *"(God makes them) From ice".* Then, T. exclaimed *"What? But they are so soft!".* Thereafter, G. responded *"Clouds are wind*" *…"If you touch them they are nothing*". Then, she was asked by the researcher *"How they are made from air?"* and she responded again *"By God".*

The comparative analysis of these explanatory schemes also revealed that the child with the relevant to the scientific explanatory scheme influenced the meaning-making of the other individual. We observed that G. did not dismiss her ideas, based on supernatural casualty, during the conversation. On the other, there was a successive removal of her reflection towards natural casualty. Observing the interactions between the two children, it was noted that this conceptual destabilization followed T.'s explanations about the phenomenon. Moreover, we may say that it was, probably, caused by T.'s disagreements and opposed arguments. As Southerland et al. (2005) mention, we remark here that children's "evaluative comments" may contribute not only to common meaning making but also in individual internalization. In parallel, we observed that T., based on his source of knowledge, constantly developed his reflection without been influenced by G. However, through the interaction with his interlocutor, T. managed to illustrate some of his ideas *"G.: (God makes clouds)… wherever he wants, T.: Down on earth you can't make clouds".*

TABLE 2
Parallel presentation of the explanatory schemes structure concerning the second pair of children

	The explanatory scheme of G.	**The explanatory scheme of T.**
Phase 1	She attributes the phenomenon to supernatural casualty (are made by Jesus)	He clearly express his disagreement about supernatural casualty
Phase 2		He designates water as the basic constituent of clouds. He explains that clouds are water in a state of gas.
Phase 3	She attributes again the phenomenon to supernatural casualty (are made by God)	
Phase 4	She designates ice as the basic constituent of clouds combining supernatural casualty	He is trying to oppose her arguments by asking her questions
Phase 5	She designates wind as the basic constituent of clouds combining supernatural casualty	

TABLE 3
Parallel presentation of the explanatory schemes structure concerning the third pair of children

	The explanatory scheme of K.	**The explanatory scheme of X.**
Phase 1	She designates flour and water as the basic constituents of clouds	She accepts the idea of her interlocutor and designates flour and water as the basic constituents of clouds
Phase 2		She rejects the idea of water being a constituent of clouds and accepts only flour
Phase 3	She takes into account the idea of her interlocutor and wonders about it	
Phase 4	She designates that both ingredients are required	
Phase 5		She takes into account the argument of her interlocutor, accepts her initial idea and reasons about it

In Table 3, we observe that the child named X. tried to approach the phenomenon of clouds' creation by giving an explanation based on "artificial casualty" *"(it is made) From flour and water",* according to Laurandeau and Pinard classification (1972). On the other hand, the other interlocutor, named K., did not expressed any different idea and, firstly, accepted the idea of X., also designating flour and water as the basic constituents of clouds. She repeated that *"(it is made) With flour and water".* However, a few minutes later she rejected the idea of water being a constituent of clouds and accepted only flour *"A, a, a… I have another idea…", "I… think that … clouds were made only with flour"*. After her comment, the conversation continued as follows:

X.: No! Because,… if it was made only from flour it would be obvious...
R: What would have been obvious?
X: That they are made only from flour… But, if they were made only from flour how could they have been solid, to do so…?
R.: Why do they have to be solid?
K.: Because… because… because if it is not then the cloud will fall down…
R.: So…
X.: So, it will split!
K.: It will split…
…
K.: … We should give it (to the cloud) flour and water to be solid. Because, if it has only flour it will split and it will fall down.

Therefore, X. took into account the idea of her interlocutor and wondered about it. Afterwards, she concluded that both ingredients are required and she argued about it. So, K. accepted the initial idea and reasoned about it.

The comparative analysis of these explanatory schemes revealed that the two children shared and also developed together an explanation irrelevant to the scientific model. Relating the phenomenon with the everyday practice of making dough, the two interlocutors expressed together an analogical reasoning. They reasoned that if clouds consist of flour, then they also have to consist of water (like dough) or else they will *"split"* and *"fall down".* Therefore, through their interaction, the two girls managed to reason their reflection about the basic constituents of clouds.

