The role of metalinguistic function in the construction of physical knowledge: A theatre semiotics approach for preschool education

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ABSTRACT

The rendering of physical knowledge in typical or non typical forms of teaching, is a process in which the spoken word and the language in general that is used centre on the (pre-) scientific code. In the case of science teaching, the special pedagogic framework places the discussion on concepts –regardless of school grade– at a metalinguistic level of elaboration. At this level, the extent of learning, internalisation and use of the special code is intensely brought out through the utterances of the teachers and the students. In this paper an attempt is made, through semiotic theatrical analysis, to study the sign-vehicles that are related to the metalinguistic function of the speech in preschool education. Thus, the "commentary on the (pre-)scientific code" as well as the "means which project the metalinguistic function of the speech" are analysed within a context set up by the physical knowledge for preschool education based on the world of drama.

KEY WORDS

Metalinguistic function, scientific code, early childhood education, theatre semiotics

RÉSUMÉ

L'appropriation de la connaissance physique sous formes typiques ou non typiques de l'enseignement, est un processus dans lequel la langue parlée est centrée sur le code (pré-) scientifique. Dans le cas de l'enseignement scientifique, un cadre pédagogique spécial conduit surtout la discussion sur les concepts –indépendamment

du niveau de l'école– à un niveau d'élaboration métalinguistique. A ce niveau, le résultat de l'apprentissage, l'intériorisation et l'utilisation d'un code spécial, apparaît dans les discours des enseignants et des élèves. Dans le présent étude, la sémiotique du théâtre est utilisée pour l'analyse des signes-véhicules qui sont liés à la fonction métalinguistique du langage parlé dans l'éducation préscolaire. Ainsi, le «commentaire sur le code (pré-) scientifique» et aussi les «moyens qui signifient la fonction métalinguistique du discours» sont analysés dans un contexte crée par la connaissance physique pour l'éducation préscolaire basé sur le monde du théâtre.

MOTS CLÉS

Fonction métalinguistique, code scientifique, éducation préscolaire, sémiotique du théâtre

INTRODUCTION

According to Jakobson (1966) the factors of oral communication, that is, the *sender*, the *receiver*, the *referent*, the *channel*, the *message* and the *code*, are corresponded to the *expressive*, *appellative*, *referential*, *phatic*, *poetic* and *metalingual* functions of language respectively (Thomadaki, 1993, p. 71). In the theatre, the *metalinguistic function* of the spoken word is evolved in the area of the performance as the play is acted out, through the verbal rendition of the meaning which the *code* carries. The metalinguistic function is especially underscored when the linguistic code that is used constitutes an object of discourse (Elam, 1980, p. 183). That is to say, when we refer to or comment upon our words in order to understand the codification they convey. Although in the theatre the metalinguistic function is predetermined by the author, it is highlighted when the characters involved, by referring to their own words or those of others, try to comment upon and to interpret the message in relation to the code (Thomadaki, 1993, p. 81). Similar situations occur in everyday life when, for example, two English-speakers are conversing and one of the two gives the meaning of a certain word that was uttered but was not understood by the other, or when the meaning of a word or phrase is explained at the level of a conventional communication, etc.

It should be noted that during oral communication, the cultural context either underlines or mutes some of the functions of the speech. For example, when Brazilians talk about how they see themselves in terms of work, love, future plans, etc., the phatic, poetic and expressive functions dominate, while in the case of the Germans it is the referential and metalinguistic functions that prevail (Schroder, 2005). Ely, Gleason, MacGibbon & Zaretsky (2001), studying the discourse that took place at dinnertime between parents of the middle class and children aged 2 to 5½, point out that a signif-

icant percentage of parents engaged in activities of reporting and commenting on speech. Moreover, in teaching and learning, especially in the case of the natural sciences, the discourse is traditionally explanatory, with the discussion of the scientific code –regardless of the pedagogical context of its use– monopolising the process. Regarding the natural sciences, the total orientation of teaching as an explanatory process includes the teaching of the "scientific language" which, in the long term, will constitute the common code for the communication between the physical knowledge and the citizens.

Furthermore, given that every utterance is transmitted carrying a certain communicative functionality, it is clear, and Soren (2001) also notes this, that it is not possible for the content of the utterance to be analysed solely in terms of reason. In fact, Soren claims that since every utterance carries speech acts, the analysis of the content of the discourse at the level of its rational organisation can only act in an auxiliary capacity, without lending information at the level of semantics. This observation transfers our interest from the study of the utterance in terms of causality (i.e. checking the correctness of the inference) to the study of how the interlocutors construct and understand the code in use.

In this study we will attempt a description of the modalities that concern the metalinguistic function of the speech within a context organised by physical knowledge for kindergarten, from the standpoint of theatre semiotics. In particular, an effort will be made to detect regularities, proposed by theatre semiotics, that refer to the treatment of the (pre-) scientific code in the discourse of young children, as well as of educators. In terms of its methodological perspective, the study uses as its empirical data various discourses/texts that have been recorded in kindergartens during researches on different topics and orientations. These texts consist of examples which define these regularities.

Our aim is to escape from the traditional approach of discourses/texts and to give the kindergarten teacher tools with a high degree of communicative functionality. That is, tools that allow the educator to interconnect theory and practice by understanding the former through the modalities that he/she himself/herself produces in his/her daily life.

Metalinguistic Modalities

The analysis focuses on two main axes: the *commentary on the (pre-) scientific code* and the *means which project the metalinguistic function of the speech* (Pfister, 1988 [1977], p. 105). Along the first axis, parameters such as "the explicit and indirect treatment of the code" are studied, while along the second we explore the "invocation of the imagination," the "question" and the "assertion" as vehicles of underlying the metalinguistic function of the speech.

Commentary on the (pre-) scientific code

As regards the dramatic context, Pfister (1988 [1977], p. 105) recognises the importance of commenting on the code in terms of word and phrase interpretation, or of when the code must be supplemented because it has been found to be deficient. Traditionally, as was mentioned earlier, the semantic orientation of the *commentary on the scientific code* is dominant in science teaching. In Examples 1 and 2 (Christidou, Bonoti, Kakana, Metallidou & Dimoudi, 2003, p. 123), which concern preschool children's conceptual representations of weather phenomena, the utterances contain comments upon the terms being used.

Example 1
Researcher: What is a *rainstorm*?
Child: It has rain, lightning, thunder.
Researcher: What happens when there's a rainstorm?
Child:…

In Example 1 it is clear that the educator's statements are oriented towards discussing the definition of "rainstorm", while in Example 2 what is attempted is a conceptual penetration into the properties of the terms "rainstorm", "rain" and "lightning".

Example 2
Researcher: Where does a *rainstorm* come from?
Child: When lots and lots of clouds gather and rain a lot.
Researcher: How is a rainstorm different from *rain*?
Child: Because it's very strong and it also has lightning and it can burn down a tree.
Researcher: What is *lightning*?
Child: Lightning […] is like … like … a fire that jumps out of the sky.

The style of the discourse is typical; that is to say, the utterances include words such as "rainstorm", "rain" and "lightning" which refer directly to the code.

On the other hand, in a more abstractive level of elaboration, the utterances can take on a purely descriptive nature, without referring beforehand to the term that is being concealed. Thus, in Example 3 (Ioannides & Kakana, 2001, p. 129), since no direct reference is made to the term being treated (i.e. "floating"), the process is initiated by concepts that revolve around it.

Example 3
Researcher: What happened to this thing [a pencil sharpener] when I put it into the water?
Costas: It *went down to the bottom.*
Researcher: Do you know of other things that go down to the bottom when you put them into the water?

Costas: Pieces of wood, iron, a rock.
Researcher: Why do they go down?
Costas: Because they're *heavy*.

In Example 3, the discussion starts off from (material) perceptive data; from an experimental activity. In this kind of activity, the interpretive framework which is set up and, by extension, the use of terms is influenced by the material organisation of the learning environment. The more the text/discourse moves away from the use of scientific terms, the more the explanations provided are placed in the "hidden" aspects of the physical world. This is of great importance for young children in the context of searching for appropriate teaching transformations in order to initiate them into the physical knowledge (Koliopoulos, 2004).

Furthermore, taking into account that the theatre constitutes a kind of matrix for the production of ineffable meanings, the discussion of the scientific code can take place in the context of the myth (fairytale). In the excerpt from Example 6, which constitutes a case of non-explicit treatment of the scientific code, a fairytale/story is used in order to explain concepts such as "thermal conductivity" (see Example 6). Actually, this term is not uttered at all.