Making a short overview of the three conversations, we noted three different types of interactions. Concerning the first couple, we noticed that the two children made several interchanges trying either to extent or to inject their explanatory schemes. Concerning the second couple, we noted that, through a parallel development of their explanatory schemes, the two children managed either to illustrate or to revise some of their ideas. Lastly, concerning the third couple we observed that the two girls tried to cooperate in order to enhance their common idea. In every aspect, we remarked a conceptual contribution of each one either to a common or to a better meaning- making.

Extending the result analysis and focusing on the broad sociocultural framework in which children structured their explanatory schemes, we also detected a series of traceable contextual factors that mediated in this process. Generally, it can be observed that children during their conversations made regular claims to their source of knowledge and tried to match them with their everyday experiences and practices in order to approach explanatory the natural phenomenon. More specifically, in all three interaction incidents that are explained above, there can be observed specific or not children references to television cartoons as well as written materials like books and newspapers (R: *"How do clouds create? A: From the rain... Really… I had seen… I had seen the clouds at "Cindy, the young scientist"* (a cartoon)

and N. continues N: *"Cindy, the little scientist"! I … Clouds are made from rain because when it rains there are clouds"*, T: "*Mr. Little Drop (a cartoon). He teaches you a lot of things"*, A: *"Clouds are made from rain.* N: *Yes, because when it rains clouds come up… Because, I have seen this… at the book that Mrs. A. brought us… This..."*, "X: "*I had red in a newspaper about a cloud"*.). Concerning the everyday experiences that the children referred to, it was observed that such experiences stem from their school environment. (X: *"You have showed us that at the blackboard (mentioning a past task when teacher draw a cloud at the blackboard while telling a story)"*, A: *"(God) puts glue and tape…*"). Concerning everyday practices, it was observed that such practices were associated, mainly, with activities in children broad environment. (K.: "… *We should give it (to the cloud) flour and water to be solid"*, T: *"Like cars are fixed"*). It should be also noted that the majority of the children made references to theological/religious elements while one of the children attempted to provide an explanation based solemnly on experiences associated with his religious knowledge (G: "*Jesus makes the clouds" ... God makes the clouds…. Together with His child"*).

DISCUSSION

In the present study we researched the conceptual and intellectual conversations between young children while approaching the natural phenomenon of clouds creation in order to map their interpersonal interactions. Our goal was not only to trace the individual's conceptions and ideas but also to profile the social construction of children's knowledge as it is molded through the interchanges between them. Our emphasis was, as also Southerland et al. noted, on: *"the ways in which children's conceptions shaped and were shaped by their participation in meaning- making"* (Southerland et al., 2005, p. 1042). Moreover, we aimed to designate the traceable contextual factors that mediate in order to underline the influence of the further cultural framework in this process of construction.

The analysis of our results led to the detection of some substantial conceptual interactions between the preschoolers. More precisely, we designated three different models of interactions between the couples that we focused on, as described above. In every case, the progression of children's explanatory schemes constituted some evidence that, by these interactions and through the mediation of several contextual factors, children's thought was lead to a higher mental level. As Vygotsky also argued (1987, 1997, 1998, 1999), thinking and learning is a process of "internalization" moving from intermental to intramental level. The study reported here, illustrate to us under which circumstances this "internalization" could take place in a process of tracing preschooler's conceptions in kindergarten. Moreover, several evidence were also noted concerning the vice versa procedure when the ideas of individuals seemed to shape the common meaning- making.

Consecutively, it seems that through a conversational approach, organized in couples, we can foster and enhance science thinking in early childhood. As Southerland et al. mentioned (2005), the concurrent exemplary models of teaching and learning in science are those based on common action and understanding. In consequence, the elements that we determined and designated in this study about conceptual and intellectual conversations of preschoolers may support those models in science education in kindergarten. The preconditions for ongoing and dynamic interchanges, the mediating role of the instructor and context correlation are parameters for further research.

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