Excerpt from Example 6
"These patches [of snow], Ziko, were formed because the paving stones aren't lying on the warm ground beneath them," explained Benji.

It is obvious that the (pre-) scientific code can be carried out either *explicitly*, through a clear reference to it, or *indirectly*, through a veiled and less concrete way.

(a) Explicit treatment
In these instances of communication, commentary is carried out through uttered phrases that include *similar*, *dissimilar* or *contrasting* concepts (Dimitriou, 1986, p. 90, 209; Pfister, 1988 [1977], p. 116) (For similar and dissimilar concepts see Examples 4 and 5 – Ioannides & Kakana, 2001, p. 130 – as well as Example 3).

Example 4
Researcher: What do you think will happen if I throw this thing [a coin] into the water? Will it *sink* or not?
Nikos: No, *it won't sink*.
Researcher: Why?
Nikos: Because it's light.

Example 5
Researcher: What happened to the thing I put into the water?
Vassilia: *It went in deep.*

Researcher: Do you know other things that *go in deep* when you put them into the water?
Vassilia: The lid.
[…]
Researcher: What do you think will happen if I toss this thing [a coin] into the water? Will it go in deep or not?
Vassilia: It'll *go in deep* because it's small.

Indeed, the term "sink" (to sink = to submerge, to inundate) (see Example 4) is similar to "go down to the bottom" (go down to the bottom = to scuttle, to plunge in water) (see Example 3), whereas it is dissimilar to "go in deep" (see Example 5). Though all three terms share most of their main conceptual features, the two first terms denote the existence of a liquid, while the third ("go in deep") has a broader meaning.

In a study of how preschool children construct the concept of "solution", Kavalari & Solomonidou (2003) note that in the case of sugar dissolving in water, the children use the term "disappeared" when they are asked to describe the phenomenon. Thus, they use terms such as "got tangled up", "got mixed up", "melted into the water", "it's inside, it melted", "it can't be seen at all", "it disappeared".

Even though the verb "to disappear" means that "something cannot be seen" (but may still exist), in the field of science education, the mental model according to which the children think that the sugar no longer exists in the liquid is referred to as the "model of disappearance". However, this does not arise either from the etymology of the term "to disappear", or from the children's explanatory statements. Indeed, in the above research, when the children were trying to explain, they used the terms "got tangled up" (to tangle up = entangle = mix with one another) and "got mixed up" (to mix up = put together similar or dissimilar things), which are similar concepts and denote the existence of at least two ingredients. They also used the term "melted" (to melt = to make liquid), which is dissimilar to the other two terms and denotes that the sugar remains together with the water (that is denoted by the preposition "inside" – "it's inside, it melted"). Finally, the children use the term "seen" ("it can't be seen at all"), which is in *contrast* to the term "disappears" (that which disappears cannot be seen). However, a conceptual similarity between "disappeared" and "seen" is grounded in the adverb "not".

In general, children claim that the sugar cannot be seen, but it remains together with the water. That is made clear since they produce supplementary utterances such as "it'll become water again but it'll be sweet", "the water took the sugar", "the spoon hits it and it melts", "the sugar is cut into little pieces" etc. Each one of the above explanatory statements contains elements that show a certain relationship between the water and the sugar. Indeed, "the water becomes sweet", the "water takes the sugar", "he hits the sugar with the spoon and it melts (in the water)" and "the sugar is cut

into little pieces (in the water)". These utterances should be explored in terms of how they are understood and how they are used by the children within the specific framework from which they arise. Besides, at preschool age it is more interesting for the researcher to investigate the precocious mental models that the children constitute in relation to the aspects of the physical world.

(b) Indirect treatment

The code can be commented on through congruent or metaphorical meanings and images which are free of any obvious connection to the typical form of the scientific code itself (e.g. in poetry we can talk about love by describing the flight of a butterfly). Moreover, we should make clear the distinction between metalinguistic function and reference. Reference denotes the object to which the spoken word refers, while metalinguistic function concerns the explanation of the code which is carried by the message.

In a study conducted by Solomonidou & Kakana (2001, p. 136) on preschool children's conceptions about electrical current and electrical appliances, when the children were shown pictures of objects such as a "juice extractor" and a "cooker", they explicitly explained the concept of "juice extractor" by using phrases such as "we squeeze oranges" and "we make juice", while for the "cooker" they used explanatory phrases such as "we make food", "that we bake", "that we put in baking dishes" etc. It should be noted that these particular statements contain explanations concerning the verbal rendering of the functions of these appliances; explanatory statements could also be produced by centring on the properties of these objects/appliances (e.g. in the case of the juice extractor: "it's yellow", "it's shaped like an egg so that the orange can fit inside" etc.; in the case of the cooker: "it also makes hot air so that it's hot all over"). One way or another, these particular utterances constitute an environment for the explicit treatment of the code.

On the contrary, Example 6[1] – which is recommended for young children – refers indirectly to concepts such as "thermal conductivity" and "heat abduction."

Example 6

The snow in the wood was falling thicker and thicker. Young Benji, the bear, looked out of the window at the trees that were now completely white. He snuggled under his blue blanket and soon found himself in a dreamland, just like he did every night. Next morning he woke up early, looked out of the window and ran to find his friends so they could all go to school together. The house smelt of biscuits, which

1 The text in question was modified by Ermina-Nektaria Manidaki. The original text is included in Verganelakis, A. (1982). *Teachers and the Teaching of Physics* (Agia Paraskevi, Attica: Democritus Nuclear Research Centre, Department of Physics), p. 16, (in Greek).

Benji loved. His mother had made enough for him and his friends. Soon, Benji, Lupcho the duck and Ziko the dog were on their way to school. It was very cold, but here and there along the way the snow had melted. "Look at the road, Ziko!" said Benji. "It looks like your skin!", Ziko is a Dalmatian; he's white with big black spots. Ziko looked down at his body and then at the road that was covered in patches of snow. "Those are white, Benji!" he replied. "Whereas my spots are black!". And he began to laugh. "These patches, Ziko, were formed because the paving stones aren't lying on the warm ground beneath them", explained Benji. "There's a space between them". As the three friends walked along they noticed that there wasn't any snow on the north side of the road. "Look, Benji!" called out Lupcho the duck. "There's no snow here, even though it's been snowing all night". "There's no snow", explained Benji, "because for the past few days the sun has let its rays take a rest from their long journey and so they've warmed up that part of the road, making the snow melt". "Look!" Ziko cried out suddenly. The three friends looked towards the south side of the road and noticed that it was covered in snow, except for the parts between the little shops. "Those are also places where the sun sends its rays to rest. They're like beds for rays!" said Ziko. "Exactly, Ziko", said Benji, "and so the sun warms the ground and the snow melts". It was getting late. In the distance, the school bell sounded. Their teacher was waiting for them. "Where are my little explorers?" she wondered.

In this particular text the indirect approach to the (pre-) scientific code is obvious; myth constitutes an adequate vehicle for the discussion of the aspects of the physical knowledge. That is to say, narration constructs spaces (narrative spaces) through relations set up between uttered entities (Pelletier & Astington, 2004). The stories (fairytales) can be framed by illustrations or kinesic/bodily expressions providing the treatment of the code at an alternative level (Pantidos, Valakas, Vitoratos & Ravanis, 2008).

Means which project the metalinguistic function of the speech

(a) Invoking the imagination

Whether the code is commented on explicitly or indirectly, it is possible to *invoke the imagination* of students, in order to describe in a tangible way the environment in which the code is elaborated. As a result, an imaginary environment is created that "imposes" its own verbal terms/codes which correspond more or less to the scientific ones.

In Example 7 (Christidou & Chatzinikita, 2003, p. 87) the conversation centres on "feeding plants", including explanatory statements concerning this phrase.

Example 7

Researcher: How does the plant take in the water that your mother gives it?

Child: Through the bucket.

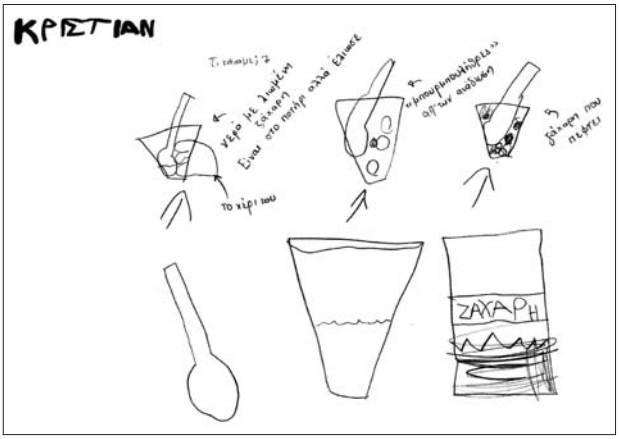
Researcher: Your mother uses the bucket to put water into the plant pot. How does the plant take in the water afterwards?
Child: It drinks the water. Through its roots.

The above dialogue describes a narrative space which consists of material objects (i.e. bucket) that do not exist in the kindergarten classroom where the particular text was recorded (Example 7). Nevertheless, the educator invokes the child's imagination in order to construct the locus: she asks the child to imagine how his/her mother waters the plant. This brings to mind images of a locus that consists of entities such as "plant pot", "mother", "home" etc. That means certain actions will be carried out, described and explained through the spoken word.

Especially for the material objects, when their use in not the common one, then they impose specific linguistic terms. That is to say, if for example, the children use their imagination to take magnets and create an "airplane", then they could produce utterances including unconventional terms such as "airplane", "it flies" etc (Pantidos, 2008b). These terms would not come up if the teaching intervention was limited to the conventional use of the objects elaborating their typical properties of "attraction" and "repulsion".

In general, such situations occur when we go from the linguistic code to the information carried by other semiotic resources such as, for example, a drawing (see Figure). In such cases it is the signifier that invokes the children's imagination imposing the terms in use.

FIGURE



A kindergarten age child's drawing of the phenomenon of solution. The child first drew the 'sugar', the 'bubbles', the 'glass of water' and the 'melted sugar' (Source: Koutsopetrou, 2008, p. 125).

(b) Question - assertion

Usually, the (pre-) scientific code is explained in order for a conceptual void to be filled. This is set into motion either by the posing of a question or by the speaker taking on an assertive style (Example 8 - Tseou, 2004, p. 47).

Example 8

Researcher: Can you explain to me what the light and his eyes did so that Costas could see?

Stergios: …Light…helps vision, and so…

Researcher: How does it help? What does the light do?

Stergios: The light falls on the… on the teddy bear. Yes, on the teddy bear and on the eye, and then…

Researcher: And then?

Stergios: And then you can see them.

It is clear that the *questions* posed elicit a series of responses from the child that construct an explanatory content of discourse as regards "light and vision".

By means of a *categorical* style, in Example 9, terms such as "salty", "water", "salt", "storm", "sank" and "waves" constitute explanatory statements for the phenomenon of solution.

Example 9

Many years ago, sea water was not *salty*; it was like drinking *water*. A ship at a harbour loaded a huge amount of *salt* in order to take it to another harbour, but on the way it ran into a *storm*. The ship *sank* and so the sea was filled with salt which the *waves* carried all over the earth (Chauvel & Michel, 1990).

Since anything that is uttered implies actions (speech acts), the particular terms used in Example 9 create visual images stimulating the children to take initiatives in order to produce individual plans.

Conclusion

This study emphasises the modes of producing and managing the code in science teaching. However, since every time people meet and make up a particular environment, there arises a unique (quantic) communicative situation of learning. Thus, there may not be much point in analysing the instances themselves but rather in broadening and enriching those tools which construct teaching instances. That means that semiotics as a field and as a *"science" of modes*, besides providing tools for analysis, can propose modalities of rendering meaning (Pantidos, 2008a). Similarly, where semiotics intersect the science teaching we can seek out relationships between the regularities, the modalities, and the sociocognitive framework that is set up.

This particular study is aimed primarily at educators, to whom it proposes tools for their cognitive constitution and their function in their daily practice. For example, in regard to the question of the appropriate teaching transformation in order to convey aspects of physical knowledge to young children, it emerges that seeking out representational forms within the framework of constructing stories (fairytales) is an interesting research prospect.

The multiplicity of modalities suggested here helps us to shed light on various aspects of the physical world, as well as to propose alternative ways of organising and processing data concerning human cognition. If this can be achieved in the field of science education (which, in my opinion, is the most suitable since this field explores the functions of human cognition within a sociocognitive pedagogic framework of principles set forth by the natural sciences), then adequate conditions will be created in order for this field to be connected to seemingly unrelated fields, such as artificial intelligence and robotics, perhaps using computer science and mathematics as a bridge of communication.

References

Chauvel, C. & Michel, V. (1990). *Les sciences dès la maternelle* (Paris: Retz).

Christidou, V. & Chatzinikita, V. (2003). Types of casual reasoning in children's thought: preschool children's conceptions about plant nutrition and growth. In M. Tsitouridou (ed.) *Physical sciences and new technologies in preschool education* (Thessaloniki: Tziolas Editions), 85-93, (in Greek).

Christidou, V., Bonoti, F., Kakana, D., Metallidou, P. & Dimoudi, A. (2003). Conceptual and drawing representations of weather from children of preschool age. In M. Tsitouridou (ed.) *Physical sciences and new technologies in preschool education* (Thessaloniki: Tziolas Editions), 117-128, (in Greek).

Dimitriou, S. (1986). *Dictionary of semantics* (v.IV) (Athens: Kastaniotis Editions), (in Greek).

Elam, K. (1980). *The semiotics of theatre and drama* (London & New York: Methuen).

Ely, R., Gleason, J.-B., MacGibbon, A. & Zaretsky, E. (2001). Attention to language: lessons learned at the dinner table. *Social Development*, 10(3), 355-373.

Ioannidis, C. & Kakana, D.-M. (2001). Preschool children's mental models about the floating of solid bodies in the water. In K. Ravanis (ed.) *Children's initiation into physical sciences* (Patras), 127-134, (in Greek).

Jakobson, R. (1966). *Essais de linguistique générale* (Paris: Minuit).

Kavalari, E. & Solomonidou, C. (2003). Child's initial conceptions about chemical substance. In M. Tsitouridou (ed.) *Physical sciences and new technologies in preschool education* (Thessaloniki: Tziolas Editions), 109-115, (in Greek).

Koliopoulos, D. (2004). *Science education topics* (Athens: Metaichmio) (in Greek).

Koutsopetrou, V. (2008). *Investigating solution in kindergarten* (Ph. D. thesis) (Rethymnon: Department of Preschool Education, University of Crete) (in Greek).

Pantidos, P. (2008a). *The constitution of a "dictionary" of semiotic analysis for physics teaching: a con-*

text for study teaching practices by means of theatre semiotics (Ph. D. thesis) (Patras: Department of Educational Sciences & Early Childhood Education, University of Patras) (in Greek).

Pantidos, P. (2008b). Material objects as vehicles of signs and meanings. An alternative approach of physical knowledge for preschool education. *5th Pan-Hellenic Conference with International Participation, Science and Society: Physical Sciences in Preschool Education*. (in press) (in Greek).

Pantidos, P., Valakas, K., Vitoratos, V. & Ravanis, K. (2008). Towards applied semiotics: an analysis of iconic gestural signs regarding physics teaching in the light of theatre semiotics. *Semiotica*, 172(1/4), 201-231.

Pelletier, J. & Astington, J. (2004). Action, consciousness and theory of mind: children's ability to coordinate story characters' actions and thoughts. *Early Education & Development*, 15(1), 5-22.

Pfister, M. (1988 [1977]). *The theory and analysis of drama* (Cambridge: Cambridge University Press).

Solomonidou, C. & Kakana, D.-M. (2001). Preschool children's conceptions about the electric current and the functioning of electric appliances. In K. Ravanis (ed.) *Children's initiation into physical sciences* (Patras), 135-140, (in Greek).

Schroder, U. (2005). The actor and the observer: on the different functions of self-representation languages by Germans and Brazilians. *Grazer Linguistische Studien*, 63, 77-91, (in German).

Soren, P. (2001). Presupposition, negation, and three-figure logic. *Vestnik Moskovskogo Universiteta, Filologiya*, 55.9(2), 117-160, (in Russian).

Thomadaki, M. (1993). *Semiotics of theatrical discourse* (Athens: Domos Editions) (in Greek).

Tseou, E. (2004). Preschool children's conceptions about the eyesight of an object: teaching approach. In L. Louka, C. Papadimitri-Kachrimani, K. P. Konstantinou (eds) *Science education and the development of new technologies in preschool education* (Nicosia: University of Cyprus), 37-53, (in Greek).